ISSN:2455-7838 (Online)
DOI : 10.36713/epra2016
SJIF Impact Factor(2024) : 8.675
ISI I.F Value : 1.241

EPRA International Journal of

# RESEARCH & DEVELOPMENT

## (IJRD)

*Monthly, Peer Reviewed ( Refereed ) & Indexed International Journal*

Volume - 9 Issue - 8 August 2024

Research & Development

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**SJIF Impact Factor (2024):8.675**
**ISI I.F. Value : 1.241**
**DOI : 10.36713/epra2016**


**EPRA International Journal of**

# Research & Development

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**Monthly Peer Reviewed & Indexed International Online Journal**


**Volume: 9, Issue:8, August 2024**


**Indexed By:**


**Published By**
**EPRA Publishing**



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SJIF Impact Factor (2024): 8.675| ISI I.F.Value:1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9| Issue: 8 | August 2024 - Peer Reviewed Journal

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# FUNCTIONING OF EKLAVYA MODEL RESIDENTIAL SCHOOL: A CASE STUDY OF TIPA SCHOOL, SAIHA DISTRICT, MIZORAM

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**ABSTRACT**
*The study focused on the functioning and infrastructural amenities in EMRS of Tipa, Mizoram. It encompasses the various management and infrastructural factors which are pre-requisite for a school to function for the welfare of the teachers and students. The study also highlighted the enrollment, dropout and pass out rates of the school under study and the importance of not only recruiting trained teachers but also retention of the teachers to reduce dropout rates of students. Though the school is well equipped in terms of infrastructural facilities, the students have no access to computer and internet connectivity and there is lack of funds for students to participate in non- academic activities. An inference drawn from the study is that the policy makers must revisit the existing guidelines of EMRS for the improvement of the school not only in the study area but also for the country at large.*
**KEYWORDS:** *EMRS, Tipa, infrastructure, enrollment, dropout, pass out*

## INTRODUCTION

Eklavya Model Residential Schools (EMRS)started in the year 1997-98 to impart quality education to ST children in remote areas in order to enable them to avail of opportunities in high and professional educational courses and get employment in various sectors. The schools focus not only on academic education but on the all-round development of the students. Each school has a capacity of 480 students, catering to students from Class VI to XII. Hitherto, grants were given for construction of schools and recurring expenses to the State Governments under Grants under Article 275 (1) of the Constitution. The Ministry of Tribal Affairs launched the scheme of 'Eklavya Model Residential School (EMRS)' for classes VI to XII during 1997-1998 under Article 275(1) of the Indian Constitution on the pattern of Jawahar Navodaya Vidyalaya. Till date, 197 EMRSs have been sanctioned by the Ministry in various parts of the county, out of which, 129 EMRSs are fully functional and the remaining 68 EMRSs are under construction. At present around 8 EMRS are in operational in Mizoram.

In order to give further impetus to EMRS, it has been decided that by the year 2022, every block with more than 50% ST population and at least 20,000 tribal persons, will have an EMRS. Eklavya schools will be on par with NavodayaVidyalaya and will have special facilities for preserving local art and culture besides providing training in sports and skill development. Across the country, as per census 2011 figures, there are 564 such sub-districts out of which there is an EMRS in 102 sub-districts. Thus, 462 new schools have to be opened by the year 2022. With these, currently Mizoram has 17 EMRS and Lunglei EMRS is the first EMRS established in Mizoram. These 17 EMRS cover all the remote Tribal areas within Mizoram for the development of Tribal Education and their career guidance and development as well.

EMRS has vision of catalyzing socio-economic development of the most underprivileged groups in India i.e. the Scheduled Tribes (STs), in a coordinated and a planned manner considering it as an effective instrument for their holistic empowerment. EMRS has mission for imparting quality education to ST children by establishment of Eklavya Model Residential Schools in order to enable them to avail high and professional educational courses and to get employment in various sectors. EMRS will ensure them opportunities at par with non-ST populations thereby providing impetus to the overall development of tribal population in the country.

### Objectives of EMRS

The objective of EMRS is to provide quality middle and high-level education to Scheduled Tribes (ST) students in remote areas, not only to enable them to avail of reservation in high and professional educational courses and as jobs in government and public and private sectors but also to have access to the best opportunities in education at par with the non-ST population. This would be achieved by:

1. Comprehensive physical, mental and socially relevant development of all students enrolled in each and every EMRS. Students will be empowered to be change agent, beginning in their school, in their homes, in their village and finally in a large context.
2. Focus differentially on the educational support to be made available to those in Standards XI to X, so that their distinctive needs can be met,
3. Support the annual running expenses in a manner that offers reasonable remuneration to the staff and upkeep of the facilities.

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4. Support the construction of infrastructure that provides education, physical, environmental and cultural needs of student life.

## REVIEW OF RELATED LITERATURE

Majority of the tribal children in Chhattisgarh, Jharkhand and Odisha fight to get access to the schools devoted for them, and those who succeed in receiving access, failed to get quality education. Different agencies and government committees planned various ways for improving access in these schools. (Jojo, 2013). The expansion of spreading education was achieved over time by opening more tribal schools like Ashram Schools, Eklavya Model Residential Schools, building residentials for students, but attention was not given on the improvement of tribal education by introducing remedial classes, counselling, and vocational education. These schools failed to deliver impartial quality education as per the requirements of the tribal students. The provisions for the education of tribal children through various schemes and policies have proved to be inadequate in addressing their educational requirements. The running of schools in tribal areas is under serious threats (Jojo, 2013). A study about the condition of education in tribal areas in Maharashtra (CBPS, 2017) cited that there is a need to boost educational opportunities and requirements for the tribal pupils, not only in terms of physical infrastructure or financial provisions but more delicately and inclusively, without disaggregating planning across the states in India. It argues that a systematic and rational approach is the need of the hour to address the poor educational outcomes of the tribal people.

Students' achievements do not reflect their socio-economic background, it mainly depends on their aptitudes and skills. Therefore, an impartial school system is fundamentally one where all the learners can reap their full potentials, regardless of their socio-economic background (Harris et.al, 2019). In schools and society where the level of challenges is intense and the jeopardy to equality of opportunities are quite significant, leading for equality is more than just a theme. Instructional headship in this setting implies that the heads' efforts should focus on student's academic advancement to improve their outcomes and the importance of refining classroom teachings. (Day, 2016). Educational plans and evaluation of the quality of teachers and their teaching should be transparent. Whereas, Shatzer (2014) highlighted that the formation of the school ethos and vision for improving the quality of education are the need of the hour for the overall alteration of schools towards a philosophy of inclusiveness in education.

Moswela et.al (2019) stated that leadership in school administration is at the apex of a more effective management and plays a pivotal role in managing and supervising the proper working of the school in order to provide better education to the pupils. It is not viable to consider school administration without heads yet gives orders and directs the organization just to keep the organizations to function. They concluded that school headship is the second most vital factor that can influence the students after classroom teaching (Fritz et.al, 2003). Good governance in education denotes the whole academia, administration, and executive systems where the stakeholders must design and implement good practices. Teaching and non-teaching staff must collaborate and interact to come up with new ideas for the smooth function of the schools. Leadership alone will not suffice to create a good work environment (Mythili, 2019). Since authority flows from the school levels to the state government levels, respecting good practices and developments and solid cooperation among the school, district and state will bring about changes in the area which will further have an indirect effect on the people for their welfare. Three indispensable features that define the substance of good governance was mentioned by Bareth (2004). First, the people must be freely and actively participated people in the decision-making process without anyone being discriminated at all the levels of governance systems; secondly, good governance favored the welfare of the people, particularly the vulnerable and socially disadvantaged section of the society, and thirdly, it works to implement positive changes in the society.

Superfluous emphasis on monetary resources supervision has somehow resulted in overlooking other important factors within the organization that affect the role of leadership at all levels. Very often, the leaders at the district levels lack the required skills to implement plans and supervise the schools. The guidelines of the Central Ministry are being sightlessly followed by the various authorities of the district and local education bureaus, which has resulted in a blurred picture when it comes to the authority and their responsibilities (Chapman, 2000). The primary tasks of the middle levels of the Central Ministry are to inform policy matters and program to schools, provide data and other necessary information from the schools to the ministry while monitoring that these schools are enduring government policies. These middle level lacks authority to decide and acts on the data available. Moreover, inspections of the schools are usually performed by workers who does not possess the necessary qualifications and lack moral ethics. General appointments through simple examinations does little improvements in their work ethics especially if they did not undergo specialized training
(Sharma, 2000).

Equality in terms of education is defined as raising the achievement level of all the students while lessening these achievement gaps between the highest and lowest performing pupils and removing ethnic and other disparities that exist amongst them. (Singleton et.al, 2006). The role of the heads significantly affects how delicate their schools are to students for the deprived backgrounds (Stanovich et.al, 1998; Gardiner et.al, 2006). However, there are differences in the opinions of the heads in understanding equality issues in education and the strategies they adopt to make an inclusive environment in their schools.

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Majority of the school leaders stated that, they did not undergo equality training during their pre-service training (Gardiner et.al, 2006; Zaretsky et.al, 2008) Another important issue is that principals are expected to create an inclusive work environment while also redefining the responsibilities of their employees. To increase equality among the students, various strategies must be employed by taking into account the cultural background of each student. Principals or heads of the school are directly involved in order to maintain equity among the staff and students so as to enhance a healthy relationship in their schools (Ross et.al, 2009).

## AREA OF THE STUDY

Mizoram is one of the States of North East India, with Aizawl as its capital city. In addition to the existing 8 districts prior to 2019, the Government of Mizoram by notification enabled the functioning of 3 new districts in the year 2019. Accordingly, administrative jurisdiction, notified towns and villages pertaining to these 3 districts had been chalked out. Saiha District is one of the eleven districts of Mizoram state in India. The district occupies an area of 1399.9 $km^2$. Saiha town is the administrative headquarters of the Mara Autonomous District Council. Tipa (also known as Tuipang) is a town located in this district and in this town, the EMR school under study is established in the year 2020.

## OBJECTIVES OF THE STUDY

1. To examine the status and functioning of Tipa Eklavya Model Residential School.
2. To evaluate the infrastructural facilities available in the school.
3. To analyze the enrollment, drop out and pass out trends during the study period.
4. To suggest measures for strengthening the EMRS program and draw implications for policy makers on the education of tribal children.

## RESEARCH QUESTIONS

1. Does the school infrastructure support access to computer and internet connectivity for enhancing students' digital skills?
2. Does the school have recreational facilities for students to enhances their talents other than academic excellence?
3. Does the school practice gender equity in terms of enrollment?
4. What is/are the main push factors for dropouts?

## METHODOLOGY

The study is based on primary data. A structured questionnaire was prepared to capture the management, functioning and infrastructural facilities of the EMR school in Tipa for the periods of 2020-2023. Secondary sources were also obtained from various journals, books and other relevant e-resources. The data collected were analyzed using appropriate statistical tools.

## RESULTS AND DISCUSSIONS

The role of headship plays a crucial role in the overall development of schools. Next to classroom teaching, it is an equally important factor that can influence students' progress directly and indirectly. Several research studies have drawn a conclusion that for equality viewpoints in general and for the marginalized in particular, school headship plays a pivotal role in enabling the school facilities available to all students to meet their individual levels of learning. On the other hand, the authority's role at all levels also plays an influential part in monitoring schools' tactical directions, executing plans and policies, and giving advices on the various challenges of the schools. The functioning of Tipa school from the perspective of the principal is presented below.

**Table 1: Functioning of Tipa EMR School on Selected Indicators-I**

| Sl. | ITEMS | Yes | No |
|---|---|---|---|
| 1. | Availability of course content separately for the school | | √ |
| 2. | Inclusions of local relevant curriculum | | √ |
| 3. | Availability of school academic calendar | √ | |
| 4. | Students' daily routine is arranged in a systematic order as per the requirement of the students | √ | |
| 5. | Sufficient number of teaching and non-teaching staffs | | √ |
| 6. | Participated in the recruitment process of teaching and non-teaching staff | √ | |
| 7. | Financial problem in running the school properly | | √ |
| 8. | Involved in the admission process of the school | √ | |
| 9. | Teachers are permitted to be engaged for tuition class | | √ |
| 10. | Remedial classes/ extra classes for students | √ | |
| 11. | Parent's Teacher meeting | √ | |
| 12. | Satisfied with the school campus | √ | |
| 13. | Morning assembly for students | √ | |

*Source: Field Survey, 2024*

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As presented in Table 1 above, the school under study did not have a separate course content for their school, they are following the pattern of the Central Board of Secondary Education (CBSE). The local related issues are not included in their curriculum design. The school followed the academic calendar prescribed for them and they prepared the daily routines for each class depending upon the requirement of the students. The principal is involved in the admission process of the students and also played an active role in the recruitments of the teaching and non-teaching staff but the number of teachers and staff are highly inadequate to meet the demand of the students and the school itself. The funds available for the smooth functioning of the school is rather limited and this factor is the major challenge faced by them. The teachers are not permitted to give tuition to the students over and above the number of teaching hours assigned to them though they are permitted to offer remedial classes. Parents and teachers' interaction are held at regular intervals and students' morning assemblies are conducted every working day.

**Table 2: Functioning of Tipa EMR School on Selected Indicators-II**

| Sl. | ITEMS | Yes | No | |
|---|---|---|---|---|
| 1 | Rewards to Meritorious students | √ | | |
| 2 | Practise gender equity | √ | | |
| 3 | Purchase of teaching- Aids | √ | | |
| 4 | Emphasis on activity-based learning | √ | | |
| 5 | Allocated of enough funds for field trips and projects | | √ | |
| 6 | Teachers evaluate class notes regularly | √ | | |
| 7 | Conduct of assessment or tests frequently | √ | | |
| 8 | Opportunity to teaching and non-teaching staff for professional development | √ | | |
| 9 | Separate time slots for students to access computers | | √ | |
| 10 | Allocated of funds for participation in school/national level sports meet | | √ | |
| 11 | Opportunities to students to expose to school-level curricular competitions | √ | | |
| 12 | Organising science exhibitions in the school | | √ | |
| 13 | National and state festivals celebration | √ | | |
| 14 | Are there regular interactions between you and the hostel superintendents? | √ | | |

*Source: Field Survey, 2024*

Rewards to meritorious students is a way to inspire good behaviors and inculcate competitive essence among the students. They are often used to recognize hard work and academic excellence. The EMR school of Tipa is practicing this activity every year and they also teaches and practice gender equity in the school to empowered both boys and girls in promoting equal developments in acquiring life skills. The use of teaching aids can facilitate the learning process of the students by making the process less time consuming and interesting, the school under study often purchased teaching aids that enables the students to use their hearing and seeing abilities thereby improving their learning potentials. As presented in the Table above, the principal stated that though activity-based learning is promoted in the school, the funds availability for students' field trips and projects is rather limited. In view of the importance of field trips and project works in promoting critical thinking and enhancing their observational skills, more funds must be allotted for field trips and projects. The teachers examine the class notes of each student, conduct class tests frequently and the teachers are given the opportunities to enhance their professional development by undergoing various training programmes. Computers are pivotal especially for students to acquire digital skills in the modern world, it is not just an advantage but a necessity for their personal growth and development. But the school does not devote time for students to access computers, this is an important area where there is a scope for improvement of the school. The students do not participate in the national or state levels sports meet due to the non-availability of funds for this purpose, they are exposed to school levels curriculum competitions only and they have never conducted science exhibitions in their school. They do observe and celebrates state and national festivals. There is a decent teamwork between the principal and the hostel wardens/ supervisors for the welfare of the students. Students and parents often ponder upon the infrastructure of the school as one of the main factors when selecting a school for admission. School infrastructure encompasses all the physical units and facilities the school offers. Education exclusively depends on the course design, teachers, and methods of learning, but a mentally motivating, peaceful and reassuring environment also plays a vital role in students' growth academically**.** Good school infrastructure must offer a favorable environment for students to be comfortable, feel safe, and focus on learning by taking into account all the resources and amenities for students. The following Tables 3, 4, and 5 shows the infrastructural facilities of the Tipa EMR School.

**Table 3: Infrastructure of the School -I**

| Sl | Items | Available | | | Not Available |
|---|---|---|---|---|---|
| | | Good | Manageable | Poor | |
| 1 | Principal Room | √ | | | |
| 2 | Staff Common Room | √ | | | |
| 3 | Office Room | √ | | | |
| 4 | Classrooms | √ | | | |
| 5 | Visitor's Room | | | | √ |
| 6 | Science | √ | | | |

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| | | | | | |
|---|---|---|---|---|---|
| | Laboratories | | | | |
| 7 | Computer Laboratories | | | | √ |
| 8 | Internet connectivity in the computer room | | | | √ |
| 9 | Library | √ | | | |
| 10 | Availability of books in the library | √ | | | |
| 11 | Toilet facilities | √ | | | |
| 12 | Drinking water Facilities | √ | | | |

*Source: Field Survey, 2024*

In Table 3, it can be seen that the school have different rooms for the principal, staff, office and science laboratories but not visitors' room. There is lack of computer laboratory and no internet connectivity. The school have a library and it is furnished with books of different kinds for the readings of the students. Toilets and drinking water facilities are in good conditions. It can be stated that since computer laboratories in schools are an indispensable resource to foster students learning and development and develop their technological skills, the school must have such laboratories which will not only prepare them for technical career but also for the digital world we live in. Furthermore, computer laboratories without internet connectivity would be meaningless, it plays a vital role in education as it contains a wealth of knowledge that will help the students to re-learn the curriculum taught in the school and also enable them to access information for their everyday lives.

**Table 4: Infrastructure of the School -II**

| Sl | Items | Available | | | Not Available |
|---|---|---|---|---|---|
| | | Good | Manageable | Poor | |
| 1 | School Bus facility | | | | √ |
| 2 | Emergency Fire exits | √ | | | |
| 3 | Fire extinguishers | √ | | | |
| 4 | Indoor stadium | | | | √ |
| 5 | Playground | √ | | | |
| 6 | Fans in the classrooms | √ | | | |
| 7 | First aid facilities | √ | | | |
| 8 | Campus security guard | | | | √ |
| 9 | Store room | √ | | | |
| 10 | Sports goods | √ | | | |
| 11 | Learning aids | √ | | | |
| 12 | Recreational room | | | | √ |

*Source: Field Survey, 2024*

The table above i.e., Table 4 shows that the school under study have no transportation facilities for students. This is acceptable since the school is a residential school and that all the students reside within the campus. The school have fire extinguishers for emergency fire outbreak, they also have a playground for the students to assemble and perform outdoor activities. Fans are fitted in all the classrooms; variety of learning aids are available and they also have a store room where school materials are being stored. At the same time, there is an absence of indoor stadium where students can perform different indoor sports and there is no recreational room for the students and the teachers. The school does not have security personnel for the safety of the school and the students. An inference that can be drawn from Table 4 is that, the school must provide an indoor sport stadium to enable students to relieve themselves from the monotonic academic exercises and enhance their sporting skills and availability of indoor stadium can give a chance to discover talents other than academic excellence. Moreover, the school must provide recreational room for students to enhances their peer-relationships and inter-personal skills. Furthermore, schools are meant to be safe for learning environment, but this might be not possible for the students without security measures put into place. Availability of security guards can offer the school the protection it needs while not interfering with the children's education.

**Table 5: Infrastructure of the School -III**

| Sl | Items | Available | | | Not Available |
|---|---|---|---|---|---|
| | | Good | Manageable | Poor | |
| 1 | Blackboard /whiteboard | √ | | | |
| 2 | Condition of tables and chairs | √ | | | |
| 3 | Well-ventilated classrooms | √ | | | |
| 4 | Presence of nurse | √ | | | |
| 5 | Teaching staff quarters | √ | | | |
| 6 | Ramps in the school | √ | | | |

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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| | | | | | |
|---|---|---|---|---|---|
| | for the disabled | | | | |
| 7 | Conditions of paths linking the buildings | | √ | | |
| 8 | Road connectivity of staff quarters via classrooms | | √ | | |
| 9 | Campus environment and it's building construction | √ | | | |
| 10 | Conditions of building roof | √ | | | |
| 11 | Are there any types of facility for the visually impaired students? | | | | √ |

*Source: Field Survey, 2024*

Table 5 presented that the school's writing boards such as whiteboards and blackboards are in good conditions and that the classrooms are well ventilated. There is a health care provider, a nurse in the school to treat students' ailments during the school hours. The school provided residential quarters for the teaching staff and there are disabled-friendly ramps in the school. The roads that connect the school and the staff quarter are barely manageable, there is a scope for improvement of the road's connectivity within the school campus. The campus itself is environmentally friendly and the roofs of the buildings are in good conditions. Though the school under study is well furnished from different angles, there is no facility for visually impaired children, this parameter alone highlighted the fact that the school is not feasible for visually impaired tribal children. The visually impaired children have the same rights with their counterparts i.e., the non-impaired, the authority of the school must take this matter into account to accommodate the visually impaired children and thereby promoting equity in the functioning of the school.

One of the ripple effects of the stifling competition for education institutes is the growing necessity for schools to enhance their mechanisms for better serving applicant's queries and objections. The debate about the effects of school size has a long history. Larger-school advocates contend that they allow for more varied curriculum and extra-curricular activities. Smaller school promoters argue that large schools allow students to fall through the cracks, whereas small schools promote more personal attention for students. School size is one potential measure of school quality over which policymakers have some control (Gershenson & Langbein, 2015). Numerous studies, reviewed by Andrews et al., 2002; Cotton, 1996 and Leithwood and Jantzi, 2009 have investigated the relationship between school size and academic achievement. Lee, et al., (2000) intheir qualitative study of small and large schools, documented that student in small schools reported generally higher levels of support and caring among the members of their school communities. New investigation designates that smaller schools have greater student success, better attendance and contribution in school actions confident interactions between students, instructors and parents. More current studies suggest that small schools are well than large ones, particularly for students with lessersocio-economic position. There are countless references, conference papers and journal articles illuminating the merits of small schools (Schneider, 2002). (Akerlof &Kranton, 2002) argued that students in small schools' benefit by being better able to identify with the school and with each other. Class size is viewed as an enabler of more effective instruction that can improve student learning (Konstantopoulos & Sun, 2014). Based on the evidences of these reviews, the following table for enrollment in Tipa EMRS is formed.

**Table 6: Enrollment in Tipa EMRS**

| Class | 2020-2021 | | 2021-2022 | | 2022-2023 | |
|---|---|---|---|---|---|---|
| | Boys | Girls | Boys | Girls | Boys | Girls |
| VI | 15 | 15 | 15 | 15 | 9 | 7 |
| VII | 15 | 15 | 15 | 15 | 8 | 13 |
| VIII | 15 | 15 | 15 | 15 | 12 | 12 |
| IX | 15 | 15 | 09 | 11 | 12 | 12 |
| X | | | | | 8 | 9 |

*Source: Field Survey, 2024*

In the above table, it can be seen that since its inception, the school has been enrolling 30 students each in all classes, i.e., class 6 to 9 with 15 boys and 15 girls in every academic year. The total enrollment in 2020-2021 is 120 students, 120 students in 2021-2022 and 150 students in 2022-2023. The enrollment increases in the third year due to the introduction of class 10 in the school. The school is planning to introduce classes 11 to 12 in the near future and this is hope to increase the enrollment rates. The drop outs during the same period under study is presented in Table 7 below.

**Table 7:Dropouts in Tipa EMRS**

| Class | 2020-2021 | | 2021-2022 | | 2022-2023 | |
|---|---|---|---|---|---|---|
| | Boys | Girls | Boys | Girls | Boys | Girls |
| VI | 15 | 15 | 15 | 15 | 15 | 15 |
| VII | 15 | 15 | 15 | 15 | 15 | 15 |
| VIII | 15 | 15 | 15 | 15 | 15 | 15 |
| IX | 15 | 15 | 15 | 15 | 15 | 15 |
| X | - | - | - | - | 15 | 15 |

*Source: Field Survey, 2024*

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From the dropouts table presented above, it can be seen that 2 students dropped out from class 6 in 2023 due to their health conditions. During the academic year of 2022-2023, 4 boys dropped out from class 10. The main reason behind these dropouts is that majority of the qualified teachers left the school for better employment opportunities and the principal hired teachers on temporary basis and the students who have dropped out could not follow the teaching methods of these hired teachers. A conclusion that can be drawn here is that retaining teachers in the EMRS must be looked into and incentives for the teachers must be enhanced. This will come a long way in not only retaining the teachers but also the students.

**Table 8: Numbers of Pass Out Students**

| Class | 2020-2021 | | 2021-2022 | | 2022-2023 | |
|---|---|---|---|---|---|---|
| | Boys | Girls | Boys | Girls | Boys | Girls |
| VI | - | - | - | - | 1 | 1 |
| VII | - | - | - | - | - | - |
| VIII | - | - | - | - | - | - |
| IX | - | - | - | - | - | - |
| X | - | - | - | - | 4 | - |

*Source: Field Survey, 2024*

Table 8 shows the number of students who succeeded in each class during the study period. In class 6, all students passed in 2020-2021 and 2021-2022, but in the academic year of 2022-2023, 6 boys and 8 girls failed in this class. In class 7, for the two consecutive years of 2020-2021 and 2021-2022, all students succeeded but in 2022-2023, 7 boys and 2 girls failed. In class 8, in the year 2022-2023, 3 boys and 3 girls were unsuccessful. In class 9, 100 percent succeeded in the first academic year under study, but 6 boys and 4 girls failed in the second academic year and 3 boys and 3 girls were also unsuccessful in the third academic year. 8 boys and 9 girls thrived in the board examination of class 10 in 2022-2023. The main reason behind why some students were unsuccessful is due to the fact that they lack proficiency in English, which hinders their learning capabilities not only in this particular subject but in other subjects as well. A recommendation that can be made here is that, the school must recruit teachers who have skills in enhancing the learning potential of the students especially in English language. Even if the school have to hire temporary teachers, let the hired teachers be trained teachers who qualified Central Teacher Eligibility Test (CTET) as far as possible.

## CONCLUSION

School infrastructure is one of the pivotal parameters that can enhance students' enrollments to achieve the educational objectives and goals. The provision of infrastructural facilities can create a productive and environmentally friendly campus. The Tipa EMR school have a scope for further improvement in terms of developing their infrastructure and the policy makers must revisit the framework and guidelines of the EMRS in order to facilitate and promote the educational rights of tribal students not only in Mizoram but also in India as a whole.

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EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# DISTINCTIVE FEATURES OF THE CHILDREN OF THE NEW DIGITAL GENERATION (Z-ZED AND ALPHA) OF THE 21ST CENTURY

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**Article DOI:** https://doi.org/10.36713/epra17902
**DOI No: 10.36713/epra17902**

## ABSTRACT

*The term "children of the 21st century" was replaced by the term **"children of artificial intelligence"** before the words **"children of computer technologies"**, **"digital technologies"** and **"nanotechnologies"** were fully used. For this reason, the difference between the older generation and the representatives of the growing generation is increasing sharply. Growing up with the Internet and portable digital technologies from infancy, children can independently use all the functions of gadgets and smartphones without having any knowledge of digital literacy. We can recognize this trend as a product of **gene mutation** from humans of the Olduvai period to modern-day **homo sapiens.***

*In the article, the study of the teachings on The **"Theory of Generation"**, one of the current topics, which is focused on day by day by scientists around the world, has now been proven to be the main support for survival and security from new dangers and threats that arise on the path of mankind. In particular, the research on the theory of generations is based on the knowledge of different approaches of scientists about the existence of physical, biological, socio-spiritual and spiritual differences between people who lived in different periods and the author has set the task of learning.*

**KEY WORDS:** *"Theory of Generation", homo sapiens, "Z-zed", "Alfa", X, "Baby bumer", "ZOOmer", Nil Xou, Uilyam Strauss, "digital technology", "nanotechnology", portable technology, "artificial intelligence", real life, virtual world, media space, gene, genetic mutation, "Internet teachers", clip memory, digital autism, dopamine crisis, life weakness of immunity.*

## INTRODUCTION

Human intelligence and achievements in science and technology have improved various aspects of social life, including living conditions. Over the centuries, the transmission of information using invisible waves, which is a miracle of human mental potential, has made it possible to easily and quickly absorb information through the media space. We can see how high the influence of media space on people is by the organization of work in the digital system of almost all areas of society.

Today, as much as the media product has a positive effect on homo sapiens, it also has a negative impact. It is the increasing differences between the representatives of the older generation and the generation that is coming of age, that explain the reasons for the misunderstanding, development of solutions and research of communication methods are carried out by studying the scientific theoretical aspects of "generation theory".

## THE MAIN PART

"Generation theory" was applied by American researchers Neil Howe and William Strauss. In 1991, they developed a concept based on the general philosophy of people of different ages and published a book called Generations [3]. This book analyzes in detail the history of each generation that has lived in the United States since 1584. After that, in 1997, a new book called "The Fourth Turning" was published, in which the theory was explained in more detail, and in most cases, generations were divided into 4 different categories that replaced each other every 20 years. We can see that there are many debates and various theories and views about the characteristics of each generation from the past to the present. Therefore, to understand them and enter into a more complete relationship, in addition to the essence and characteristics of generations, the process of genetic mutation is increasingly perfected, and it can be understood that time plays a big role in this. During their research, researchers Neil Howe and William Strauss divided the generations that lived in Western countries into the following stages: "Arthurian"- 1433-1460 years, "Humanist" - 1461-1482 years,"Reformation" - 1483-1511 years, "Repression" - 1512-1540 years, "Elizabeth" - 1541-1565 years, "Parliamentary Generation"- 1566-1587 years, "Puritan" - 1588-1617 years, "Knights"- 1618-1647 years, "Glorious" - 1648-1673 years,"Enlightened" - 1674-1700 years,"Awakening" - 1701-1723 years,"Liberty" - 1724-1741 years, "Republican"- 1742-1766

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years, “Compromise” - 1767 -1791 years, “Transcendent” - 1792-1821 years, “Gilded” - 1822-1842 years, “Progressive”- 1843-1859 years, “Missionary” - 1860-1882 years, “Lost” - 1883-1900 years, “Great”- 1901-1924 years, “Quiet” - 1923-1943 years, “Baby Boomer” - 1943-1963 years, “X”- 1963-1984 years, “Y” - 1984-1996 years, “Z”– “Zed” - for the years 1996-2010 [2].

We can see that the development of human intelligence and great achievements in science, together with the development of society, have a significant impact on its natural and biological characteristics, and we can see that today’s people’s facial structure and worldviews have changed significantly. In the book “Dictionary of Basic Concepts of Spirituality”, which contains such views, the concept of generation is defined as follows: “generation - children and their descendants who are the successors of a particular person, family or dynasty in the narrow sense, while in a broad sense, humans, who at a certain stage of the development of a nation, a people, or a civilization emerge with a single idea with goals and tasks, ensure coherence and continuity in the process of development, determine the image of their time, rise to the level of a social phenomenon”. In this regard, the Head of State, speaking about the “generation,” said that “the youth of today’s world is the largest generation in the history of mankind because they make up 2 billion people. He puts forward the opinion that the future of our planet, the well-being of our children, depends on how our children grow up to be human beings [1]”. According to experts, for the first time in the history of mankind, we are living in a time where the majority of the people living on earth are made up of the young generation. Therefore, in the process of struggle for the human heart and mind, it is felt necessary to study the characteristics of each generation separately to properly establish relations with young people who can become weapons of alien forces.

When talking about **“generations”**, this concept is:
***The First Meaning —*** *a group of people equally distant from their common ancestors by kinship, relationship;*
***The Second Meaning –*** *people of a certain era, that is, a group of people born in a certain historical period.*

Even though researchers from Western countries have periodized the theory of generation based on the character of people who lived in certain periods and the environment of the time, we have not found news about the theory of generation by Eastern scientists.

However, since our research work is closely related to this topic, we will analyze it based on the results of our scientific research. Generations typically change every 25 years because people at the same developmental stage are exposed to similar trends and tend to have similar behaviors, beliefs, and motivations. According to the theory of generations, the values and habitual actions formed in the period from birth to 10 years of age change. Most sociologists argue that in theories of average generational change, the existing gap in age groups between 20 and 25 years is narrowing and that the changes have a simple explanation, but require reasonable proof.

## STUDY OF THE TOPIC

As a result of the research, the opinions of many foreign sociologists, philosophers, political scientists, ideologists, pedagogues, biologists and other scientists and researchers were studied regarding the development of the generation on a global scale and their characteristics of the times. In the existence of a person and his development, the effective organization of labor and production activities of people is inextricably linked with the perfect social consciousness and social thinking. The change of people in certain periods according to their generation characteristics and relationships with the adaptation process, the interaction between society and humans, relations between characteristics of society and the individual are represented in many theories about describing social processes in works such as Plato’s “The work of the state”, Aristotle’s “Politics”, Hegel “Dictionary of Philosophy”, Kant’s “The idea of universal history in a world-civil sense”, Levi Strauss’s “The First Logic”, N.A.Berdyayev’s “The free spirit of Philosophy”, Confucian teachings, Farabi’s “City of Virtuous People”, Beruni’s “India”.

Views on this matter M.Kastels, Yu.Habermas, Neil Howe, William Strauss, Yu.Levada, L.Kogan, L.P.Krasnorusky, M.Gandhi (West) and I.Karimov, Sh.Mirziyoyev, N.Jurayev, Sh.Pakhrutdinov, Sh.Goyibnazarov, Q.Nazarov, Sh.Turayev, Sh.Kudratkhujayev, O.Khasanov (Uzbek), scientists, politicians, representatives of the field of philosophy and ideology, in scientific lectures and books, there are opinions on current issues such as the concept of generation and the characteristics of our youth, ways to influence them.

## DISCUSSION SECTION

What is the term Z-zed generation, which is one of the phrases that are often heard in the social sphere? There are many people who have either heard about this or not. At the same time, representatives of this generation are also called “Zumers”, and according to experts, the concept of “ZOOmer” [4] is a model modeled on the children who came into the world between 1996 and 2005, i.e. “boomers” (*in some sources it is given as 2000-2011, 1996-2010*). The “zoomer” gene we see is modeled after the “Z”, a common contraction of the phrase “boomer” and used to refer to physically active baby boomers. At the moment, it has evolved into the appearance of Zoomer. The Zoomer Generation Millennials are the generation after Generation Y and before the new Generation **“Alpha”**. Studies show that the members of Generation **“Zed”** are the children of Generation X and Y. The gene resulting from the

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union of representatives of two generations differs from representatives of other generations by showing new characteristics. As a result of the transformation of Zeta genes and the strengthening of leading gene characteristics, their activity and intelligence, ability to reason and to work with a team led to the formation of the **heppir** generation layer.
Representatives of this generation are very important for the world economy and the age of technology. By generational characteristics, the differences between Boomer-X-Millennial-Zomer are increasing day by day. Even the difference between the children born in 2000 and those born in 2015 is causing great misunderstandings between generation X-Y and generation Z. Among the generations, **the Baby-Boome**r who is dissatisfied with the current state of the planet Earth, while the X-Y generations object to the Zetas for their indifference to the socio-political state of the world, representatives of Z and **Baby-Boomer** and X-Y admit their discontent as the reason why the world has become the way it is today.

The theory of descent is so complex that it has experienced evolutionary progress from the first man to the modern **homosapiens**. He actively encounters internal and external threats in the processes of adaptation to the surrounding social existence. As a result, it experienced a period of mutation based on the characteristics of a certain time and period from the processes of self-transformation and adaptation. These concepts were used for the first time in the Urban Dictionary network in order to solve the complex nature of social relations between people every day and to eliminate problems in working with them [5]. In the dictionary, "zoomer" does not refer to Generation Z, but rather as an evolution of the term "boomer". Origin of the term In the early 1990s, zoomer was also known as a personal digital assistant, and the term "ZOOM" consisted of two seasons: the first, from 1972-1978, and the second, from 1999-2005, each season featured a different group of kids, referred to as "ZOOMers" or "boomers"[6]. None of this contradicts the boomer meaning of zoomer, but it can be said that gen Zed is the successor of the meaning of generation. The lifestyle and values of the "ZOOMers" were completely different from those of the generation of the late 1950s and 1960s. Earlier, representatives of this generation grew old in sedentary conditions, but now they are lively, active, busy and do not retire at the age of 65, as before. They are essentially "growing up"[7], and most of their generation, according to statistics, have nothing to do with a wasteful lifestyle. At the moment, according to the observations of Western scientists, boomers between the ages of 50-60-70 lead a healthy lifestyle and are very active not only at home, but also in gyms. We wouldn't be wrong to say that they are real time-appreciators.

One of the biggest problems facing humanity is the limited natural resources and unlimited human needs. In this period, it is very important to prevent the difference in worldviews between the representatives of BB, X-Y and Zed, which is increasing day by day. Gen "Z" is equally important in terms of the demographic problems that may arise after globalist ideas occupy the minds of generations and the increasing number of people's relationships in virtual life.

Compared to the previous generation, the presence of aggression in everyday life, different views on status, gender, religion and existence, and the belief that they have a special individuality are also distinguished by differences between generations. In some developed countries, Zomers are distinguished by their behavior, the level of reaction to surrounding events, and their attitude towards dangers. In comparison to their youth, the life style of the Zomers is much slower than that of the representatives of the generation before them [8]. Views on time are also fundamentally different from those of the Baby Boomers and X-Y generations. The gradual emergence of a generation of free-spirited and free-spirited people has led to the rise of strict rules and regulations, and the biggest of these is the deepening of misunderstandings between the classes, from the baby boomers to the Zetas.

In the case of generations, our work shows the need to provide more complete information about the larger groups associated with them. Let's look at the main large group that we are familiar with: *(years are given differently in many sources, the difference between them is 1-3 years, and they do not affect the general essence of the term.)*

**Baby Boomer**: This generation is made up of children born in 1943-1963 [9]. They are mainly self-demanding, adapted to physical labor, hard-working, willing to engage in team work, and they like team games [10]. At the same time, the main part of this layer is pensioners, but among them there are also those who are engaged in work. One of the main characteristics of the representatives of this generation is their resilience to difficulties. They are not afraid to talk about the problems in the world and they believe that they can change the world. Due to the fact that they spend a lot of time on work and career, this generation has more divorces in relation to family and children in the world.

The representatives of the **X generation** are people born in 1963-1984, their distinctive features are that they believe in themselves more, are able to think differently, they are always aware of the changes taking place in the world, at the right time able to choose and change [11]. They are mostly loners, and they are willing to work hard to achieve individual goals through this, a group of people who are trying to grow professionally in their fields in one direction. Unlike baby boomers, they focus all their energy on the well-being of their families. One of the distinctive features of Generation X is that they give their children everything they don't have as their main task: good clothes, modern gadgets, higher education, car, apartment and things that help them feel comfortable and independent [12]. They do not believe in any kind of state or social assistance, they rely only on themselves. They like clear deadlines and boundaries in life and work.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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**Millennials** (**Y)** are born between 1984 and 1996 [13]. Millennials are one of the most difficult generations for the public to understand, and we'll try to understand why. The name comes from the Latin word "millennium" - a thousand years [14] and representatives of Generation Y were born on the eve of the beginning of the millennium. People of this category grew up in very difficult times: reconstruction, wars and epidemics. However, it should be noted that there are positive changes - global progress in the field of information technologies. Thanks to smartphones, gamers have been called the thumb generation because they were the first to type messages on a phone with one finger. They have different concepts of goal-setting and success, and in most cases they don't like to start their professional activity at the lowest levels, hoping that after a few years they will "raise". Their main focus is on rapid growth, and this, in turn, is their weakness. However, this shortcoming is turned into a positive side by their desire to be professional in several fields at the same time. That is, there is no need for them to be specialists in only one direction. Generation Y is the hope of modern business, they are ready to work more than the specified working hours, they are also considered to be more technologically literate. Many experts say that Generation Y will soon become the global workforce. They are also distinguished by the fact that they are supported by their parents until they start their studies and work.

**Generation Z** or **Zoomers** were born between 1996 and 2010. A category of people born in the era of postmodernism and globalization. We can say that they were born with a smartphone or tablet in their hands [15]. No doubt, you yourself have noticed several times with your children or friends, the children do not yet know how to read or speak, but they know how to turn on the tablet or computer.

In other words, not only parents, but also YouTube, TikTok, Instagram and many other bloggers related to modern technologies are involved in the upbringing of zoomers. They don't have childhood memories with friends in the yard. Therefore, they do not have the experience of working in a team, it is necessary to teach it. Sh.Torayev said about this, "Today, children do not need to go out and call a friend to play a game and wait for their parents to answer. They continue to communicate with their smartphone or iPhone even sitting wherever they want".

Usually, as soon as people get to know themselves, they start communicating with the people around them. They ask them, they play together, and as a result of these friendships, close relationships and games, people's worldview is formed [16]. It can be seen from this that people entering into social relations is the first step for entering into social relations between members of family, school and society. It is the delay in taking these steps that causes people to rush from real life to virtual life. Since these situations have also been observed in the Zetas, it takes time to teach them to work as a team.

**Generation Alpha** is a term coined by an Australian researcher, and representatives of this generation cover the period from 2010 to 2024. Alphas are the first generation to be fully born in the 21st century, making up more than 2 billion of the world's population as the largest generational group in human history. Their characteristic difference from all their predecessors is that they do not have their own point of view and clear position on any important topics: politics, economy, psychology, relations between children and parents, global changes in the world, etc. and they can be easily influenced. Alpha appreciates listening to their words from a very young age, they like to acquire new knowledge, except in cases related to memorizing and processing a large amount of information.

They get the basic information from the internet, and the knowledge they get is too abstract, and it can give them a warning that they don't have a specific source. Alphas do not really understand what is useful in education and learning in schools and universities. Therefore, it is a generation that can count birds in class and not worry about the presence or absence of spelling mistakes in their writing. Earlier, baby boomers and other generations worked for hours on handwriting and spelling, but alphas often ask one question: is it necessary to write in education at all? All information referred to as "Internet Teachers" is of a complete material nature (subject to a certain temporary event). But, on the other hand, they stand out from others because of their amazing versatility and strong innovative creative thinking skills. One of the important nuances is that they are very capricious and mentally unbalanced individuals and prone to selfishness. If their request is denied, they may start a fight. Representatives of this category of people are free creators. They do not need comfortable conditions, stable work and financial benefits. They are attracted to new and unfamiliar things. It doesn't matter to them where to sleep or what to do.

## CONCLUSION

Unlike all previous generations, Alphas are not interested in money, expensive cars, apartments. They, unique people, think like this: "Getting attached to everything will not lead to good results, you can rent an apartment or a car. Why is it necessary to buy them?"

Material or financial indicators are not important for them. The most important criterion for them is the spiritual component. They are not interested in anything except parties and events that allow them to experience new emotions in life. For example, travel or new gadgets that they were not familiar with before. It can be said that they are increasing interest in self-education. "They are distinguished from their predecessors by their unusual thinking and early development. They are interested in adult questions: Who

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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does mom or dad work for? how much do they get paid? Is this money enough to meet their needs? Will this money be suitable for them in the future? Also, some children are born "with a tablet in their hands [17]."

Alphas are fundamentally different from their predecessors in many ways. The reason is dynamic users of the Internet. About 80% of children at the age of 2 are already actively playing games on smartphones and tablets. *According to data provided by Ofcom:*

*1. Every 4th child has his own gadget at the age of 3-4.*
*2. Every 3rd child has his own gadget at the age of 5-7.*
*3. Every 2nd child has his own gadget at the age of 8-11.*

It would be safe to say that Alfa is the first generation that has not been beaten with a belt. We ourselves did not even have time to understand when this global, but imperceptible revolution in human consciousness took place. 20 years ago, no one paid attention to parents who severely punished their child for misbehavior or behavior. However, today this action is definitely condemned. This situation is recorded on our smartphones and phones, and in most cases it is posted on social networks. After that, guardianship services come into action to protect the child. Therefore, in modern life, parents are trying to avoid unnecessary aggression towards their children.

Consequently, alphas don't tend to get overly bitter. However, they are distinguished by a sense of self-esteem from a young age and communicate with older people at the same level. Compared to their predecessors, they are adults and find it difficult to accept the reality of independent life. Earlier children, starting from elementary school at the age of 7-9, prepared food themselves and went home after school. then he took his brothers and sisters from kindergarten like their parents. This generation is extremely helpless and weak, not independent.

## SUGGESTIONS AND RECOMMENDATIONS

Due to the demands of the times, today's children hardly go out, they are overprotected, they may be afraid of getting their clothes dirty or their feet scratched. But we can expect great results from them in the way of scientific development. After all, then they have to pass the state exam for higher education, so they go to tutors in various subjects: mathematics, history, social studies, English and, of course, several other subjects.

Based on such analysis, the following characteristics of alpha can be noted:

- Practicality in almost everything;
- They love fashion (trend) things and have a high interest in unlimited toys, clothes and modern equipment;
- Instantly lose interest in anything and are difficult to impress or please;
- They pose well for photos;
- They easily master modern editing tools that adults cannot yet understand;
- Know a number of psychological methods that help parents and can easily analyze their situation internally and understand the causes of depression or, on the contrary, raise their spirits;
- They are ready to suffer any punishment, but no matter what happens, they stand in their place;
- Alphas become knowledgeable and competent in many matters that children of 10 years ago could not understand. For example, they can analyze the relationship between parents, the causes of financial problems in the family, and why money is needed. They also process data very quickly and analyze it in detail.

## DISADVANTAGES OF THE ALPHA GENERATION

*- It is very difficult to keep the information they received in their heads. In some cases, they may not even remember the address where they live;*
*- Clip Memory;*
*- Digital Autism;*
*- Lack Of Dopamine;*
*- Weakness of Vital Immunity.*

- You can read about each of the above generations and draw conclusions by comparing and contrasting them. But it should not be forgotten that the difference between them is conditional. In general, the differences between Baby-Boomers, X-Xer, Y-Millennials, Zed and Alpha can be logically deduced;
- as a result of the development of technological progress, there are threats related to the violent mutation of generations in a short period of time. Including;
- economic threat;
- political threat;
- military threat;
- social and moral threat;

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- constant exposure to natural and ecological threats led to the acceleration and change of their development processes. Therefore, all the things and features that are not present in each generation and which they try to achieve, are manifested in a more perfect form in the next generation.

As a result, due to the influence of the miracles of science and development of mankind, the formation of Zed and Alpha children with smartphone and gadget management skills was achieved. It has been proven that parents, family, children, homeland, faith, etc., which have reached the level of value for these generations freed from physical hard work, can be degraded for centuries. When it comes to modern threats, the children of today, the growth of this generation has a significant impact on the values of humanity. It should not be forgotten that this issue related to the children of not only our country, but also the whole world, may become a great threat to mankind tomorrow if the opportunity to start their views on the right path is not sought [18].

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# RETURNS OF SOCIAL AND PRIVATE INVESTMENT IN VOCATIONAL EDUCATION IN NIGERIA

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**Article DOI: https://doi.org/10.36713/epra17892**
**DOI No: 10.36713/epra17892**

## ABSTRACT
*Globally, the world of work has shifted its focus from just education obtained through theoretical courses to vocational education and training because of the recorded returns in social and private investment. Thus, the sector has been at the heart of recent economic reforms worldwide. However, despite the upsurge in the supply of academic university graduates in Nigeria, employers of labor still face a supply shortage of skilled labor and this has been linked to the theory-oriented curricula of academic universities which do not prepare students for skill-intensive jobs. According to the Nigerian Bureau of Statistics report (2024), statistics the overall unemployment rate in Nigeria for the Q2 of 2023 was 4.2%, while among youth aged 15-24 years, the unemployment rate in Q2 of 2023 was 7.2%, up from 6.9% in Q1 2023. Meanwhile, in urban areas, the unemployment rate reached 5.9% in 2022, compared to 5.4% in Q1 2023. Within vocational training, the economic returns to practical or in-plant training seem to be slightly higher than those in school training. It is clear that tremendous resources, both human and material, are required to redress the situation. As Nigeria is lagging in preparing its workforce for the challenges of the rapidly changing global economy, the government must invest captiously and pay particular attention to vocational and technical education. Also, there is the need to improve the earnings of vocational school graduates through an increase in salary and attractive remuneration which will induce individuals to take vocational education and skills acquisition more seriously.*
**KEYWORDS:** *Vocational Education, Education, Returns, Social and Private Investment and Nigeria.*

## INTRODUCTION
Lately, the workplace has changed its emphasis from merely using education from academic courses to emphasizing practical knowledge and abilities acquired via vocational education and training. This is a result of the shown benefits and returns linked to hiring people with vocational education and training. Therefore, the core of recent global economic changes has been the vocational education and training sector (Chappell 2003; Tran 2021). Still, some countries find it difficult to improve their labor force to keep up with these shifts. Since education continues to be a key factor in the economic development and advancement of nations worldwide, it has been offered as a way to enhance people's knowledge and whole personalities. Additionally, as education can be seen as both a consumer good and a capital good, many countries want to continuously enhance their educational and training programs since doing so will increase their human capital and provide them with a workforce fit for the twenty-first century. A nation's educational system must adapt to better prepare upcoming graduates for the labor market (Chen & Pastore, 2024). Thus, vocational education is essential to a nation's educational system. More and better education and training are frequently considered as all that is required for some traditional nations, like Nigeria, where skill shortages are occasionally the most evident, to significantly improve their economy and their standing in the international community.

According to a website (http:Japanese education jhtm), Japan's education system played a significant role in the country's ability to meet the challenges posed by the necessity of swiftly assimilating Western ideas, science, and technology during the Neij period (1868–1912), as well as in the country's subsequent rapid economic growth and recovery in the decades that followed World War II. The experiences of developing nations over the past few decades have demonstrated that a lack of the abilities and skills necessary for development can significantly impede economic advancement (World Bank, 1995). Nigeria cannot, therefore, afford to let personal preferences and whims dictate how its citizens are educated. Given the extremely limited resources available for development, governmental strategies in the field of education must fully include the needs of the country in terms of the development of manpower and skills (Okuwa, 2004).

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Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

Nigeria's educational system has been plagued by a persistent crisis in recent times, which has resulted in a reduction in the quality of education at all levels of the country. This crisis stems from several factors, including the declining state of education institutions, issues with classrooms and other infrastructure, the welfare of teachers, the rising expense of education, and the resulting persistent mismatch between labor supply and demand. The theory-oriented curricula of academic institutions, which do not prepare students for the skill-intensive profession, have been connected to employers' shortage of skilled labor, despite the increase in the number of academic university graduates in Nigeria. In addition, university graduates only prefer white-collar jobs and are reluctant to do blue-collar jobs.

Since the 1990s, the Chinese government has actively promoted vocational education as a means of mitigating the scarcity of trained workers in industrialized nations such as China (Chen & Pastore, 2024). However, the labor market continues to lack sufficient supply of skilled individuals (Fudan University, Tsinghua University 2016). This ongoing supply deficit is probably the result of two factors. One explanation is the enduring attitude that denigrates vocational graduates, which deters parents from enrolling their kids in vocational schools in the first place. The second factor is that not enough students are drawn to vocational education due to low labor market returns (Chen & Pastore, 2024).

Vocational education, also known as Vocational Education and Training (VET) or Career and Technical Education (CTE), equips students for manual or practical work-based careers that are typically non-academic and associated with particular trades, occupations, or vocations (UNESCO & NCVER, 2020). The term "technical education" is occasionally used to describe it since the learner gains direct proficiency in a certain set of methods or technologies. The focus of education in typically broader scientific domains, such as higher education, on theory and abstract conceptual understanding, can be contrasted with vocational education. Consequently, instruction, training, and skill development for a variety of vocations are included in vocational education and training. It comprises work-based learning, continuing education, and training, and it can occur in secondary schools and postsecondary education. On the other hand, return on investment is a measurement of an investment's value about its cost. Accordingly, the value that people, businesses, and countries receive from investing in vocational education and training is known as the Return on Investment (ROI) in the context of VET (VET Glossary 2017).

To give governments and funders analytical data or concrete proof of the system's performance and to further justify TVET spending, it is crucial to provide information on the Returns on Investment (ROI) from Technical Vocational Education and Training (TVET). This is according to the 2017 Organizations' Global Education Monitoring Report (UNESCO & NCVER, 2020). In addition to being helpful at the corporate and individual levels, ROI data may also be used to assess public TVET-related initiatives. There are also other uses for a ROI analysis. It can assist with funding agreements, investment decisions, and strategic planning. It can also be used to encourage business efficiency and improvement. It can support decision-making, convey impact, draw in investment, and educate public policy. The most significant feature is that it can assess performance at the individual, organizational, and economic/societal levels for all entities: the economy, non-profits, small and large businesses, and workers. It can support decision-making, convey impact, draw in investment, and educate public policy. The most significant feature is that it can assess performance at the individual, organizational, and economic/societal levels for all entities: the economy, non-profits, small and large businesses, and workers.

Vocational education was linked to the lower socioeconomic strata until the end of the 20th century since it concentrated on certain trades like welding and auto repair. It thus attracted a certain amount of stigma because vocational education and training are linked to the conventional apprenticeship educational system. However, as the labor market becomes more specialized and economies demand higher levels of skill, governments and corporations are investing more in the future of vocational education through publicly funded training organizations and subsidizing apprenticeship or traineeship initiatives for businesses. Post-secondary vocational education is often provided by an institute or school of vocational/technology study. Vocational education has grown over the 20th century to encompass a wider range of industries, including retail, tourism, computer technology, cosmetics, funeral services, and traditional crafts. Because a large number of young people lack "employability" skills, which are often obtained from vocational schools, youth unemployment seems to be skyrocketing. According to the Nigerian Bureau of Statistics report (2024), the overall unemployment rate in Nigeria for the Q2 of 2023 was 4.2%, which increased slightly from the previous quarter (Q1 2023) when it was 4.1%. Among youth aged 15-24 years, the unemployment rate in Q2 2023 was 7.2%, up from 6.9% in Q1 2023. While in the urban areas, the unemployment rate reached 5.9% in 2022, compared to 5.4% in Q1 2023.

The Nigerian Bureau of Statistics, the National Social Safety-Nets Coordinating Office (NASSCO), the United Nations Development Programme (UNDP), the United Nations Children's Fund (UNICEF), and the Oxford Poverty and Human Development Initiative (OPHI) conducted the 2022 Multidimensional Poverty Index survey, which found that 133 million Nigerians, or 63% of the country's

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population, are multidimensionally poor. The National MPI of 0.257 shows that slightly more than 25% of all potential deprivations are experienced by the poor in Nigeria. In most states, the prevalence of multidimensional poverty is higher than that of monetary poor. Nigeria's national monetary poverty line for 2018–19 states that 40.1% of the population is impoverished, whereas the National MPI 2022 states that 63% of Nigerians are multidimensionally poor. In rural places, multidimensional poverty is more prevalent in rural areas, where 72% of people are poor, compared to 42% of people in urban areas.

**Vocational Education and Training for Economic Growth**

Nigeria's workforce appears not to speed up on the demands of the quickly evolving global economy. As a result of this, the country needs to make cautious investments in education, paying special attention to vocational and technical education. The economics of education and the New Theory of Endogenous Growth can be quickly used by determining the contributions of vocational education and training to economic growth or by examining the private and social costs of and returns to higher qualification of the (active) population. The new growth theory, in contrast to previous growth theories, clearly takes into account not just actual capital and labor, but also technical advancement and its drivers. The primary determinants of endogenous technological advancement are innovation and research and development, namely the degree of training, credentials, and abilities of the labor force.

The rate of return approach or cost-benefit analysis are other names for the Investment Efficiency approach. It holds that the value that education will give should be taken into consideration when providing it. The economic investment theory of cost-benefit analysis is used to evaluate educational investments. This method entails figuring out how much schooling will cost and comparing that cost to the expected returns. Decisions about the future distribution of resources to and within the education sector are made based on this. This strategy has the benefit of allowing governments and private citizens to keep funding education since they see it as a "profitable investment." Investments made by the government in education are referred to as social investments, whereas individual or parents investments is referred to as private investment.

**Table 1: Social and Private Cost of Education**

| Social Costs | Private Costs |
|---|---|
| **Direct** | **Direct** |
| 1. Teachers' Salaries | a. Tuitions fees less average value of scholarship or bursaries |
| 2. Non - Teachers' Salaries and Allowance | b. Private expenditure on books, stationary, transport, practical Materials, etc. |
| 3. Expenditure on books, stationery and transp | |
| 4. Other educational services and goods | |
| 5.Imputed rent on educational building | |
| Indirect | Indirect |
| Income forgone before tax | Income forgone after tax. - |

**Table 2: The Benefits of Vocational Education and Training by Stakeholder Groups**

| Individual | Employer | Economy |
|---|---|---|
| ***Job-related*** | ***Market*** | ***Economic benefits*** |
| Employment/higher employability | Productivity | Higher employability |
| Higher salaries | Sales and profitability | Increased participation in the workforce |
| Higher savings levels | Customer service and satisfaction | Decrease in unemployment levels |
| Improved working conditions | Occupational health and safety | Productivity gains |
| Professional mobility | Quality products and services | Higher skilled workforce |
| Productivity (highly skilled) | Saving on material and capital costs | |
| ***Non-job-related*** | ***Non-market*** | ***Societal benefits*** |
| Higher education pathway | Motivated workforce | Improved Health |
| Pathway to further study | Improved organizational | Improved environment |
| Improved self-esteem | Climate and culture. | Reduced national crime |
| Communication skills | Increased literacy in the workplace | Increased social cohesion |

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| | | |
|---|---|---|
| Engagement, social inclusion<br>Improved problem solving<br>Improved health and well-being<br>Improved economic<br>standards of living<br>Life satisfaction | Employee skill gains<br>Employee well-being<br>Employee workplace practices | Increased social inclusion<br>Strengthened social capital<br>Active citizenship<br>Technological change<br>adaptation |

**Source: Schueler et al. (2017)**

For the computation of the cost-benefit or rate of returns analysis, this paper focused on the direct economic benefits. These are benefits that can be measured in monetary terms through the earnings received by a vocational-educated person as a proxy measure. For us to get the correct earnings for our computation, the earnings differential of the vocational trained and other lower levels of vocational education are always considered.

**Cost Benefit Analysis:** This is one of the approaches to decision-making. It tries to add up and compare the costs and benefits (to the extent that numerical addition and comparison is possible) of doing particular things in particular ways at particular times and places. CBA implies a systematic comparison of the magnitude of the costs and benefits of a form of investment to assess its economic profitability.

**The Benefits - Costs Ratio (BCR**): This is calculated by dividing the present value of benefits by the present value of costs. This will tell us how large the gains are relative to the size of the investment.

**Net Present Value Method:** This is calculated by discontinuing the stream of future benefits back to the present (usually defined as the time a person or group finishes a program) and subtracting the accumulated costs from this total, (including interests) calculated at that same point in time. A Programme/project is said to be profitable if the net present value of benefits is greater than zero.

**The Internal Rate of Returns (IRR):** This is the interest rate that is equal to the present value of costs plus the discounted present value of expected benefits. The discount rate that corresponds to the stream of lifetime profits from extra years of school to the entire personal costs of obtaining the additional education is estimated via private rates of return estimates based on the IRR technique. This method's primary advantage is its ability to account for the impact of individual educational expenses, such as tuition and other fees, as well as funding options and lost income when estimating "rates of return" for different educational levels. This is also true for social rates of return on education, which often take into account the impact of lifelong after-tax income benefits from higher education levels as well as individual expenses of schooling like lost wages. The IRR technique assumes that age income profiles at a particular point in time also represent how a person can anticipate earning income throughout the course of their lifespan.

**Cost of Vocational Education:** The cost of vocational education includes all such expenses a student incurs in the course of his vocational career. They include yearly school fees, Examination Fees, Registration Fees, Library Fees, cost of practical Materials, Transportation, Feeding, Hostel/Accommodation Fees, Etc. The "cost in vocational education represents the value of all resources, in terms of money and sacrifice used to accomplish an education project.

**Employment-Related Benefits:** It is a fact that a good education is a major tool to success, one can acquire the food things of life with a good and sound education, hence organizations and societies always give their employees the best of available facilities in terms of conditions of service. These good conditions in turn attract the best employable employee to such an organization or society; hence there exists a form of reciprocal relationship between the employer and the employees.

**Challenges of Vocational Education and Training in Nigeria**

The government of Nigeria has made several attempts to halt the downward trend in the educational system and the high unemployment rate among graduates of tertiary institutions. However, despite these initiatives, the crisis in the country's educational system, particularly at the tertiary level universities, polytechnics, technical schools, colleges of education, and vocational training centers and its underlying causes namely, the egregious underfunding of these institutions and the unfavorable working conditions of their academic staff have persisted unabatedly (Okuwa, 2004). Inadequate adaptation of vocational education curricula to labor market demands may also be the cause of increased vocational education costs and altered skill requirements resulting from structural change. The monetary benefits of in-plant or practical training appear to be marginally higher in the vocational training context than those of classroom instruction. Enormous amounts of material and human resources are needed to correct the situation. Policymakers usually support sharing responsibility for education finance between the government, the private sector, and the beneficiaries, particularly in higher

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education, due to the high expense of education in the nation (Chen & Pastore, 2024).

## CONCLUSION

In conclusion, education such as vocational has been found to produce highly skilled graduates capable of restoring competitiveness, growth, and equity in nations. For developing countries more basic levels of education and training hold out hopes of modernizing their traditional sectors, facilitating the growth of more modern sectors and stabilizing economic conditions. The higher the level of vocational/skilled education, the higher the level of vocational/technical skilled education, and the higher the rate of return to individuals. Thus this makes vocational education a worthwhile investment for individuals.

In conclusion, it has been discovered that vocational education produces highly trained graduates who can bring back growth, equity, and competitiveness in countries. More fundamental education and training programs offer emerging nations the chance to modernize their historic industries, spur the expansion of more contemporary industries, and stabilize their economies. Thus, the rate of returns to individuals increases with the amount of vocational/skilled education, the level of vocational/technical skilled education, and both. Vocational education is therefore a wise investment for people.

### Recommendations

In light of the conclusion above, it is suggested that more attention should be given to vocational education/skills acquisition in the nation's education system. To do this, the following are the actions recommended;

- There is a need to educate the citizenry particularly the youth to appreciate vocational skills. Indeed, people differ widely in interests, abilities and aptitudes, hence not all young people have an aptitude for theoretical subjects that require abstract reasoning to bring out facts and ideas. Such youths may be good at applying specific knowledge to doing something successfully with their hands and maybe well-fitted for a vocational-technical career.
- There is the need to include technical subjects or courses at both the secondary and tertiary levels of the education system in respective of subject bias and course of training;
- The government should improve the earnings of vocational school graduates through an increase in salary and attractive remuneration which will induce people to take vocational education and skills acquisition more seriously.
- Finally, all vocational/technical schools should be properly funded and well equipped with modern technology, especially the laboratory, library, information system and infrastructure.

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# MEDIATING EFFECT OF STUDY HABITS ON THE RELATIONSHIP BETWEEN MATHEMATICAL READING COMPREHENSION AND PROBLEM-SOLVING SKILLS OF JUNIOR HIGH SCHOOL STUDENTS

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**Article DOI: https://doi.org/10.36713/epra17897**
**DOI No: 10.36713/epra17897**

## ABSTRACT

*This study aimed to determine whether study habits significantly mediate the relationship between mathematical reading comprehension and problem-solving of students in mathematics of Grade 8 students in the Division of Davao del Norte. A descriptive-correlational research design was used. The respondents of this research were 302 Grade 8 learners from four public secondary high schools in Davao del Norte. A stratified random sampling was utilized. This study used one adapted questionnaire and two researcher-made questionnaires. Mean, spearman rho, standard deviation, and bootstrapping were used as statistical tools. Results of the study revealed that mathematical reading comprehension is infrequently manifested, problem-solving skills of students is rarely manifested, while the study habits of the students are oftentimes manifested. The findings further revealed that the variables mathematical reading comprehension and problem-solving skills are significant with one another but infrequently manifested that they are not significant with study habits. Moreover, mathematical reading comprehension exhibits a direct significant effect on problem- solving skills but study habits do not significantly mediate the relationship between mathematical reading comprehension and the problem-solving skills of the students. The results conclude that mathematical reading comprehension is contributory factor to improve the problem-solving skills of the students. The researcher recommends that the school administrators provide an opportunity to the teachers in professional development programs to improve students' mathematical reading comprehension and problem-solving skills.*

**KEYWORDS:** *Mathematics education, problem-solving skills, mathematical reading comprehension, study habits, descriptive and correlational design, bootstrapping, Davao del Norte, Philippines*

## INTRODUCTION

Problem-solving skills helped students gain confidence in their ability to handle difficult situations in the real world. To develop these abilities, mathematical reading comprehension is required (Krawitz et al., 2021). Problem-solving was more difficult for people who believe they lack the ability to do so since they will put less effort into it (Ozturk et al., 2020). On the other hand, several studies have attested that a students' problem-solving skill is heavily affected by their mathematical reading comprehension and study habits (Capone et al., 2021; Fitriani et al., 2018). Students with lower levels of reading comprehension may struggle to understand the material presented in a problem,whereas those with higher levels of reading comprehension are more likely to make connections and effectively solve the problem (Capone et al. 2021). Additionally, Fitriani et al. (2018) suggested that students who do not take the time to review their math concepts may struggle when presented with a problem-based learning situation. Also, students who struggle to comprehend mathematical texts may face difficulty understanding directions, formulas, and the underlying concepts of a problem (Horne & Lowe, 2018).

In Indonesia, the 2019 PISA test results showed that students aged 15 had an average math score of 386, which is still considered to be at level two. It was identified that students' problem-solving skills have not yet advanced to the point where they can draw conclusions from a variety of data and solve problems using a variety of procedures (OECD, 2020). In India, Nurkaeti (2018) observed that some junior high school students still struggle with the ability to solve mathematical problems, carry out numerical operations, and provide reasonable justifications and consideration, particularly comprehending the mathematical problem, coming up with a plan for how to solve it, connecting different mathematical ideas, and checking the accuracy of the answers with questions. The difficulties faced by students in these areas are causing them to struggle in solving mathematical problems, leading to incorrect or incomplete solutions. Moreover, in Turkey, a study revealed that a significant percentage of high school students struggle with problem-solving skills, with a percentage of 77.6% experiencing difficulty. In the initial test, 17.10% of students left their answer sheet blank,64.80% of answers were incorrect, and only 18.10% of junior high school students obtained a correct answer. These findings highlight a concerning issue of insufficient problem-solving skills among high school students in Turkey, indicating the

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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need for effective interventions to improve students' mathematical abilities (Ulu, 2017).

In the Philippines, Filipino students have consistently exhibit far below average on national achievement exams (NAT) (Suarez & Casinillo, 2019). In the 2018 NAT, the average score of Grade 6 students in Mathematics was only 49.54%, which is significantly lower than the international average of 61.37%. Moreover, in the 2019 NAT, the average score of Grade 10 students in Mathematics was only 36.48%, which is also significantly lower than the international average of 55.49%. Filipino students performed worse than the majority of students from other countries, especially when it comes to problem-solving, in the 2018 Programme for International Student Assessment (PISA), Filipino students' average score in problem-solving was only 353 points, significantly lower than the international average of 487 points. These statistics indicate a pressing issue of insufficient problem-solving skills among Filipino students (Oclarit & Casinillo, 2020).

In the division of Davao del Norte, based on the proficiency level report in the firstquarter of one school, the grade 8 students score poorly in problem-solving during the exams in the school year 2022-2023. The results of the item about problem-solving in periodical exam shows that out of 1127 students took the exam, 56% of students failed to answer the six (6) problem-solving questions correctly and they got 43.69% of proficiency level which is far below from at least 75% required by Department of Education in DepEd order number 55, series 2016.

This study could be used to inform educational practices, policies, and curriculumdevelopment particularly in improving the mathematical reading comprehension and problem-solving skills of students. Further, this could lead to the formation and development of effective study habits, and the use of educational practice such as study groups and tutoring. This study could also raise awareness in the educational society and serve as a basis for finding interventions in the teaching and learning process in mathematics education. Solve it, connecting different mathematical ideas, and checking the accuracy of the answers with questions. The difficulties faced by students in these areas are causing them to struggle in solving mathematical problems, leading to incorrect or incomplete solutions.

## OBJECTIVES

The purpose of the study was to determine whether study habits significantly mediate the relationship between mathematical reading comprehension and problem- solving of students in mathematics of Grade 8 students in the Division of Davao del Norte.
Specifically, this sought answers to the following questions:

1. What is the level of mathematical reading comprehension of students interms of: (a) reading comprehension of mathematics with symbols; and (b) reading comprehension of mathematics without symbols?
2. What is the level of study habits of students in terms of: (a) note taking; (b) use of library; and (c) time allocation to study?
3. What is the level of problem-solving skills of students in terms of: (a) understanding the problem, (b) devising a plan; (c) carrying out the plan; and (d) looking back?
4. Is there a significant relationship between: (a) study habits and mathematical reading comprehension; (b) study habits and problem-solving skills; and (c) mathematical reading comprehension and problem-solving skills?
5. Do study habits significantly mediate the relationship between mathematicalreading comprehension and problem-solving skills?

## METHODOLOGY

### Research Design

This quantitative study employed descriptive and correlational approaches. Quantitative research design is used to discover trends, averages, forecasts, as well as cause-and-effect connections between variables being investigated (Bhandari, 2022). In this study, the researcher used this design to determine, describe, and measure the level of mathematical reading comprehension, problem-solving skills, and study habits of junior high school students.

On the other hand, descriptive approach is to precisely and methodically describea population, situation, or phenomena. It can also be used to explore a certain population or group of people in order to gain a better understanding of their attitudes, beliefs, and behaviors (McCombes, 2022).

Moreover, correlational research design examines the correlations between variables without the researcher influencing or regulating them. In addition, indicates the intensity and/or direction of the association between two or more variables (Bhandari, 2022). The overall exposure-outcome impact is decomposed into a direct effect and an indirect effect via a mediator variable in mediation analysis. As a result, mediation analysis is an essential statistical method for learning about variable processes (Nguyen et al., 2021).

The correlation design, on the other hand, examined the relationship between the study habits, mathematical reading comprehension, and problem-solving skills to determine if there is a significant correlation between the three variables. This provided the researcher

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with an understanding of the mediating effect of study habits on the relationship between mathematical reading comprehension and problem-solving skills among junior high school students.

The above mentioned descriptive and correlation research designs are bothappropriate for this type of study because they are used to understand existing relationships and identify causal relationships between variables. The descriptive design allows for the collection and analysis of data related to the study habits, mathematical reading comprehension, and problem-solving skills of junior high school students. The information was then used to determine the extent to which study habits mediate the relationship between these two variables. The correlation design, on the other hand, examined the relationship between the study habits, mathematical reading comprehension, and problem-solving skills to determine if there is a significant correlation between the three variables. This provided the researcher with an understanding of the mediating effect of study habits on the relationship between mathematical reading comprehension and problem-solving skills among junior high school students.

**Sampling Design**

The respondents of this research were the Grade 8 learners of the four public secondary high schools in the west district of Santo Tomas, Davao del Norte enrolled during the school year 2023-2024. The population size of all four schools were 1400 students. There were 1100 students in school A, 133 students in school B, 115 students in school C, and 52 students in school D. In gathering data from the population, stratified random sampling technique utilizedfor the final selection of respondents. Based on the computation of the qualtrics online sample size calculator, and by following a 95% confidence level (Z-Score=1.96) as well as a 5% margin of error, the recommended sample size was 302 respondents. There were 237 students in school A, 28 students in school B, 25 students in school C, and 12 students in school D. On the other hand, figure 2 presents the map for Davao del Norte, where the study was conducted.

**Research Instrument**

This study collected data using one adapted instrument and two researcher-made instrument to assess study habits, mathematical reading comprehension, and problem-solving skills ofthe students in mathematics.

Mathematical Reading Comprehension Questionnaire (MRCQ) was a researcher-made questionnaire and assesses two components: reading comprehension of mathematics with symbols and reading comprehension of mathematics without symbols.

Problem-Solving Skill Questionnaire (PSQ) was researcher-made questionnaire. It contains a 10-item questionnaires comprising the following dimensions such as understanding the problem, devising the plan, carrying out the plan; and looking back.

Study Habits Questionnaires (SHQ) was from Sarikudeen and Sanni (2017) and is divided in three dimensions: note-taking, use of library and time allocation to study.

**Statistical Design**

In this research, the data from each instrument were tallied and recorded accurately. In context of the purpose of the study, the following statistical tools wereused to evaluate and interpret the data in the analysis of data.

**Mean.** This is also known as an arithmetic mean, which is a value that helps summarize a large number set. This statistical tool was used to determine the level of study habit, problem-solving skills, and mathematical reading comprehension of students in mathematics. This answered research questions 1, 2, 3, and 4.

**Standard Deviation.** A standard deviation is a measure of a data set's dispersion in proportion to its mean. This statistical tool was used to determine if the scores are evenly distributed or close to the mean. This answered research questions 1, 2, and 3.

**Spearman rho.** This statistical tool is a measure of correlation used toevaluate the strength of a linear relationship between two variables. This statistical tool was used to determine the significance of the relationship between study habits and mathematical reading comprehension, study habits and problem-solving skills, and mathematical reading and problem-solving skills. This answered research questions 4, 4.1, 4.2, and 4.3.

**Bootstrapping.** This statistical tool was utilized to ascertain the mediating effect of study habits on the connection between mathematical reading comprehension and problem-solving skills of the students in Mathematics. This tool was utilized to address the research question 5.

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## RESULTS

1. The over-all mean on the level of mathematical reading comprehension is 37.38 with a standard deviation of 14.18 and a descriptive equivalent of low.
2. The over-all mean on the level of study habits is 3.13 with a standard deviationof 0.57 and a descriptive equivalent of moderate.
3. The over-all mean on the level of problem-solving skills of students is 8.83 witha standard deviation of 11.06 with a descriptive equivalent of very low.
4. The relationship of mathematical reading comprehension (rs=*0.046,* p=*0.43)* tostudy habits of students has no significance, and the relationship between mathematical reading comprehension (rs= 0.047, p=0.419) to study habits has no significance. Both values mentioned have a p-value greater than 0.05 level of significance, therefore, the null hypothesis failed to reject. While the mathematical reading comprehension (rs=0.289, p=<.001 has a positive correlation. The values mentioned have a p-value lessthan 0.05 level of confidence. Thus, the null hypothesis was rejected.
5. Based on the mediation analysis, the result revealed a non-significant indirect and direct effects of study habits on the relationship between mathematical reading comprehension and problem-solving skills of the students.

## SUGGESTION

Based on the findings, analysis, and conclusions drawn in this study, the following recommendations are summarized:

1. To improve mathematical reading comprehension, the teachers may conduct concept mapping, visualize concepts, key information identification, and various solution approaches. They may also conduct surveys to understand students' study habits and focus on building a strong foundation in mathematical reading comprehension, enabling more effective problem-solving approaches.
2. Students are encouraged to be an active reader and practice solving mathematical problem regularly to develop the comprehension in the mathematical text. This is particularly in leading students to enhance their comprehension, improve problem- solving skills, have better application of concepts, and develop their critical thinking skills. Also, students may enroll in a tutorial or mentoring services to help them develop mathematical reading comprehension and identify the areas where the students would need reinforcement.
3. School administrators may provide equal opportunities to all teachers in professionaldevelopment programs to improve students' mathematical reading comprehension and problem-solving skills. They may also incorporate study skills workshops intothe curriculum to foster effective learning habits. Additionally, they may support research-based instructional methods that directly target these skills, enhancing students' understanding of math concepts.
4. The researcher also recommends similar study to be done by the other researchers to investigate further if study habits have mediating effect on the mathematical reading comprehension and problem-solving skills with different respondents. Future research for developing intervention programs may be needed to improve mathematical reading comprehension and problem-solving skills.Top of Form

## CONCLUSION

The findings of the study led the researcher to draw the following conclusions. The students' level of mathematical reading comprehension is poor, students' level of study habits is fairly evident, students' level of problem-solving skills is very poor, there is no significant relationship between study habits and mathematical reading comprehension, nor between study habits and problem-solving skills. However,a statistically significant relationship exists between mathematical reading comprehension and problem-solving skills and study habits do not significantly mediate the relationship between mathematical reading comprehension and problem-solving skills.

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## FIGURES

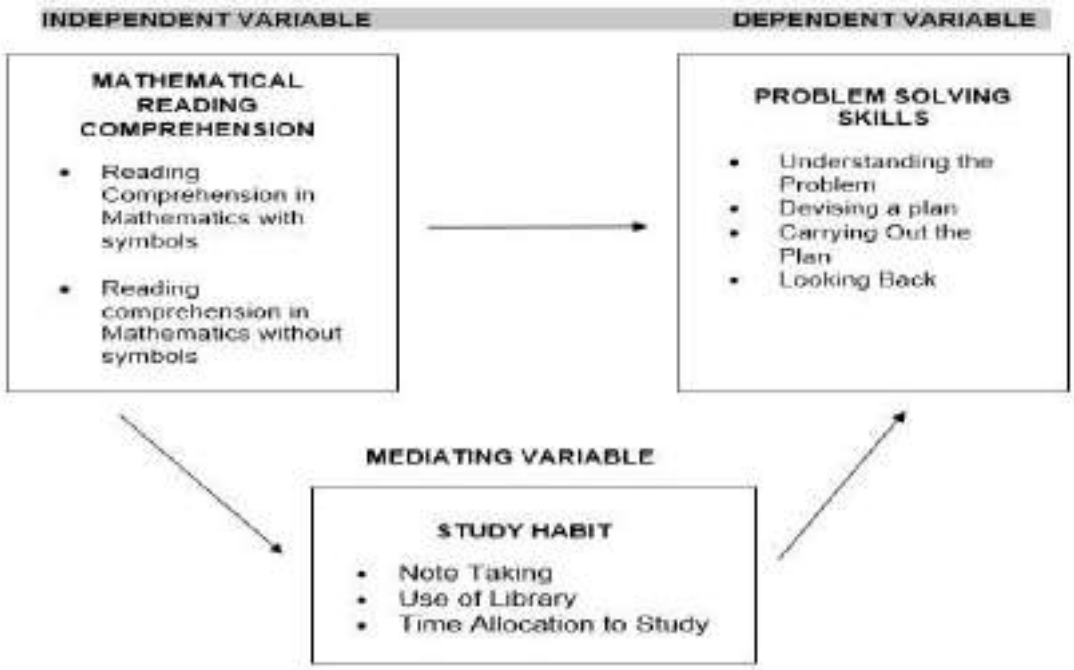


**Figure 1. Conceptual Framework of the Study**

Source: https://store.mapsofworld.com/digital-maps/spanish/davao-del-norte-map

**Figure 2. Map of Davao del Norte**

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## TABLES

**Table 1**
**Level of Mathematical Reading Comprehension of students**

| Indicators | SD | Mean | Descriptive Equivalent |
|---|---|---|---|
| Reading Comprehension mathematicswith symbol | 15.30 | 39.10 | Low |
| Reading Comprehension of mathematics without symbol | 14.57 | 35.65 | Low |
| **Category Mean** | **14.18** | **37.38** | **Low** |

**Table 2**
***Level of Study Habits***

| Indicators | Mean | SD | Descriptive Equivalent |
|---|---|---|---|
| Note Taking | 3.60 | 0.63 | High |
| Use of Library | 2.49 | 0.82 | Low |
| Time Allocation to Study | 3.29 | 0.83 | Moderate |
| **Overall Mean** | **3.13** | **0.57** | **Moderate** |

**Table 3**
***Level of problem-solving skills of students***

| Indicators | Mean | SD | Descriptive Equivalent |
|---|---|---|---|
| Understanding the Problem | 5.75 | 12.95 | Very Low |
| Devising a Plan | 16.61 | 18.43 | Very Low |
| Carrying out the Plan | 12.18 | 15.31 | Very Low |
| Looking Back | 0.78 | 3.41 | Very Low |
| **Category Mean** | **8.83** | **11.06** | **Very Low** |

**Table 4**
***Significance of the Relationship Among Mathematical Reading Comprehension, Study Habits and Problem-Solving Skills of the Students***

| Variables Correlated | rs | p-value | Decision on Ho | Decision on Relationship |
|---|---|---|---|---|
| Mathematical Reading Comprehension and Study Habits | *0.46* | 0.43 | Failed to reject $H_o$ | Not significant |
| Study Habits and Problem-SolvingSkills | *0.47* | 0.419 | Failed to reject | Not significant |
| Mathematical Reading Comprehension and Problem-Solving Skills | 0.189 | .001 | Reject $H_o$ | Significant |

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**Table 5**

**Mediation Analysis of Study Habits to the Relationship betweenMathematical Reading Comprehension and Problem-Solving Skills**

| | | | | 95% C.I. (a) | | | | |
|---|---|---|---|---|---|---|---|---|
| Type | Effect | Estimate | SE | Lower | Upper | β | z | p |
| Indirect Component | Mathematical Reading Comprehension ⇒ Study Habits ⇒ Problem Solving Skills | -0.004 | 0.004 | -0.019 | 0.004 | -0.005 | -0.856 | 0.392 |
| | Mathematical Reading Comprehension ⇒ Study Habits | 0.003 | 0.002 | -0.002 | 0.008 | 0.066 | 1.154 | 0.248 |
| | Study Habits ⇒ Problem Solving Skills | -1.420 | 1.113 | -3.296 | 0.623 | -0.073 | -1.276 | 0.202 |
| Direct | Mathematical Reading Comprehension ⇒ Problem Solving Skills | -0.103 | 0.044 | -0.194 | -0.016 | -0.131 | -2.306 | 0.021 |
| Total | Mathematical Reading Comprehension ⇒ Problem Solving Skills | -0.106 | 0.045 | -0.197 | -0.011 | -0.136 | -2.386 | 0.017 |

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EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# ENHANCING SOCIOECONOMIC DEVELOPMENT IN ISIOLO COUNTY THROUGH COLLABORATIVE SYNERGY BETWEEN THE STATE AND CIVIL SOCIETY ORGANIZATIONS

**Agatha Makhanu**

**ABSTRACT**

*This article proposes an alternative developmental framework that synergizes the roles of both the state and Civil Society Organizations (CSOs) to achieve sustainable socio-economic development in Isiolo County. The guiding research question was: What kind of developmental model can enhance the partnership between the state and CSOs for sustainable socioeconomic progress in Isiolo County? Challenging the neoliberal and donor-driven notion that non-state actors alone can drive socioeconomic development, this article asserts that the state's role remains crucial. Using the developmental state theory to analyze findings and a descriptive design for its methodology, data were gathered from both primary and secondary sources through snowball and purposive non-probability sampling techniques. The results reveal that CSOs working independently are insufficient for achieving sustainable socioeconomic development without the state's regulatory and coordinating involvement. Moreover, existing complementarity strategies, where the state and CSOs pursue similar objectives with different approaches, have not been successful. This paper advocates for a collaborative state-CSO approach, where both entities share aligned goals and methods to effectively drive socioeconomic transformation in Isiolo County.*

**KEY WORDS**: *socioeconomic development, Isiolo County, Northern ASALs, Policies, CSOs, state-CSO collaboration.*

## 1.0 INTRODUCTION

Socioeconomic development, as defined by the United Nations Development Programme (UNDP), aims to improve the economic and social conditions of individuals and communities by focusing on economic growth, access to education and healthcare, reducing inequality, and promoting sustainability (UNDP, 1990; 2000; 2010). Historically, the state has primarily driven this process. In Kenya, the government led socioeconomic development efforts from independence until the mid-1970s. The first national policy, Sessional Paper No. 10 of 1965, emphasized agriculture as the cornerstone of the economy. However, this strategy failed to address the unique challenges of the Northern Arid and Semi-Arid Lands (ASALs), including Isiolo County, which faces unique challenges like marginalization, climate variability, poverty, and socioeconomic inequality. Consequently, the strategy did not effectively reduce inequality and poverty, as highlighted in various government and development reports.

From the 1980s, Kenya encountered economic challenges due to the global oil crisis, inflation, a drop in agricultural exports, and a burgeoning debt crisis. In response, International Financial Institutions (IFIs) imposed Structural Adjustment Programs (SAPs) that promoted market-led solutions, reduced government intervention in socioeconomic development, and elevated the role of Civil Society Organizations (CSOs). As a result, CSOs became prominent in public life, complementing state efforts. CSOs encompass a broad spectrum of non-profit entities, including Non-Governmental Organizations (NGOs), labor unions, indigenous groups, charitable organizations, and other non-profit institutions (Diamond, 1994; 2008; World Bank, 2006; UN General Assembly, 2005). While NGOs are often the most recognizable form of CSOs, the terms are used interchangeably in this paper to denote entities engaged in advocacy, service provision, and community development. This article specifically focuses on International Civil Society Organizations (ICSOs) active in Isiolo County.

The aid community also adopted the New Policy Agenda (NPA), shifting aid from states to CSOs, perceived as more effective, flexible, participatory, and accountable (Edwards & Hulme, 1992; Hearn, 2007; Brass, 2012). This shift reinforced CSOs as key stakeholders in driving socioeconomic progress, particularly for the poor and marginalized. In Isiolo County, data from the NGO Board shows that over 500 NGOs, both local and international, were registered between 2014 and 2020. Among these, more than 100 were ICSOs actively engaged in socioeconomic development alone (NGO Board, 2019). This extensive presence underscores the critical role of CSOs in complementing state efforts where traditional government interventions have often fallen short.

Despite increased CSO involvement, the Kenyan government continued to promote socioeconomic policies, such as the District Focus for Rural Development (DFRD) in 1988, Poverty Reduction Strategy Papers (PRSP) in 2000, Economic Recovery Strategy (ERS) in

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
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2003, Kenya Vision 2030 in 2008, and the 2010 constitution. These initiatives aimed to address the unique conditions of Northern ASALs, with the 2010 constitution decentralizing development funds to counties and establishing a rights frameworks for marginalized groups (GOK, 2003; 2008; 2010).

Despite these efforts, the socioeconomic indicators in Northern ASALs, including Isiolo County, remain poor. Reports such as the Kenya National Human Development (KNHDR) (1990, 1999, 2001, 2006, and 2009), Kenya Integrated Household Budget Survey (KIHBS) 2005/2006, Commission for Revenue Allocation (CRA) (2011), and the County Integrated Development Plan (CIDP, 2015) reveal persistent disparities. This scenario prompts a reevaluation of the state's role in socioeconomic development alongside CSOs. The state has a crucial responsibility towards its citizens as the primary duty bearer, even with diminishing resources since the 1970s. Consequently, this paper advocates for a collaborative framework between the state, CSOs, and other non-state actors that can synchronize socioeconomic efforts in a long-term and sustainable manner. This approach emphasizes coordinated strategies, resource allocation, and leveraging the strengths of both the state and CSOs to achieve these goals in Isiolo County.

## 2.0 METHODOLOGY

The purpose of this article is to propose a developmental framework that aligns the objectives and strategies of both the state and CSOs to maximize and accelerate sustainable socioeconomic development in Isiolo County. The central research question is: What kind of developmental model can enhance engagement between the state and CSOs for effective and sustainable socioeconomic development in Isiolo County? This paper challenges the neoliberal and donor-driven notion by asserting the crucial role of the state in socioeconomic development despite the rise of various non-state actors. Focusing on Isiolo County, part of Kenya's Northern ASALs, the research faced challenges such as security threats, vast and sparsely populated areas, poor infrastructure, and high illiteracy rates among pastoralist communities. These were mitigated using local guides, translators, and triangulation methods to validate data from multiple sources.

Framed within the developmental state theory, which emphasizes the state's pivotal role in guiding and coordinating socioeconomic efforts, the paper employed a descriptive research design and was conducted in Nairobi and Isiolo Counties, covering the period from 1963 to 2015. The target population included the entire civil society involved in socioeconomic development in Isiolo County, including ICSO officials, state officials, development agencies, project beneficiaries, and Key Informants. Snowball and purposive sampling techniques were used to identify ICSOs, resulting in access to 47 representatives. For project beneficiaries, purposive sampling was employed to organize Focus Group Discussions (FGDs) that included both men and women. Data collection involved both primary and secondary sources, using questionnaires, interview schedules, and an FGD guide. The research process was authorized by relevant authorities before data collection commenced.

## 3.0 RESULTS AND DISCUSSION

This section examines the feasibility of an alternative socioeconomic development framework that aligns the goals and strategies of the state and CSOs in Isiolo County, aimed at fostering sustainable socioeconomic progress. The discussion is informed by the developmental state theory, with Mkandawire (2001) being a key scholar who laid the foundation for comprehending the modern concept. The developmental state theory underscores the state's pivotal role in steering economic development and industrialization within the political economy context. Key principles include a strong role of the state in economic development, an efficient and independent bureaucracy crucial for policy formulation and implementation, strategic planning that targets pivotal industries for growth, and close collaboration between the state and private sector to foster industrial innovation. This theory is pertinent to this work as it illustrates how the state can actively shape socioeconomic progress through strategic planning and execution, diverging from a reliance on neoliberal policies. It also emphasizes economic growth with a focus on redistribution, leading to societal benefits such as improved living standards. By acknowledging the contributions of various stakeholders in socioeconomic advancement, this theory highlights opportunities for CSOs to address the needs of marginalized populations, such as those in Isiolo County, alongside state initiatives.

Socioeconomic development in this paper encompassed health, education, water, sanitation, and livelihood interventions. Agriculture, livestock management, relief efforts, and welfare projects were considered essential strategies for promoting livelihoods. Specifically, welfare initiatives entailed providing financial support to small-scale enterprises, facilitating income-generating activities, and distributing cash transfers to vulnerable families, as reported by ICSO officials.

The findings reveal persistent challenges in socioeconomic development in Isiolo County, as the independent efforts by ICSOs and various state policies have failed to achieve sustainable progress. This is evidenced by human development indicators. The current approach to socioeconomic development is characterized by complementary strategies between the state and ICSOs, albeit with distinct methodologies. According to the UNDP (2010) and Amartya Sen (1999), there is an inherent connection between human development and socioeconomic indicators. Human development is the process of enhancing people's well-being by broadening their choices, with

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the most critical aspects being living a long and healthy life, being educated, and having access to resources needed for a decent standard of living. Human development is evaluated through the Human Development Index (HDI), which considers these crucial aspects of human life. The HDI indicators compare individuals' access to these essentials. Other metrics of human development include the Gender Development Index (GDI), which focuses on gender-related disparities, and the Human Poverty Index (HPI) and Multidimensional Poverty Index (MPI), both of which assess the distribution of progress and deficits across various dimensions of the HDI. Both the HDI and GDI use a scale from 0 to 1, where 1 represents the highest level of human development and 0 the lowest. The HPI and MPI use percentages to gauge poverty, evaluating the extent of deprivation across various dimensions of human life.

According to the KNHDR (1994), the HDI for Northern ASALs was 0.311, and the GDI for the same period was 0.301, compared to the national averages of 0.504 and 0.501, respectively. The national MPI was 26.5%, while Northern ASALs had the highest MPI of 43.3%. The KNHDR (2001) demonstrates a national HDI value of 0.539 and a GDI of 0.519. The Northern ASAL region had the lowest HDI of 0.413, and the GDI was 0.401. The HPI of Northern ASALs was the highest at 44.8% against the national average of 34.5%. The KNHDR (2006) indicates that the national HDI was 0.532, and the GDI was 0.547. The national HPI was 37%. The Northern ASALs combined achieved the lowest HDI of 0.285. Northern ASALs had the lowest GDI score of 0.285 in the country. The HPI of Northern ASALs was again the highest at 50.5% against the national average of 37%. According to the KNHDR (2009), the national HDI was 0.561. Northern ASALs scored 0.417, the lowest in the country. The national GDI value was estimated at 0.492. Northern ASALs scored the lowest GDI at 0.347. The national HPI for the period was 29.1%, and Northern ASALs had the highest HPI of 56.8%.

Furthermore, the Kenya Integrated Household Budget Survey (KIHBS) of 2005/2006 reveals that the literacy rate in Northern ASALs was the lowest in the country at 24.8%. Nationally, the average access to clean water sources was 57.0%, while Northern ASALs lagged at 34.6%. Additionally, the CRA report (2011) highlights a poverty incidence rate of 72.6% in Isiolo County, compared to the national average of 66%. The county was ranked 40th among the 47 counties in terms of poverty level. According to the Isiolo County Integrated Development Plan (CIDP) (2015), 93% of the population in Isiolo County lacks access to clean water within a five-kilometer radius, 56% face inadequate sanitation, and 85% are illiterate. Furthermore, over 70% of rural residents lack sufficient, accessible, and affordable healthcare, and more than 80% rely solely on emergency food aid from NGOs and the government due to severe food shortages, especially during floods and droughts.

These statistics demonstrate that residents of Northern ASALs have limited access to health and education, as well as low purchasing power, compared to other regions in the country. They also indicate growing socioeconomic disparity over time, illustrating ongoing marginalization. Thus, there is a critical need to reassess both the complementary model and the state's role in promoting socioeconomic advancement in Isiolo County. Historical examples, such as the Great Depression of the 1930s, demonstrate how socioeconomic stagnation led developed capitalist countries to adopt state-centered solutions inspired by Keynesian economics (Willis, 2011). Similarly, Khan and Christiansen (2011) highlight that the global financial crises of the 1990s and late 2000s prompted significant state intervention in most Western countries. These instances underscore the necessity of reconsidering the state's role in addressing socioeconomic development challenges, particularly in Africa and Kenya.

Persistent economic stagnation, rising poverty rates, and widening socioeconomic disparities, particularly exacerbated by SAPs, underscore the imperative for renewed state intervention (Ake, 1996; Musamba, 2010; Andreasson, 2010; Wade, 2011; UNDP, 2013). According to the UNDP (2013), socioeconomic indicators in African nations consistently lag behind global averages. Wade (2011) notes that the number of people living in absolute poverty in Africa (earning less than $2 per day) increased significantly after 1980. Moreover, the income inequality gap between Africa and industrialized regions has continued to widen, with Africa failing to narrow this disparity both pre- and post-1980. This trend contrasts sharply with other regions like East and South Asia, which have seen notable reductions in poverty levels during the same period. These observations highlight the inadequacy of the conventional developmental path of market-driven strategies in Africa and Kenya. Such approaches have typically diminished the state's role in socioeconomic development and have failed to stimulate meaningful socioeconomic transformation, particularly in marginalized regions like Isiolo County.

In light of these insights, several scholars have argued that Africa should adopt the developmental state model, incorporating certain key features (Mkandawire, 2001; Edigheji, 2005; Kalinowski, 2009; Musamba, 2010; Andreasson, 2010; Wade, 2011; UNDP, 2013; Nwapi and Andrews, 2017). According to Mkandawire (2001) and Musamba (2010), this model is not entirely unfamiliar to the continent. Mkandawire (2001) asserts that this was a primary concern of immediate post-colonial leaders, and African states should have been considered 'developmental' based on their aspirations and economic performance. For example, Kenya achieved growth rates comparable to those of East Asian developmental states from the early 1960s to the mid-1970s. Mkandawire insists that failed developmental outcomes may be due to external or unforeseeable factors beyond the state's control or simply ill luck. Therefore, he

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EPRA International Journal of Research and Development (IJRD)
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adds, the definition of a developmental state should account for these factors that may obstruct genuine developmental commitments and state efforts.

Nevertheless, several scholars have contested these claims (Ake, 1996; Van de Walle, 2001; Olukoshi, 2004; Musamba, 2010). According to Ake (1996), post-colonial ruling elites prioritized consolidating their power over nation-building and socioeconomic development. Van de Walle (2001), Olukoshi (2004), and Musamba (2010) contend that the developmental state ambitions pursued were not supported by sustainable visions of development. This was evident in the overbearing state intervention in the economy, dependence on income from the export of primary products, and the maintenance of non-performing state-run projects by the treasury, which drained limited foreign exchange reserves. Additionally, corruption, a lack of an autonomous and efficient bureaucracy, and a disregard for the importance of the private sector in economic growth contributed to the failed developmentalism.

Some scholars have also challenged the feasibility of the developmental state model in Africa under existing circumstances (WB, 1993; Diamond, 1999; Johnson, 1999; Hewitt, 2001; Beeson, 2004). According to the WB (1993), Hewitt (2001), Stein (2000), UNCTAD (2007), and Fritz and Menocal (2007), the concept is not viable because the East Asian development model is not replicable. The WB (1993) report demonstrates that this is due to limitations in African states, such as a lack of ideology, dependency, susceptibility to predatory rule, and state capture by vested interests. Johnson (1999) argues that the Japanese development model is difficult to emulate unless a state shares a similar commitment "to the mobilization of industry" (p. 52). Hewitt (2001) contends that the institutions associated with East Asian developmental states are highly contextual and time-specific. Beeson (2004) argues that the effects of globalization and liberalism present challenges to developmental states that wish to pursue policy options for the protection of their nascent industries. Additionally, the interrelationship between industrial, technocratic, and political players crucial for the development of East Asian governments has been eroded by the emphasis on governance reforms and the expanded roles of non-state actors like CSOs, IFIs, and business networks.

Furthermore, questions have arisen regarding Africa's institutional framework and the state's ability to create, implement, and oversee the complex and demanding policies that formed the basis of East Asian success (UNCTAD, 2007; Stein, 2000). As a result, the state's ruling class often lacks the commitment to fulfilling its development obligations (Fritz and Menocal, 2007). Stein (2000) asserts that the state-business relationship is underdeveloped, and the private sector is poorly coordinated and fragmented. With the exception of Botswana, Mauritius, and South Africa, Diamond (1999) argues that African nations lack three crucial political governance prerequisites for becoming a developmental state: a viable state, a secure lawful political order, and an appropriate state authority.

The observations above indicate that post-colonial African developmental efforts lacked the core characteristics of a developmental state and prospects for adopting this model are fraught with challenges. While the developmental state model has its critics, I support its approach of re-centering the state's role in socioeconomic development in African nations. This approach focuses on achieving targeted economic growth to boost Gross Domestic Product (GDP) and address structural inequalities, contrasting with dominant liberal and trickle-down strategies that have often neglected marginalized populations. Despite facing criticism, CSO activities have delivered short-term benefits to marginalized groups such as the residents of Isiolo County. Therefore, both CSOs and the state play crucial roles in advancing socioeconomic development. The critical challenge, however, is devising effective strategies that enable the state to enhance the standard of living for its population. To maintain its crucial role in socioeconomic development, the state must strengthen and reinforce its position. Therefore, this paper extends beyond the traditional developmental state model by building on its strengths and incorporating new elements to foster synergy between the state and CSOs for sustainable development in Isiolo County.

Firstly, this paper proposes a collaborative framework between the state and CSOs in Isiolo County to optimize synergies. This entails aligning state and CSO strategies toward socioeconomic development to promote sustainability. By harmonizing their goals, visions, and agendas, and pooling resources such as funds, expertise, and manpower, they can collectively address complex societal challenges more effectively than they could separately. This approach allows both entities to leverage their unique strengths within a capacity-building framework, fostering a more cohesive and impactful effort. This approach is distinct from the current complementarity strategies, which have not yielded the desired outcomes, indicating a need for an alternative method. It is worth noting that starting in the 1990s, multilateral institutions like the UNDP (1991), the World Summit for Social Development (1995), and the WB (1997) began to highlight the importance of partnerships between CSOs and the state as crucial conditions for receiving aid. This marked a shift from the earlier minimalist view of the state's role in providing socioeconomic services, recognizing instead the essential role of the state. In light of these developments, CSOs involved in socioeconomic development in Isiolo should reassess their relationship with the state to align effectively with this renewed emphasis on collaboration, ensuring effective synergy. By building on the strengths of both the state and CSOs, this proposed framework aims to create a sustainable and inclusive model of development that addresses the needs of all residents, particularly the most vulnerable.

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To facilitate effective collaboration, a comprehensive regulatory framework must be established. This framework should engage key stakeholders such as the national NGO Coordination Board, the county government, NGOs involved in socioeconomic services, and local Community-Based Organizations (CBOs). Given the state's pivotal role in socioeconomic development, it must lead in establishing this cooperative policy framework. Through its regulatory mandate, the state can oversee and coordinate the activities of non-state actors, ensuring cohesive efforts that are aligned with overarching socioeconomic development objectives. The persistent socioeconomic inequality in Isiolo County, despite the significant presence of CSOs generally, may be partly due to the state's inadequate regulatory oversight of these organizations. Although there is a national regulatory body, its main function is limited to the registration of NGOs that have submitted their annual returns. This oversight measure is insufficient, as findings in this research have revealed the presence of unregistered NGOs operating in Isiolo County. This observation is consistent with findings by Kameri-Mbote (2002) and Omiti et al. (2002), who also identified similar regulatory gaps. These anomalies suggest that the national registration body is not fully enforcing its regulations. Furthermore, there is a weak connection between the national NGO Coordination Board and the Isiolo County government, exacerbating the challenges in effectively overseeing and coordinating NGO activities at the local level.

The state is also uniquely positioned, through its regulatory capacity, to create an enabling environment that aligns the objectives of CSOs with the county's long-term socioeconomic development plan as outlined in the County Integrated Development Plan (CIDP). The CIDP is a strategic five-year plan that outlines the county's socioeconomic development goals and priorities. By aligning the efforts of NGOs with the CIDP, the state can ensure long-term sustainability. This proposed framework not only addresses the regulatory shortcomings but also seeks to create a more structured and cooperative environment where both the state and CSOs can work together more effectively. By fostering a stronger partnership and ensuring that all activities are in line with the CIDP, this approach aims to achieve sustainable socioeconomic progress for Isiolo County.

Secondly, synergy between the state and CSOs can enhance responsiveness to socioeconomic development through active engagement with key stakeholders, including local CBOs and beneficiaries. Responsiveness aligns closely with the modern principle of public participation, an aspect that is also emphasized in the Kenyan Constitution of 2010. The persistent lack of socioeconomic transformation in Isiolo County underscores the limitations of a top-down approach employed by both the state and CSOs. This approach often fails to address the unique needs and priorities of the local community. Mercer (2002) points out that the rise of the participatory model in development was largely due to the failures of top-down strategies. Thus, participation allows planning that is based on the needs, perceptions, and experiences of local communities, fostering a sense of ownership over projects (UNDP, 1993). By engaging and nurturing communities in consultation and decision-making processes, state-CSO collaborations can ensure that local CBOs and beneficiaries in Isiolo County are actively involved in the socio-economic development process. This inclusive approach provides an opportunity to capture their lived experiences, leading to more effective and sustainable outcomes. To support this, a needs assessment data system could be established and maintained to continually reflect the evolving needs of the community, ensuring that socioeconomic development is approached from the ground up. The Constituency Development Fund (CDF) in Kenya exemplifies an attempt at a bottom-up approach. However, the state still exerts significant influence over the expenditure of CDF funds, while constituency needs remain diverse and varied. Therefore, adopting a responsive approach to socioeconomic development could form the cornerstone of a state-led strategy. This approach can enable the state to address the dynamic needs of the community more effectively and coordinate with key stakeholders to create sustainable and inclusive socioeconomic development outcomes.

Thirdly, enhancing responsiveness through collaboration between the state and CSOs can significantly strengthen social safety nets and welfare programs, reducing extreme poverty and socioeconomic inequality in Isiolo County. By working together, these entities can create comprehensive, targeted interventions that address the root causes of poverty and inequality, leading to more sustainable and equitable outcomes. According to Sen and Drèze (2013), social safety nets are designed to support the most vulnerable populations by meeting their immediate needs while building long-term capacity and resilience. Implementing tailored programs such as direct cash transfers, food aid, school feeding programs, and subsidies for essential goods can effectively address the needs of the poor and marginalized. In Isiolo County, ICSOs were already involved in crucial socio-economic programs, including health, education, water, sanitation, agriculture, pastoralism, and financial assistance through cash transfers. A robust synergy between CSOs and the state has the potential to expand these efforts and focus on tailored social safety net programs specific to Isiolo County's needs. For instance, implementing conditional cash transfers linked to school attendance or health check-ups could simultaneously promote education and healthcare access. Mobile clinics and schools could extend these services to remote areas. Scholarships and vocational training tailored to Isiolo's youth could enhance human capital and alleviate poverty. Expanding access to loans and promoting mobile banking systems like M-Pesa in remote areas could foster economic independence and growth. Given Isiolo's semi-arid environment, initiatives promoting sustainable agriculture, such as training in drought-resistant farming techniques or providing livestock insurance, could enhance food security and livelihoods. These efforts underscore the importance of a collaborative framework for inclusive and impactful

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socio-economic development. Such collaboration ensures that both state and non-state actors work together effectively to address the specific challenges faced by marginalized communities in Isiolo County.

While the benefits of CSO-state collaboration in the socio-economic development of Isiolo County are substantial, it is crucial to recognize and address the challenges that can arise, since this model will inevitably encounter both opportunities and challenges for all involved. As Brass (2014) notes, state-NGO relations are inherently complex and diverse, and cultivating these relationships requires strategic navigation to achieve long-term and sustainable development. Therefore, it is essential for CSOs and the state to continuously evaluate and adapt their collaborative strategies. Establishing feedback mechanisms and fostering a culture of learning can help refine the partnership and address emerging challenges proactively. The following section will delve into the potential benefits of such a collaborative approach in addressing the unique needs and context of Isiolo County.

**State-CSO Framework for Sustainable Socioeconomic Development in Isiolo County**

State-CSO collaboration necessitates a coherent policy framework to ensure effective cooperation and coordination. Studies by scholars such as UNDP (1991), Clark (1995), Whaites (1998), and Hulme (2010) indicate that without such a framework, CSOs often operate in an uncoordinated manner. Findings from ICSO officials in Isiolo County further support this conclusion. To establish coordination, two major umbrella forums have been developed. The County Steering Group (CSG), initiated by the County government and co-chaired by the County Governor and County Commissioner, coordinates the sectoral work of all CSOs in the county. All CSOs must register with the CSG before commencing operations. The CSG facilitates regular meetings, typically monthly or quarterly, to discuss strategies for mitigating climate variability-related hazards. These meetings are conducted under the guidance of the National Drought Management Authority (NDMA), which coordinates the development and implementation of drought contingency plans in the county, involving various stakeholders, including government agencies, NGOs, and communities (GOK, 2013). The CSO Network Forum provides a platform for all CSOs to meet regularly, present their sector functions, prevent duplication of services, and share experiences. Since 2015, USAID has also launched the Local Development Organization (LDO), which operates similarly to the CSO network forum, with objectives focused on enhancing coordination and collaboration among CSOs.

All 47 ICSO officials interviewed confirmed their awareness of these CSO network forums and their respective mandates. Even with these well-meaning initiatives, there were still challenges in CSO coordination because there were no binding arrangements. This is underscored by Key Informant-1 below:

> There is no effective policy framework to ensure that all CSOs avail themselves for the NDMA meetings or in CSO Network Forums. Often times CSOs proceed with operations without consulting or registering with the CSG. CSO officials only come to our offices here at the county government after they have encountered challenges that they cannot handle (OI, Isiolo County, 10/05/2019).

The introduction of a new CSO forum by USAID, a donor agency, to promote collaboration among CSOs in Isiolo County underscores the weak policy framework between the state and CSOs, as well as among CSOs themselves. This situation suggests that without engaging with the state, neither donor agencies nor CSOs can effectively address coordination challenges. CSO-state collaboration holds the potential to enhance coordination by establishing a structured policy framework. This framework would compel CSOs to operate within defined guidelines rather than pursuing individual ad hoc approaches.

State-CSO collaboration has the potential to amplify the impact of socioeconomic initiatives by facilitating the cascading of CSO interventions across geographical areas, as noted by Clayton et al. (2000). By increasing the number of NGOs addressing specific needs in Isiolo County, such collaboration can promote consistency, continuity, and socioeconomic access for a larger portion of the population. A state official - 1 stated:

> The Kenyan state has realized the disadvantage of individual NGO operations and is in the process of implementing a framework that will pull the resources of all developmental CSOs together within Northern ASAL regions (OI, Nairobi, 06/05/2019).

The combined efforts of both the state and CSOs have the potential to effectively address issues related to duplication, access, coverage, and equity in socioeconomic service provision. Findings from ICSOs confirmed these challenges. Each of the 47 ICSOs was engaged in multiple socioeconomic activities simultaneously, including functions such as education, health, water, and sanitation, often within the same period and geographical area. Key Informant -2 remarked:

> …in some cases, up to ten CSOs concentrate their projects in the same village, offering similar services, and you wonder what they are trying to prove! (OI, Isiolo town, 15/05/2019).

The findings indicate that NGOs have struggled to leverage each other's strengths despite having similar intentions. Research by Robinson and White (1998), Martin (2002), and the KNHDR (2006) highlights that duplication of efforts among CSOs impedes their effectiveness in reaching the most vulnerable populations. The KNHDR (2006) specifically notes that NGOs often compete on similar

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projects without adequate collaboration, leading to poor coordination and inefficient resource use. In Isiolo County, ICSO-supported projects are unevenly distributed. Most projects were concentrated in or near urban areas and along major roads, such as those in Isiolo North (Bula Pesa, Chari, Cherab, Ngare Mara, Wabera, Burat, and Oldonyiro), which are relatively accessible and better serviced. In contrast, Isiolo South, including more rural and less accessible wards like Garba Tulla and Merti, received fewer projects. Specifically, of the 47 projects, 25 (53%) were in Isiolo North, 19 (40%) were spread across both constituencies, and only 3 (6%) were in Isiolo South. This uneven distribution highlights the need for a more equitable allocation of resources to address socioeconomic disparities across Isiolo County. This weakness was acknowledged by Key Informants -3 & 1 respectively, in statements such as the following:

> …Isiolo North has a higher concentration of NGO projects, despite Isiolo South being more vulnerable. Most CSOs in this county have their projects located not more than 5km from the highway (OI, Isiolo town, 30/5/2019).
>
> …..conditions in Isiolo South are very difficult, but you will find that most NGOs, whether national or international, concentrate most of their activities in Isiolo North constituency. This is especially true in Isiolo Central, which covers Wabera and Bulla Pessa wards (OI, Isiolo town, 10/5/2019).

This demonstrates that urban areas or those along the highway may have been over-served, while most residents continue to remain on the fringes of society. This unequal distribution exacerbates the severe deprivation observed throughout the county, particularly in Isiolo South. Similar research findings from various studies conducted in different parts of the world demonstrate this irregularity. Da Costa's (2016) analysis of NGO locations in Brazil revealed that poor socioeconomic indicators did not significantly influence their placement. Instead, the primary motivation was the presence of a high pre-existing density of other NGOs in the area. In Kenya, Brass (2012) found that convenience factors, such as access to beneficiaries, donors, and elite resources, played a more substantial role than poverty in determining NGO locations. Similarly, Omiti et al. (2002) discovered that factors such as organizational size, mission, infrastructure availability, proximity to urban areas, and security considerations were influential. Consequently, urban areas with robust infrastructure, both human and physical, had the widest coverage, while remote areas with low population density and inadequate communication networks had the lowest coverage. It can therefore be concluded that NGOs, operating independently cannot adequately address socioeconomic inequality and vulnerability of the marginalized majority.

The close interaction between CSOs and the government could address funding challenges by reducing donor dependency and combining resources for similar programs. Additionally, the government could offer financial support through local revenue if long-term funding measures are established with CSOs (Clayton et al., 2000). ICSOs in Isiolo face issues such as budget cuts, rising costs, and competition for funds, which affect project sustainability. Findings revealed that nearly 49% of ICSOs had operated in the area for less than 10 years, with donor funding typically supporting projects for only 3 to 5 years. This short-term funding often forces ICSOs to either hand over projects or initiate new ones when funding ends. Even long-standing ICSOs, like World Vision (operating since 1974), reported sponsoring projects for less than five years, contributing to high turnover in the area. Similar issues have been observed in other regions. Martin (2002) notes that limited donor project phases in Tajikistan hinder long-term solutions, while Robinson and White (1997) and Clayton et al. (2000) highlight that high NGO turnover obstructs continuity and sustainability in service provision. Therefore, sustainable socioeconomic development requires a progressive approach with long-term funding to ensure continuity and impact. The challenge of ICSO funding was summarized by an ICSO official-1 who stated:

> The main challenge to socioeconomic development in Isiolo County is that the NGO sector is heavily dependent on donor support. I wish we could also get government support (Isiolo County, OI, 17/5/2019).

CSO-state collaboration, therefore, offers the advantage of pooling resources, thereby achieving improved sustainability and effectiveness. Thus, CSOs that are entirely dependent on external donors have an opportunity to diversify their funding base, including from the host government.

CSO-state collaboration enables CSOs to work with government entities at national and county levels. The Constitution of Kenya (2010) supports devolution of socioeconomic functions like agriculture, health, and livestock to counties, offering opportunities for resource exploitation in Isiolo County. This collaboration can involve various county bodies, increasing accountability and funding for local services and enhancing devolution to reduce socioeconomic inequality. Brass (2014) found that CSOs in Kitui County successfully engaged in development through government collaboration and policy-making. Similarly, findings from ICSOs in Isiolo County indicate collaboration with the county government and participation in policy-making processes at the local level. Key Informant-1 observed the following about CSOs in Isiolo County:

> Most CSOs cooperate with all the county-line ministries such as the ministries of environment, health, agriculture and livestock, and education, among others (OI, Isiolo County, 10/05/12019).

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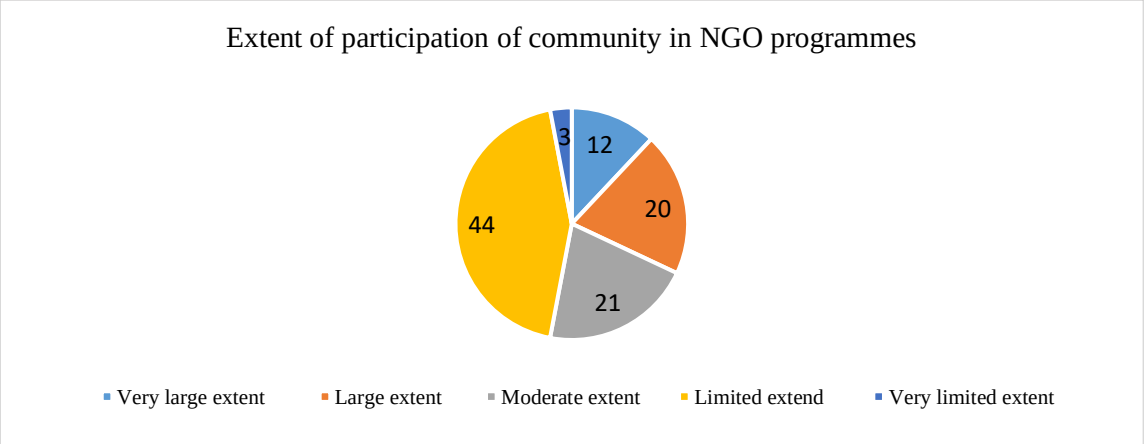
The above examples demonstrate that there are already various opportunities for CSOs to work with the government at the county level to improve service delivery. However, these relationships are in their initial stages. Therefore, a properly established policy framework could enhance and institutionalize CSO-state collaboration, leading to constructive working relationships with the decentralized government.

Decentralization also holds the potential to facilitate a more inclusive and responsive approach to socio-economic development. However, findings from ICSOs indicate that the experiences and contributions of local CBOs and beneficiaries had not been fully leveraged. Despite all 47 ICSO officials interviewed stating that they promoted participation to enhance project ownership and sustainability, findings contradict these assertions. This is what Key Informant -5 stated:

> …in most cases, the involvement of locals in NGO work is limited to public participation in the initial stages but wanes as the projects advance (OI, Isiolo town, 12/05/2019).

The Key Informants' assertions were echoed by FGD discussants when asked about the extent of community participation in NGO projects as revealed in Table 1 below:

**Table 1: Extent of Participation of Community in NGO Programs**




44% of respondents revealed that community members' involvement in NGO programs was limited. ICSOs therefore could not be described as people-centered and grass-roots-oriented in their activities since the collective and individual creativity of beneficiaries was undervalued and underutilized.

State-CSO synergy is crucial for ensuring effectiveness in the policy-making process. CSOs can play a vital role in advocating for policy changes and reforms based on grassroots experiences and evidence, while the state can implement and enforce these policies at national or county levels. Effective advocacy and policy influence requires the active involvement of the state. Thus, CSO-state collaboration offers new opportunities for CSOs to influence and enhance government policies, which can be slow-moving and subject to setbacks (Hulme, 2010). According to Kalinowski (2009), the state holds the mandate to formulate universally valid policies and enforce them more effectively than NGOs. Addressing the root causes of poverty and socioeconomic inequality involves navigating the structural framework of society, making policy implementation a critical function of the state. Therefore, for CSOs to effectively contribute to policymaking and socioeconomic development, collaboration with the state is essential. This partnership ensures that policies are grounded in local realities, effectively implemented, and sustainable over the long term.

Moreover, according to Green and Matthias (1997) and Rose (2009), health and education are fundamental public goods in society that should be overseen by the state, even if it may not be the implementer. This calls for designing effective policies and providing an enabling environment for these sectors to thrive under the guidance of the state. Green and Matthias (1997) note that CSOs cannot often formulate clear healthcare policies and regulations, despite potentially having advantages over the state in certain contexts. They emphasize that amidst the increasing privatization of healthcare, whether by voluntary or commercial sectors, the state must establish an overarching framework that delineates the role of CSOs in healthcare provision. Rose (2009) contends that education, as a public good, holds unique importance because it can be utilized by governments to promote greater equity among citizens. Thus, there is a need for governments to play a role in regulating and monitoring CSO activities in the provision of these public goods to ensure policy compliance. This can effectively be achieved through CSO-state collaboration with shared vision and goals.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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State-CSO collaboration has the benefit of enhancing accountability to beneficiaries as programs are jointly implemented. CSOs have faced criticism for prioritizing accountability to their funders over their beneficiaries and operating with less transparency towards the host government. This lack of accountability makes it challenging for the state to assess the individual performance and impact of CSO interventions. Thus, collaboration can improve Monitoring and Evaluation (M&E) practices by providing insights into what strategies have been successful and why. This collaborative M&E approach fosters greater consistency and continuity in socioeconomic programs, ensuring that interventions are aligned with community needs and government priorities in Isiolo County. Key Informant -1 expressed concerns about CSO operations in Isiolo County:

CSOs rarely share Monitoring and Evaluation (M & E) results with the County government. I think this is one of the main reasons why the actual needs of the community are wrongly identified (OI, Isiolo County, 10/05/2019).

Combined program implementation could enhance the state's legitimacy by increasing its involvement in socioeconomic service provision and meeting community expectations. Findings from FGD discussants shows that they were acutely aware of their marginalization compared to other Kenyans. Notably, (96%) of FGD particpants acknowledged their marginalization and were able to articulate the specific conditions contributing to it as presented below:

**Table 2: Criteria for Identify Marginalization**

| Criteria | Frequency | Percentages |
|---|---|---|
| Poor roads | 21 | 9 |
| Poor access to health facilities | 42 | 18 |
| Access to water services | 55 | 23 |
| Level of literacy | 32 | 13 |
| Historical injustice | 54 | 22 |
| Poverty | 36 | 15 |
| No sure | 14 | 6 |
| **Total** | **240** | **100%** |

Table 2 shows that FGD discussants were able to describe how marginalization manifests based on the outlined conditions. They contrasted their experiences with those of other regions, particularly Nairobi, which they referred to as representing the "real Kenya."

CSOs contribute significant financial resources, expertise, and knowledge to partnerships, while governments, in collaboration with academic and research centers, provide valuable data for designing and implementing programs for the poor (Kalinowski, 2009; Banks & Hulme, 2012). Therefore, bypassing the state is not advisable, as CSOs alone cannot achieve sustainable socioeconomic development. Studies in Isiolo County underscore this need for state involvement. Kihara (2007) found that individual Muslim NGOs struggled to mitigate food insecurity, highlighting the importance of integrating strategies among stakeholders. Kagunyu (2014) observed that NGO-led climate variability mitigation strategies for the Borana were neither sustainable nor long-term. Similarly, Agade and Halakhe (2019) noted that the national government was more effective than NGOs in managing conflict and its causes in Isiolo. These studies illustrate the limitations of CSO intervention strategies without state involvement, underscoring the importance of state-CSO collaboration for effective and sustainable socioeconomic development. Key Informant-6 emphasized the crucial role of the state:

> The failure of CSOs to partner with the government harms program sustainability because once the NGO exits the area, the community also abandons the projects. It is the government officials who help with follow-up measures so that the project is sustainable (OI, Isiolo County, 26/5/2019).

Despite financial challenges and the presence of numerous CSOs, the state remains actively involved in socioeconomic service provision. This is evident from FGD participants' observations, who identified the state as the primary sponsor of most schools in the region as shown in figure 3 below.

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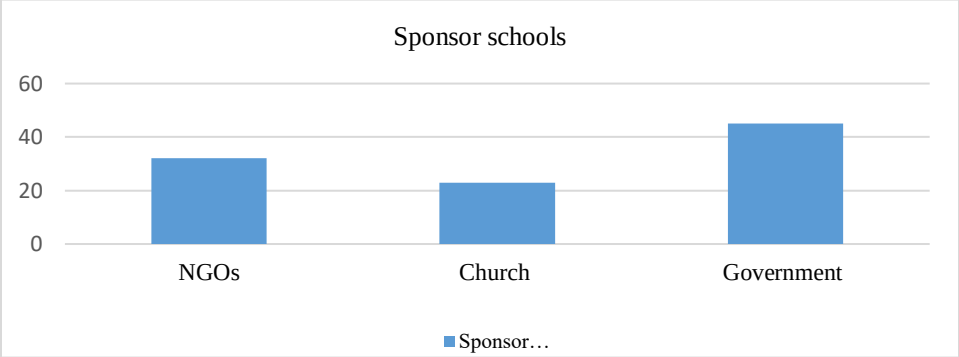
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

**Figure 3: Sponsor of Schools**




From Figure 3, the government sponsored the highest number of schools (45%), followed by NGOs (32%) and churches (23%). This indicates that the government plays a significant role in socioeconomic development, particularly in areas where NGO services have been less impactful.

From the above discussions, CSO-State collaboration holds significant potential for enhancing socioeconomic development in Isiolo County. Globally, successful collaborations between states and CSOs have been well-documented. Bartley and Rose (2011) highlight effective partnerships in Bangladesh, India, and Pakistan, where government policies included commitments to work with NGOs for basic services. For example, in Bangladesh, health sector collaboration was guided by a directive policy and coordinated donor funding. In India, the government funded NGOs through formal contracts to support universal education. Pakistan has maintained a formal relationship with NGOs since the 1990s, following multilateral donor recommendations. These examples illustrate that similar collaborative frameworks could effectively enhance the impact and sustainability of socioeconomic development efforts in Isiolo County and Kenya, leveraging the country's robust NGO sector.

In Kenya, NGOs and CSOs are effectively collaborating to drive positive change. An illustration of such collaboration involves the private sector, including companies like Safaricom, KAPA Industries, Colgate Palmolive, and the NGO Shining Hope for Communities (SHOFCO). SHOFCO operates in urban slums, providing essential services, advocacy platforms, and leadership development for women and girls, serving over 350,000 residents in Nairobi, Mombasa, and Kisumu. During the COVID-19 pandemic, SHOFCO expanded its reach to over 2.4 million individuals, leveraging resources and expertise in healthcare, sanitation, education, and livelihoods (Fingo, 2021). Adopting and enhancing a similar collaborative model in Isiolo County could drive significant socioeconomic progress.

For CSOs to be truly effective, they should not assume a leading role in socioeconomic development without the active involvement of the state. Kalinowski (2009) argues that when CSOs operate without sufficient state involvement, it can weaken government influence in developing countries, leading to less effective CSO programs and hindering sustainable transformation. In Isiolo County, despite a significant presence of CSOs, low socioeconomic indicators persist due to inadequate state coordination. A sustainable solution requires not only supporting CSOs but also strengthening the state's role in coordinating socioeconomic development. The state's role in crafting policies to address structural inequalities is crucial, especially for marginalized communities like those in Isiolo County. By fostering a robust CSO-State collaboration, both entities can work together to create meaningful and lasting change.

## 4.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

This paper explored an alternative developmental framework that integrates both the state and CSOs to achieve sustainable socioeconomic development in Isiolo County. It examined developmentalism, highlighting the essential roles of both CSOs and the state in addressing socioeconomic issues. The findings indicate that despite the efforts of ICSOs and various policies, desired socioeconomic outcomes have not been achieved in Isiolo County. The research underscores the necessity of state involvement and CSOs in operations to address broad societal challenges such as poverty and inequality, particularly for marginalized populations. By adopting a regulatory and coordinating role through a collaborative policy framework, the state can effectively align stakeholder efforts and improve living standards for marginalized communities. Given this evidence, the following recommendation is made:

i. Developing and testing various models and approaches, including CSO-state collaboration, to identify the most effective strategies for maximizing socioeconomic development, particularly in Northern ASALs.

Future research should conduct empirical comparisons of socioeconomic projects implemented by both the state and CSOs to evaluate their impact in the socioeconomic development of Northern ASALs.

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# MINI REVIEW ON PIROXICAM DERIVATIVES SYNTHESIS IN THE LAST 10 YEARS

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**Article DOI: https://doi.org/10.36713/epra17905**
**DOI No: 10.36713/epra17905**

**ABSTRACT**
*Today the focus is on reducing the likelihood of creating a potentially hazardous substance by concentrating on the synthesis of derivatives from approved medications. Non-steroidal anti-inflammatory medicines (NSAIDs) are a popular class of medications used to treat painful arthritis. The medication piroxicam is a non-steroidal anti-inflammatory. Piroxicam has been the basis for the synthesis of several derivatives with various biological activity in recent years. This mini review aims to describe the biological activities of these derivatives that have emerged in the previous ten years.*

**KEY WORDS:** *piroxicam , non-steroidal anti-inflammatory, anti-glycation , anti-nociceptive , anti-HIV.*

## INTRODUCTION

The first medication in the "oxicam" class, piroxicam (4-hydroxy-2-methyl-2H-1,2-benzothiazine-1-(N-(2-pyridinyl)carboxamide)-1,1-dioxide) is an NSAID that was discovered in 1972 and released into the market by Pfizer in 1982. [(1)] Used in soft-tissue disorders, acute gout, postoperative pain, rheumatoid arthritis, osteoarthritis, ankylosing spondylitis, acute gout, and rheumatoid arthritis, including juvenile idiopathic arthritis. However, systemic usage in Europe is currently limited to chronic painful and inflammatory conditions. [(2,3)] An enolized β-dicarbonyl moiety is responsible for the somewhat acidic nature of oxicams, a class of NSAIDs that are defined by the absence of a carboxyl group. They are structurally either thienothiazine-3-carboxylic acid amides or benzothiazine-3-carboxylic acid amides (e.g., meloxicam, piroxicam). It has been demonstrated that piroxicam and meloxicam block angiogenesis and the proliferation of cancer cells, as well as the emergence of secondary tumors caused by surgery. [(4)] Piroxicam belongs to a class of pharmaceuticals called non-steroidal anti-inflammatory drugs (NSAIDs), which are widely used to treat inflammatory illnesses that are both acute (such as fever and discomfort) and chronic (such as rheumatoid arthritis). [(5)] Additionally, it has been demonstrated that NSAIDs offer defense against a number of dangerous diseases, including cancer and heart attacks. [(6)] Non-steroidal anti-inflammatory medications (NSAIDs) work by inhibiting the cyclooxygenase enzyme (COX1,2), which is essential for the manufacture of prostaglandins, which play a major role in inflammation. [(7-10)] Non-steroidal anti-inflammatory drugs (NSAIDs) have the potential to cause peptic ulcer disease, small bowel enteropathy, and symptoms in the foregut even though they are often used. Such an iatrogenic harm may be made worse by gastrointestinal tract perforations and hemorrhage. Lowering the dosage of NSAIDs or taking them in conjunction with proton pump inhibitors (PPIs) decreases the risk of issues, dyspepsia, and peptic ulcer therapy. [(11)] Improved bioavailability can result from the use of prodrugs containing ester; the ester functions are removed by either spontaneous hydrolysis or enzyme catalysis. [(12)] A paper published in 2014 stated that derivatives of piroxicam containing ester group had been synthesized and showed minimizing in the toxicity to the stomach and retention the anti-inflammatory activity by converting the enolic group to ester group. [(13)]

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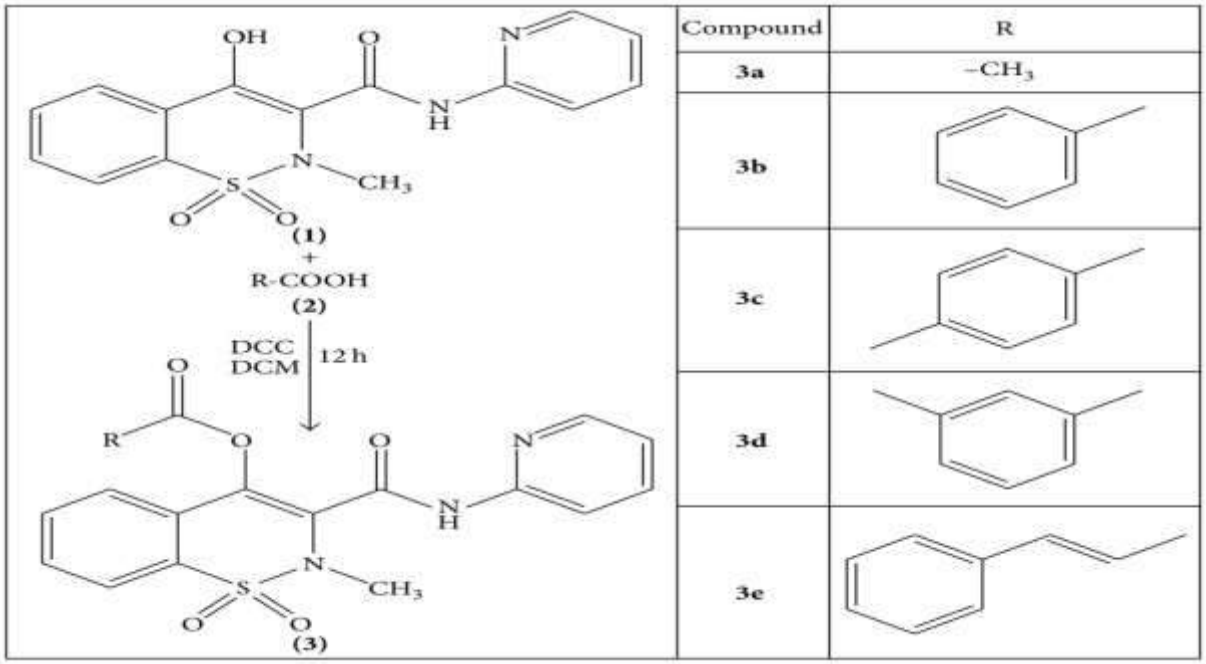
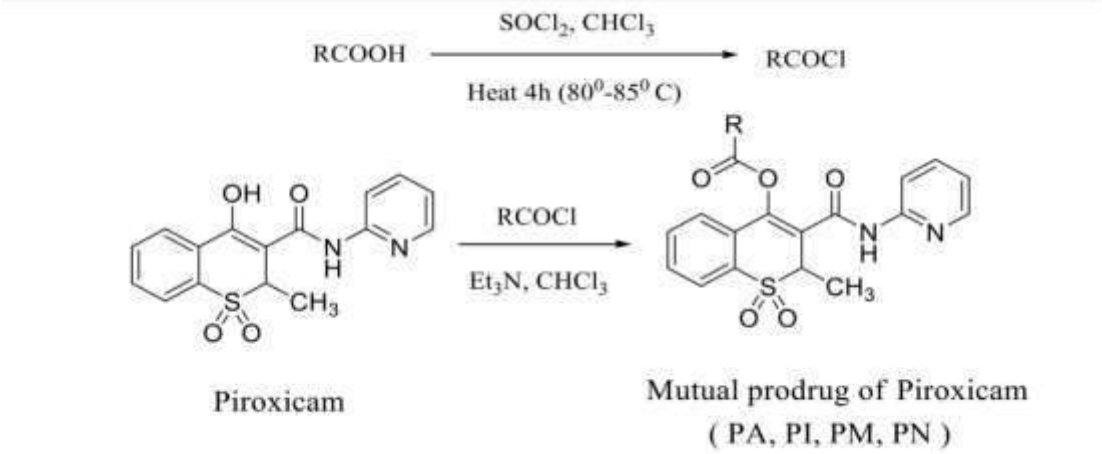



| Compound | R |
|---|---|
| 3a | $-CH_3$ |
| 3b | |
| 3c | |
| 3d | |
| 3e | |

**Scheme 1: Synthesis of Ester Derivatives from Piroxicam [13]**

The scientific community is very interested in prodrug techniques in the difficult drug development program. Molecules having little to no biological activity on their own that activate to become pharmacologically significant are referred to as "prodrugs." After being delivered, the prodrug may undergo chemical or enzymatic processing before exhibiting pharmacological activity. Mutual prodrugs is one of the various varieties of prodrugs. The primary benefit of mutual prodrugs lies in their ability to release two or more active molecules at the same level (the target tissue) after administration and bioconversion, hence utilizing a synergistic effect. Sometimes the second pharmacophore targets a separate biological activity of the parent chemical, giving it additional benefits. Other times, it acts as a carrier to direct the parent drug to a particular region of action. [14,15] In 2016 a research article showed the synthesis of mutual prodrugs from piroxican and some of other NSAIDs. This approach increased the therapeutic effectiveness of piroxicam under two lines; firstly, masking of enolic hydroxyl group through acids and converting them to esters and secondly, utilizing the known NSAIDs for achieving the synergistic effect.[16]




**Scheme 2: Synthesis of Mutual Prodrug from Piroxicam [16]**

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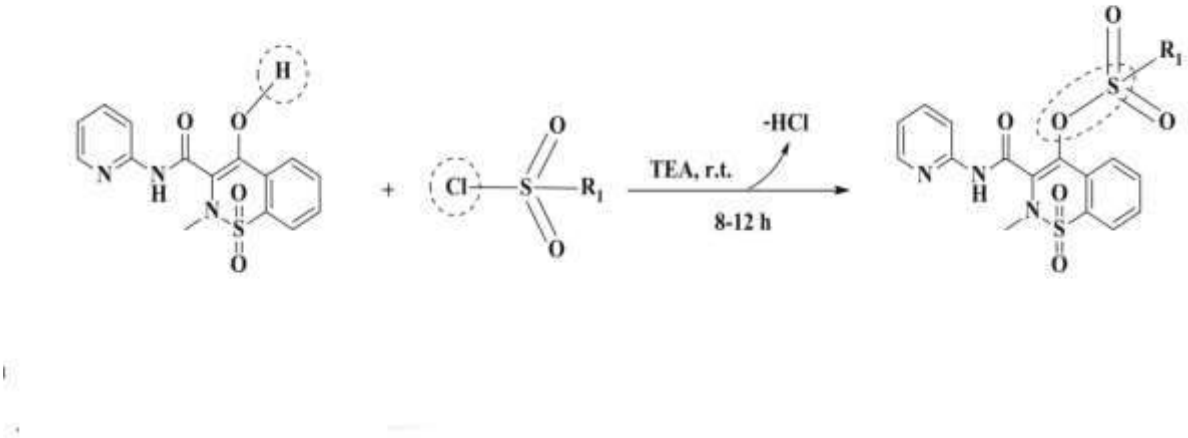
Neuropathic pain and inflammatory pain are two different conditions that can cause clinical pain. Neuropathic pain results from injury to the nerve system. The presence of spontaneous pain, hyperalgesia (an increase in reaction to noxious stimuli), and allodynia (pain in response to ordinarily harmless stimuli) are the characteristics of this type of pain. Painful stimuli are recognized by unique sensory receptors known as nociceptive receptors, and the brain receives a signal from these receptors to initiate the process of nociception, which causes pain perception. [17,18] Chronic diabetes mellitus is a highly frequent condition that is linked to non-enzymatic protein glycation and oxidative stress. Because hyperglycemia speeds up the production of advanced glycation endproducts (AGEs), it has been proposed that inhibiting AGE development could delay the onset of diabetes complications and slow down the aging process. [19,20] Sulfonates are a crucial group in chemical synthesis because they are simple to make and can be transformed into carbanions, which allows them to go through processes similar to those of aldols and alkylation. [21] In 2016 and 2021 two papers published synthesized solfonates derivatives from piroxicam act as anti-nociceptive agent or as anti-glycation agent. [22,23]




**Scheme 3: Synthesis of Sulfonate Derivatives from Piroxicam. [22,23]**

HIV integrase is an enzyme that is necessary for viral replication and viron generation. It integrates the double-stranded DNA product that is produced when viral RNA is reverse-transcribed into the host genome. One possible target for HIV infection treatment is the inhibition of this enzyme. [24,25] In 2022 an article published synthesized analogues of piroxicam some of them act as good anti-HIV integrase activity.[26]

## CONCLUSION

piroxicam drug is a non-steroidal anti-inflammatory drug but can be used to synthesize derivatives that may improve effectiveness or give different types of activities like anti-glycation, anti-nociceptive and anti-HIV. So it may be investigated to design derivatives have different types of activities other than listed above.

**Acknowledgements**

The authors are greatly thankful to management and principal, Department of Pharmaceutical Chemistry/ College of Pharmacy/ Mustansiriyah University for their help and support.

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# SELF-REGULATED BEHAVIOUR OF SECONDARY STUDENTS IN RELATION TO ACADEMIC ACHIEVEMENT

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**ABSTRACT**
*Self-regulation is a process that helps students manage their thoughts, behaviours, and emotions to successfully navigate their learning experiences. This process involves students' purposeful actions and efforts directed toward acquiring information or skills. The main objective of this study is to analyze the relationship between self-regulated behaviour and academic achievement among secondary-level students. The investigator used the survey method and selected the sample using random sampling techniques. In this study, 295 ninth-grade students from government, private, and government-aided schools in the Erode district were selected as a sample. The findings of the study indicate a significant difference in the self-regulated behaviour of students from government, aided, and private schools. Additionally, a significant relationship exists between self-regulated behaviour and the academic achievement of secondary-level students.*

**KEYWORDS:** *Academic Achievement, Behaviour, Cognition, Relation, Self-regulation, Self-regulation behaviour, school students.*

## INTRODUCTION

Self-regulation is a process that helps students manage their thoughts, behaviors, and emotions to navigate their learning experiences successfully. This process occurs when a student's purposeful actions and processes are directed toward acquiring information or skills. Generally, models of self-regulated learning are separated into phases. One popular cyclical model discusses three distinct phases: forethought and planning, performance monitoring, and reflections on performance (Pintrich & Zusho, 2002; Zimmerman, 2000). Self-regulation is a deep, internal mechanism that enables children, as well as adults, to engage in mindful, intentional, and thoughtful behaviors.

Self-regulation has two aspects. First, it involves the ability to control one's impulses and stop doing something when necessary. For example, a child can resist the immediate inclination to blurt out an answer when the teacher poses a question to another child. Second, self-regulation involves the capacity to do something because it is needed, such as waiting one's turn or raising one's hand. Self-regulated children can delay gratification and suppress their immediate impulses enough to think ahead to the possible consequences of their actions or consider alternative, more appropriate actions. While most children know they are supposed to "use their words" instead of fighting, only those who have acquired a level of self-regulation can actually do so (Rajkumar & Harikrishnan, 2017). This ability to both inhibits one behavior and engage in another on demand is a skill used not just in social interactions (emotional self-regulation) but in thinking (cognitive self-regulation) as well. Research shows that children's self-regulation behaviors in the early years predict their school achievement in reading and mathematics better than their IQ scores (Blair, 2002; Blair & Razza, 2007).

## SELF-REGULATION BEHAVIOUR

Behavior regulation, sometimes also known as "self-regulation," refers to our ability to use self-control to behave appropriately. This may involve controlling our impulses to stop doing something, or it may mean doing something even if we don't want to. It includes managing our energy, emotions, attention, and behaviour in ways that are socially acceptable and help us achieve our goals. It enables us to stay calm, focused, and alert and to handle stressors such as excessive noise, fatigue, challenging situations or tasks, and distractions.

Our ability to regulate or manage our behaviour allows us to focus despite distractions, pay attention to important information, take turns, wait, follow rules, adapt to new situations, suppress outbursts of anger, and take on challenges. Behaviour regulation develops gradually during childhood. This process doesn't happen overnight, and some children cope with daily stresses more easily than others.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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**ACADEMIC ACHIEVEMENT**

A measure of knowledge gained in formal education usually indicated by test scores, grade, grade points, average and degrees. Here, the achievement level of the student is judged by the marks that the students have scored in the examinations. Academic achievement performance is the outcome of education the extent to which a student, teacher or institution has achieved their educational goals.

**Self-Regulation Strategies for Students**

***Goal Setting:*** Goals can be thought of as the standards that regulate an individual's actions (Schunk, 2001). In the classroom, goals may range from earning a good grade on an exam to gaining a broad understanding of a topic. Short-term, attainable goals are often used to reach long-term aspirations. For example, if a student sets a long-term goal to do well on an exam, they may also set attainable goals such as studying for a set amount of time and using specific study strategies to help ensure success. Research suggests that encouraging students to set short-term goals for their learning can be an effective way to help them track their progress (Zimmerman, 2004).

***Planning*:** Like goal setting, planning helps students self-regulate their learning before engaging in tasks. Research shows that planning and goal setting are complementary, as planning aids learners in establishing well-thought-out goals and strategies for success (Schunk, 2001). Planning occurs in three stages: setting a goal for a learning task, establishing strategies to achieve the goal, and determining the time and resources needed (Schunk, 2001). Teaching students to approach academic tasks with a plan effectively promotes self-regulation and learning (Pressley & Woloshyn, 1995; Scheid, 1993).

***Self-Motivation*:** Self-motivation happens when a learner independently employs strategies to stay focused on their learning goals. It plays a crucial role in self-regulation because it requires learners to take control of their learning process (Corno, 1993). Additionally, self-motivation occurs without external rewards or incentives, indicating a growing autonomy in the learner (Zimmerman, 2004). When students set their own learning goals and find internal motivation to progress towards those goals, they are more likely to persevere through challenging tasks and often find the learning process more rewarding (Wolters, 2003).

***Attention Control*:** To self-regulate effectively, learners need to manage their attention (Winne, 1995). This cognitive process demands substantial self-monitoring (Harnishfeger, 1995). It often involves clearing the mind of distractions and finding environments that are conducive to learning, such as quiet, noise-free areas (Winne, 1995). Research shows that students' academic performance improves with focused, on-task time (Kuhl, 1985). Therefore, teaching students to concentrate on learning tasks should be a priority. Teachers can assist by eliminating potential distractions and offering frequent breaks to help students gradually increase their attention spans.

***Flexible Use of Strategies***: Successful learners can employ various learning strategies across different tasks and adapt them as necessary to achieve their goals (Paris & Paris, 2001). However, it's important to recognize that most students, particularly those in primary grades, generally lack a wide range of learning strategies (van de Broek et al., 2001). It takes time for students to learn and become comfortable with different strategies. Teachers can aid this process by demonstrating new strategies and offering appropriate scaffolding as students practice, helping them to become independent strategy users.

***Self-Monitoring*:** To become strategic learners, students must take ownership of their learning and achievement outcomes (Kistner et al., 2010). Self-regulated learners assume this responsibility by tracking their progress toward learning goals. The process of self-monitoring incorporates all these strategies. To self-monitor effectively, a learner must set their own learning goals, plan, motivate themselves independently, concentrate on the task at hand, and use learning strategies to enhance their understanding of the material (Zimmerman, 2004).

***Help-Seeking*:** Contrary to common belief, self-regulated learners do not attempt to tackle every task independently but often seek assistance from others when needed (Butler, 1998). What distinguishes self-regulated learners from their peers is that they seek help with the intention of becoming more autonomous (Ryan et al., 2001). Teachers can encourage effective help-seeking behaviors by offering clear, ongoing feedback on students' progress and providing opportunities for students to resubmit assignments after making necessary revisions.

***Self-Evaluation*:** Students are more likely to develop into self-regulated learners when they can assess their own learning independently of teacher-issued summative assessments. This ability allows them to evaluate their learning strategies and make adjustments for similar tasks in the future. Teachers can encourage self-evaluation by assisting students in tracking their learning goals and strategy use, and by guiding them in modifying these goals and strategies based on their learning outcomes (Zimmerman, 2004).

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Self-regulated learners are capable of setting both short- and long-term goals, planning how to achieve them, motivating themselves, and concentrating on their progress. They can use various learning strategies, adjust these strategies as needed, monitor their own progress, seek help when necessary, and evaluate their learning goals based on outcomes. Teachers at the primary and secondary levels can implement these strategies to foster self-regulation in their classrooms. However, it is important for teachers to recognize that students develop at different rates, and what works well for one learner may not be effective for another.

## NEED AND IMPORTANCE OF THE STUDY

A study examining the relationship between self-regulated behavior and academic achievement among secondary level students can help identify academic issues, particularly those related to exams. Schools are social institutions established for the benefit of their members, and society places its hopes and expectations on its students. When a child fails to meet societal expectations in academic achievement, they may encounter difficulties, as their self-regulated behavior might be hindered by a persistent fear of failure.

Self-regulated students can delay gratification and control their impulses enough to anticipate the consequences of their actions or consider more appropriate alternatives. Self-regulation encompasses both social-emotional and cognitive behaviors, such as memory and attention. These aspects of self-regulation are interconnected; students who struggle with emotional control are less likely to follow directions or become reflective learners. Secondary students' learning is often focused on academic content, and self-regulation does not develop automatically. However, these skills are crucial for lifelong learning. Thus, it is important for teachers and parents to support and encourage the development of self-regulatory behaviour. This is why the researcher chose to study the "relationship between self-regulated behaviour and academic achievement at the secondary level." The investigation also aimed to compare self-regulated behaviour scores with academic achievement.

## REVIEW OF RELATED STUDIES

Kate Elizabeth Williams (2023) analyzed how self-regulation from birth to age seven relates to maternal mental health, parenting, and later child behavior. Her research provides new Australian evidence using a large, long-term dataset and modern statistical methods.

Chung and Mantak Yuen (2021) explored the role of feedback in improving students' self-regulation. They highlight how detailed, personalized feedback in a supportive environment can help students become more autonomous learners. The paper offers suggestions for school staff and future research.

Joseph Tadlock and Sharon Zumbrunn et al. (2021) reviewed self-regulated learning (SRL) in the classroom. They discuss SRL's importance for student motivation and achievement, provide strategies for promoting SRL, and address challenges educators might face in teaching students to be self-regulated, lifelong learners.

McAuley et al. (2021) studied self-regulation and exercise adherence in older adults. They found that better executive function and use of self-regulation strategies improve confidence in exercise abilities, which leads to greater adherence to exercise programs.

## OBJECTIVES OF THE STUDY

- ✓ To study the self-regulated behaviour of students at secondary level based on their gender, locality of student, type of school.
- ✓ To find out the relationship between self-regulated behaviour and academic achievement of students at secondary level.

## HYPOTHESES OF THE STUDY

- ❑ There is no significant difference in students' self-regulated behaviour based on their gender, locality, and type of school.
- ❑ There is no significant relationship between self-regulated behaviour and academic achievement of students at secondary level.

## METHOD OF THE STUDY

The investigator used the survey method for the study. This method collects data from a relatively large number of cases at a specific point in time. It focuses on the overall statistics derived from aggregating data across multiple individual cases, rather than examining the characteristics of each individual case separately.

### Population, Sample and Sampling Method

The study's population includes all secondary students in government-recognized schools within Erode district. Using a stratified random sampling technique, the investigator selected 295 ninth-class students from government, private, and government-aided schools in the district.

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**Tool Used for the Study**

In this study, the investigators employed a self-regulated behavior questionnaire developed and standardized by themselves. The tool includes 30 statements with both positive and negative questions. For positive questions, scores are assigned as 4, 3, 2, and 1, while for negative questions, scores are assigned as 1, 2, 3, and 4.

**Validity and Reliability**

The investigator validated the items with the assistance of experts, ensuring both face validity and content validity. The reliability of the tool, determined using the Spearman-Brown prophecy formula, was found to be 0.73.

**TESTING OF HYPOTHESES**

**Table-1: Significance of difference in students' self-regulated bahaviour based on Gender**

| *Gender* | *N* | *Mean* | *Standard Deviation* | *'t' value* | *Level of Significance* |
|---|---|---|---|---|---|
| Boys | 171 | 95.36 | 9.09 | 1.10 | Not significant |
| Girls | 124 | 94.12 | 9.78 | | |

From Table 1, it is observed that the calculated 't' value is 1.10, which is lower than the tabulated value of 1.96 at the 0.05 significance level. Therefore, the null hypothesis is accepted, indicating that there is no significant difference in students' self-regulated behavior based on gender.

**Table-2: Significance of difference in students' self-regulated bahaviour based on Locality**

| *Locality* | *N* | *Mean* | *Standard Deviation* | *'t' value* | *Level of Significance* |
|---|---|---|---|---|---|
| Rural | 122 | 94.23 | 9.18 | 1.67 | Not Significant |
| Urban | 173 | 96.28 | 9.79 | | |

From Table 2, it is observed that the calculated 't' value is 1.67, which is lower than the tabulated value of 1.96 at the 0.05 significance level. Therefore, the null hypothesis is accepted, indicating that there is no significant difference in students' self-regulated behavior based on their locality.

**Table-3: Significance of difference in students' self-regulated bahaviour based on Type of School**

| *Type of school* | *Mean* | *Standard Deviation* | *Sources of Variation* | *Sum of Square* | *df* | *Mean Square* | *F value* | *Level of Significance* |
|---|---|---|---|---|---|---|---|---|
| Govt | 97.42 | 8.02 | Between Groups | 1136.033 | 2 | 568.02 | 6.67 | Significant |
| Aided | 93.62 | 11.35 | | | | | | |
| Private | 93.14 | 8.31 | Within Groups | 24831.4 | 97 | 85.03 | | |

From Table 3, it is noted that the calculated F value is 6.67, which exceeds the tabulated value of 3.02 at the 0.05 significance level. Therefore, the null hypothesis is rejected, indicating that there is a significant difference in students' self-regulated behaviour based on their type of school.

**Table-4: Significant of relationship between self-regulated bahaviour and academic achievement of students**

| *Sample* | *Self-regulated bahaviour* | *Academic achievement* | *Correlation 'r' value* | *Level of significant at 0.05 level* |
|---|---|---|---|---|
| 295 | 95.02 | 69.50 | 0.602 | Significant |

From Table 4, it is noted that the calculated "r" value is 0.602, indicating a positive correlation between the two variables. Consequently, the null hypothesis is rejected, and it can be concluded that there is a significant relationship between self-regulated behaviour and academic achievement among secondary level students.

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## FINDINGS OF THE STUDY

The study found that there is no significant difference in self-regulated behaviour between male and female students. Additionally, there is no notable difference in self-regulated behaviour between urban and rural students at the secondary level. However, a significant difference was observed in self-regulated behaviour among students from government, aided, and private schools. Furthermore, a significant relationship exists between self-regulated behaviour and academic achievement among secondary level students.

## CONCLUSION

Based on the findings, it can be concluded that while self-regulated behaviour does not significantly differ between genders or between urban and rural students, it varies significantly across different types of schools. Furthermore, self-regulated behaviour has a significant relationship with academic achievement among secondary level students. This study advocates that enhancing self-regulated behaviour can lead to improved academic performance. Academically, this underscores the importance of developing self-regulation skills in students, which can be achieved through targeted interventions and support from both teachers and parents. By fostering self-regulation, teachers can help students achieve better academic outcomes and become more effective learners.

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EPRA International Journal of Research and Development (IJRD)
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# EXAMINING THE CORRELATION BETWEEN SOCIAL COMPETENCE AND SOCIAL INTELLIGENCE AMONG ADOLESCENTS: A COMPARATIVE STUDY OF RURAL AND URBAN STUDENTS

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**Article DOI: https://doi.org/10.36713/epra17935**
**DOI No: 10.36713/epra17935**

**ABSTRACT**

*Education plays a crucial role in promoting personal and societal growth of individuals. It significantly impacts different aspects of a person's life, such as their personality, social connections, and the pursuit of their goals. This study investigates the correlation between social competence and social intelligence among adolescent students in both rural and urban schools. A sample of 200 adolescent students, with an equal representation from different localities, went through assessment using the Social Competence Scale and Social Intelligence Scale. The results indicate notable variations in social intelligence depending on the location, while no significant variations were found in social competence based on location. Additionally, social competence and social intelligence were not shown to be significantly correlated. The findings offer important implications for educational practices and policies.*

**KEY WORDS:** *Social Competence, Social Intelligence, Adolescents, Comparative study*

## INTRODUCTION

Education is a cornerstone of individual and societal development, fostering not only intellectual growth but also the holistic development of students. It equips individuals with the knowledge and skills necessary to navigate and contribute to an increasingly complex world. Among the various attributes that education aims to develop, social competence and social intelligence are crucial for effective interpersonal interactions and societal progress.

Social Competence refers to the ability to interact effectively with others, encompassing a range of social, emotional, cognitive, and behavioral skills. It involves understanding social cues, regulating emotions, and behaving appropriately in various social contexts. Social competence is vital for building and maintaining relationships, achieving personal and professional success, and overall well-being. Research has shown that socially competent individuals tend to perform better academically and have more positive social interactions (Zorza et al., 2013).

Social Intelligence, on the other hand, is the capacity to understand and manage social relationships (Hernez-Broome, 2012). It includes the ability to interpret social signals, understand the perspectives of others, and respond appropriately in social situations. Social intelligence is essential for navigating social environments, building rapport with others, and resolving conflicts. It plays a significant role in personal and professional life, influencing an individual's ability to connect with others and work collaboratively.

The relationship between social competence and social intelligence is an area of growing interest among educators and researchers. Understanding how these constructs interact can provide valuable insights into the development of effective social skills and inform educational practices. This study aims to explore the relationship between social competence and social intelligence among adolescent students, with a specific focus on the influence of demographic factors such as locality (rural vs. urban).

## OBJECTIVES

1. To examine the social competence of adolescents in rural and urban schools.
2. To investigate the social intelligence of adolescents in rural and urban schools.
3.To determine the relationship between social competence and social intelligence among adolescents.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

## HYPOTHESES

1. There is no significant difference in social competence between adolescents studying in rural and urban schools.
2. There is no significant difference in social intelligence between adolescents studying in rural and urban schools.
3. There is no significant relationship between social competence and social intelligence among adolescents.

## RATIONALE OF THE STUDY

The developmental phase of adolescence is crucial for the formation of social skills and intelligence, which significantly influence an individual's ability to navigate social interactions, build relationships, and achieve personal and professional success. Given the diversity in educational and social environments, particularly between rural and urban settings, it becomes imperative to understand how these differences impact the social competence and social intelligence of adolescents.

Previous research has often focused on academic achievements and cognitive development, leaving a gap in understanding the interplay between social competence and social intelligence, especially in varying geographical contexts. Social competence, which encompasses the ability to interact effectively with others, and social intelligence, the capacity to understand and manage social situations, are critical for adolescents' overall development and well-being.

This study aims to fill this gap by examining the correlation between social competence and social intelligence among adolescents in rural and urban schools. By analyzing these relationships, the study seeks to identify specific factors that may contribute to variations in social skills based on location. Understanding these dynamics can provide valuable insights for educators, policymakers, and parents to develop targeted interventions and support systems that foster social development in diverse settings.

Furthermore, the findings of this study can inform educational practices and policies to ensure a more inclusive and supportive learning environment. Tailoring educational approaches to meet the unique needs of students in different localities can enhance their social skills, preparing them for future challenges and opportunities. Thus, this research holds significant potential to contribute to the broader discourse on adolescent development and the role of education in shaping socially competent and intelligent individuals.

## LITERATURE REVIEW

Social competence encompasses emotional, cognitive, and behavioral skills necessary for social adaptation. Definitions by various scholars, such as (Greenspan, 1980; Ten Dam & Volman, 2007), highlight their importance in interpersonal interactions. Social intelligence, as discussed by Willmann et al. (1997), varies across cultures and is crucial for social adjustment and well-being.

### Theoretical Perspectives

The relationship between social competence and social intelligence has been explored from various theoretical perspectives. Social intelligence is thought to be the critical component of overall intelligence and plays a key role in effective social functioning (Thorndike & Stein, 1937). Recent theories, such as those proposed by (Mayer et al., 2008), emphasize the interconnectedness of social and emotional intelligence, suggesting that both contribute to social competence.

### Empirical Studies

Empirical research supports the notion that social competence and social intelligence are closely related. For instance, a study by (Silvera et al., 2001) found that individuals with high social intelligence scores also exhibited high levels of social competence. Similarly, research by (Wong et al., 1995)indicated that social intelligence predicts social competence and success in social interactions.

### Influence of Demographic Factors

Several studies have examined the influence of demographic factors, such as gender and locality, on social competence and social intelligence. For example, research by (Maccoby, 1988) found gender differences in social behaviors, suggesting that girls tend to be more socially competent than boys. Study by (Ginsburg & Bronstein, 1993) explored the impact of rural versus urban settings on social development, finding that environmental factors significantly shape social skills and intelligence.

The literature indicates a strong correlation between social competence and social intelligence. Both constructs are essential for effective social functioning and are influenced by various demographic factors. This study aims to contribute to this body of knowledge by examining the relationship between social competence and social intelligence among adolescents in different localities .

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## METHODOLOGY

### Method

This study employs a comparative research design to investigate the correlation between social competence and social intelligence among adolescent students from rural and urban schools.

### Sample

The sample of the study consisted of 200 adolescents studying in class 10. Out of them, 100 students were from urban areas and 100 from rural areas of Ludhiana, Punjab.

### Tools

In the present study, for the collection of necessary data the following tools were used:

1. Social Competence Scale by Dr V. P. Sharma
2. Social Intelligence Scale by Dr N. K. Chadha

## DATA ANALYSIS

The present study was undertaken with the purpose of studying social competence in relation to their social intelligence among adolescents of secondary school. This objective was achieved within the framework of hypotheses. The data pertaining to Social Competence and Social Intelligence were collected from 200 adolescents, comprising 100 urban and 100 rural students. To screen the data for meaningful purpose and to test the hypotheses, the data was analyzed with the help of various statistical techniques. Following types of analysis were carried out for this purpose:

***Descriptive Statistics*:** Means, standard deviations, and frequencies were calculated to provide an overview of the data.

***Inferential Statistics:***

**Independent Samples t-Test:** Used to compare the social competence and social intelligence scores between rural and urban students.

**Pearson Correlation Coefficient:** Applied to examine the relationship between social competence and social intelligence across the entire sample.

### Hypothesis Testing & Discussion of Results

**Hypothesis 1: There is no significant difference between the social competence of adolescents studying in rural and urban schools.**

**Table 1: Distribution of mean scores of social competence of adolescents studying in rural and urban schools.**

| Sr. No. | Group | N | Mean | SD | MD | SE | df | t-value | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Urban | 100 | 7.61 | 5.51 | 1.55 | 0.818 | 198 | 1.89 | Not Significant (at 0.05level) |
| 2. | Rural | 100 | 9.16 | 6.07 | | | | | |

**Table 1** depicts that in the total random sample of 100 urban adolescents' value of the mean is 7.61, SD is 5.51. The Value of mean of 100 rural adolescents is 9.16, the SD is 6.07, the mean difference is 1.55, standard error is 0.818 and the t-value is 1.89. The calculated value (t-ratio) is less than the tabulated value at 0.05 level. The result shows that there is no significant difference between the social competence of adolescents studying in rural and urban schools.

Therefore, the hypothesis stating that, "There is no significant difference between the social competence of adolescents studying in rural and urban schools." stands accepted.

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**Hypothesis 2: There is no significant difference between the social intelligence of the adolescents studying in rural and urban schools.**

**Table 2: Distribution of mean scores of social intelligence of the adolescents studying in rural and urban schools.**

| S. No. | Group | N | Mean | SD | MD | SE | DF | t-value | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Urban | 100 | 9.36 | 5.98 | 1.95 | 0.80 | 198 | 2.43 | Not Significant (at 0.05 level) |
| 2. | Rural | 100 | 7.41 | 5.53 | | | | | |

**Table 2** depicts that in the total random sample of 100 adolescents studying in urban schools, value of the mean is 9.36, SD is 5.98. The value of the mean of 100 adolescents studying in rural schools is 7.41, SD is 5.53, the mean difference is 1.95, standard error is 0.80 and the t-value is 2.43. The calculated value (t-ratio) is less than the tabulated value at 0.05 level. The result shows that there is no significant difference in the social intelligence of adolescents studying in rural and urban schools.
Therefore, the hypothesis stating that, "There is no significant difference between the social intelligence of the adolescents studying in rural and urban school." stands accepted.

**Hypothesis 3: There is no significant relationship between social competence and social intelligence of adolescents.**

**Table 3:Coefficient o f correlation between social competence and social intelligence of the adolescents.**

| Coefficient of Correlation (r ) | |
|---|---|
| **Social Competence and Social Intelligence of the Adolescents** | **0.119754** |

**Table 3** depicts that the value of correlation coefficient is 0.119754 which indicates a very weak positive linear relationship between these variables. This means that changes in one variable (social competence) are associated with very small and inconsistent changes in the other variable (social intelligence). Hence, we can say that there is no significant relationship between Social Competence and Social Intelligence of adolescents.
Therefore, the hypothesis stating that, "There is no significant relationship between social competence and social intelligence of adolescents" stands accepted.
Based on the statistical analysis of data, the following inferences were drawn:

1. The study revealed that there is no significant difference between social competence of adolescents studying in rural and urban schools.
2. The study revealed that there is no significant difference in the social intelligence of the adolescents studying in rural and urban schools.
3. The study revealed that there is no significant relationship between social competence and social intelligence of adolescents.

## CONCLUSION

The study concludes that neither social intelligence nor social competence is influenced by locality. No relationship was found between social competence and social intelligence, suggesting the need for further research to explore other influencing factors. The finding indicates that there is a very weak positive linear relationship between social competence and social intelligence among the sample population. This implies that changes in social competence are only minimally associated with changes in social intelligence. Since the correlation is weak, it suggests that factors other than social competence may have a stronger influence on social intelligence. Researchers may need to explore additional variables or factors that contribute more significantly to social intelligence among the study participants. In conclusion, while a weak positive correlation suggests a subtle relationship between social competence and social intelligence, its implications underscore the need for nuanced interpretation, consideration of alternative factors, and potential adjustments in research methodologies and educational strategies.

**Educational Implications**

The findings offer important implications for educational practices and policies. Tailored interventions are necessary to address the location-specific variations in social intelligence, with different strategies required for rural and urban schools. Adopting a holistic approach to education that emphasizes social skills alongside academic achievements is crucial. Gender-inclusive programs should be

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implemented to ensure equal opportunities for both boys and girls in activities that promote social skills. Teacher training programs need to include modules on fostering social intelligence and competence, equipping educators with strategies to create supportive and engaging classroom environments.

Parental involvement should be encouraged through workshops and seminars, highlighting the importance of social skills and how they can be supported at home. Schools should offer a variety of extracurricular activities that encourage teamwork, communication, and leadership skills. Establishing support systems such as counseling services and peer mentoring programs can provide personalized guidance to students struggling with social interactions. Regular assessment and feedback on students' social competence and intelligence can help identify areas for improvement and guide students in their social development.

Policymakers should mandate the inclusion of social skills development in school curricula and provide the necessary resources and support. By implementing these educational implications, schools can create an environment that prioritizes both academic success and the development of social skills, preparing students to thrive in their social environments and contributing to their overall personal and societal growth.

This study highlights the importance of fostering social intelligence in adolescents to improve their social competence. Educators, counselors, and parents can use these insights to support adolescents in their social development.

**Suggestions for Future Research**

Future studies could explore the relationship between social competence and social intelligence in a larger sample size and include additional variables. Comparative studies involving different age groups and educational levels could also provide deeper insights.
Any research work cannot say the final words of a problem because it is very difficult for researchers to touch all the aspects of a problem.

The following suggestions can be considered for further research investigation.

1. The study may be conducted to study the relationship of social competence and social intelligence in the large number of secondary school students.
2. The study may be conducted by taking other variables with social competence and social intelligence of secondary school students.
3. Similar study may be conducted on the college going students.
4. A comparative study may be conducted to see the relationship between social competence and social intelligence of secondary school students.

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# SMART E-COMMERCE LOGISTIC CONSTRUCTION MODEL BASED ON BIG-DATA ANALYTICS

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**ABSTRACT**
*This Paper proposes an revolutionary and affordable deliver chain construction model for e-commerce that enhances the energy of large data analytics to optimize and amplify the efficiency of the logistics continuum.The number one goal entails very well exploring how large information analytics can successfully amass, scrutinize, and extract important insights from the huge form of logistics-related records in the e-trade landscape. This encompasses various resources which include order data, inventory statistics, transportation logs, and visitors styles.in the end, the studies targets to create an wise logistics creation version, harnessing large statistics analytics skills. This consists of the mixing of data mining, system gaining knowledge of, predictive analytics, and optimization algorithms.*
**KEYWORDS;** *R-Revolutionary, A-Analytical, S-Succesfully, E-Encompasses,A-Alogorithms*

## INTRODUCTION

With the continuous improvement of the marketplace economic system, society's demand for logistics has deepened, and the improvement of the logistics industry has made a first rate contribution to the boom of the country wide economic system . At the side of the rapid development of internet generation and E-trade, the development of cutting-edge logistics has generated a new state of affairs. at the identical time, but, the explicit industry has also added many demanding situations, including a high rate of empty warehouses and low warehouse running performance and carrier first-rate . The primary reason at the back of that is the lack of a sophisticated warehouse management model, the low stage of records era, and the pretty immature era of warehouse control records structures. At present, shrewd garage generation is growing hastily . That is specifically pondered inside the non-stop intelligence and networking of garage centers, automation and standardization of system operation, interconnection of garage systems with different structures, and using big records to reap the combination and usage of storage sources. among them, the application of warehousing records generation is growing most hastily . Warehouse statistics era is especially through intelligent generation that makes the use of storage sources and warehouse operation method transparent and virtual. With the industrial upgrading of the specific industry, intelligent warehousing is the future route of improvement. Warehouses are divided into forms of warehouses according to their function. Sorting warehouses are warehouses wherein parcels of different sizes and locations are looked after, and they may be transfer stations wherein items are sorted and disbursed. for this reason, we need to apply conversation or clever generation to monitor and digitally manipulate the operation of the sorting warehouse, in particular through setting up a tracking and counting system for distinct types of parcels and then integrating the statistical facts and monitoring records into the management terminal device of the sorting warehouse. The layout of an shrewd and efficient parcel detection and counting system is of first rate importance for the shrewd control of the sorting warehouse.

The Sorting warehouse has some of conveyor lanes, which are driven by using vehicles jogging on conveyor belts. The conveyor aisles are divided into main and subtrunk aisles, wherein parcels meet or are diverted at the intersection of the conveyor aisles. The conveyor channels of the sorting warehouse are abstracted right into a transmission network, and the drift of parcels within the transmission network now wishes to be monitored to facilitate the management of the sorting warehouse. At gift, the device solutions for monitoring the float of parcels inside the transmission community are based totally on Radio Frequency identification (RFID) generation and laser scanning-based totally detection records device answers .

RFID technology is a noncontact and non-line-of-sight seize technology. It's far based on the precept of the usage of radio waves for rapid records trade and storage. The General RFID device consists of 3 parts : The Reader, the electronic tag, and the data control. however at this degree of RFID technology parcel tracking detection system scheme, there are many problems; first of all, glide thru the

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transmission network monitoring point of the parcel extent size alternate is enormously large, the digital tag connected to the outer floor of the parcel makes the digital tag cannot continually be very near the reader, will produce ignored detection of the parcel. And the digital label production price is incredibly high, and it is the regular barcode label dozens of times. consequently, the implementation potential of this application isn't high.

The Implementation of a parcel monitoring and tracking machine primarily based on on-line laser scanning requires system to generate a special laser and acquire a laser response above the transmission channel on the tracking point . A Barcode label with a reflective laser is hooked up to the outer floor of the parcel, the parcel flows through the laser's irradiated vicinity reflecting the laser, and the laser receiving reaction device accepts the records to upload the facts to the warehouse control system. The Gadget is easy and smooth to enforce however calls for human involvement to make sure the accuracy of the monitoring machine, as the answer is predicated on laser verbal exchange; as soon as the laser verbal exchange is interrupted, there might be issues, which include the barcode that reflects the laser being obscured or the parcel being flipped in transit with the label aspect on the back side of the laser receiving device; there might be many parcels that leave out information. therefore, the implementation of the scheme could have critical shortcomings, requiring guide involvement in adjusting the state of the parcels at the transmission channel, annoying high conditions on-web page, and not being very intelligent.

To This end, we use laptop vision technology and clever technology .To enforce a monitoring, detection, and counting device for exclusive kinds of parcels. Deep mastering-based goal detection and machine imaginative and prescient-primarily based multitarget monitoring are used inside the design of the parcel tracking and counting machine to improve the statistical accuracy of the parcel monitoring and counting machine . The Gadget is practical and clean to use and has essential manufacturing applications as it is able to shop real-time web page tracking records for a period of time. The Remaining paper is arranged in the following manner.

## TARGET DETECTION

The Function of goal detection is to the extraction of goals of interest from video surveillance or non-stop pix, and it's miles the idea for next tracking and recognition of goals of interest . Goal detection is the segmentation of uninteresting backgrounds in addition to foreground goals of interest, and it is able to be divided into background-based totally modelling and foreground-based modelling strategies , Depending on the item to be processed. The historical past modelling method is based totally on processing the history, developing a time-established background model, and not directly segmenting the foreground by way of evaluating the background models of pictures in special time sequences to acquire the foreground region for monitoring objectives . The Foreground-based modelling approach directly fashions the region of the picture where the goal is placed, extracts features which include greyscale and texture, and designs a suitable classifier to classify and discover it .

The Method based totally on historical past modelling is to first establish the general model and the history model of successive frames, then evaluate the overall model of the modern frame with the historical past model of the cutting-edge body, and determine whether each pixel in the current frame belongs to the motion foreground through the brink approach. The Foreground location is then divided, and the tracking target is obtained by way of operations including growth or erosion of the graph and locating the rims of the place. The History modelling method commonly includes the initialization of the background model, the maintenance of the model, and the detection and segmentation of the foreground, and the general procedure is proven in parent shows the number of video frames used for background model initialization, and history initialization refers to the initialization of the picture background to build the version.

## GOAL MONITORING

With the improvement of motion target monitoring algorithms, those tracking techniques can be divided into three principal classes: traditional classical monitoring techniques, correlation filtering techniques, and deep studying techniques. The traditional classical tracking strategies are divided into generative and discriminative strategies, with the generative methods being represented by way of filtering, Camshift monitoring, and optical go with the flow monitoring; all of them are slow. The Discriminative magnificence of methods is represented through tracking mastering and detection (TLD). The distinction between discriminative and generative methods is the inclusion of a classifier, that's educated the use of device studying to distinguish between foreground and heritage.

The Applicable filtering class techniques are represented with the aid of minimal Output Sum of Squared blunders filter out (MOSSE) Discriminative Scale area Tracker (DSST) , and so on. The Middle concept of the correlation filter out class is to train a clear out template that plays a correlation operation with the eigenvalues of the image. most effective the response of the operation with the

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tracked region is maximized, and from the most role of the response, the important function of the tracked goal can be determined, and the anticipated function end result is then used to replace the parameters of the filter out for the subsequent prediction.

The Deep learning class is represented by way of detect and tune (D&T). This approach is a trendy approach used to solve the video preferred method to the goal detection hassle. Our purpose is to use convolutional neural networks for each detection and tracking by way of simultaneously without delay inferring tracklet over a couple of frames. This technique uses detection and tracking-based totally loss to educate an give up-to-quit absolutely convolutional structure, which is also called a joint detection and tracking method. The Enter to the network includes successive frames of snap shots that are first surpassed through a convolutional community spine to generate convolutional functions which might be shared in the detection and tracking responsibilities. neighborhood displacements at special feature scales are estimated by way of calculating the convolutional correlation values among the feature responses of adjacent frames of the pics. similarly to these functions, this method uses an ROI pooling layer to classify and regress preselected square packing containers (box) and an ROI monitoring layer to regress container ameliorations (translations, scales, and component ratios) across frames. The latter part of the algorithm's structure consists of a completely convolved ROI pooling layer and an ROI monitoring layer and may be skilled quit-to-give up for object detection and tracking. subsequently, that allows you to infer the trajectory of the item in the video, this technique connects the detection primarily based on monitoring small segments.

**Overall Layout of the Machine**

The Design of a detection and monitoring gadget for logistics is based on a multitarget tracking and monitoring procedure with non-stop frame images. the primary layout of the device can be divided into the design of goal detection and the layout of goal monitoring or goal detection mixed with goal tracking. the acquisition of continuous frame photographs calls for the secondary improvement of the economic digicam. The target detection module needs to be designed with a appropriate deep getting to know model, balancing detection velocity with detection accuracy. within the design of target tracking, now not only can monitoring algorithms be taken into consideration, however also hardware detection strategies can be taken into consideration to gain the motion country of the moving goal. the overall platform design of the gadget have to remember records alternate between modules, statistics garage and information question, real-time detection show, and so forth.

**Encoder Module**

This Module is in particular liable for the communique and information processing among the machine and the encoder. It obtains the pulse facts from the encoder by writing a question application, converts it into displacement statistics, and accordingly obtains the motion repute of the parcel at the transmission channel.

**Interface Operation and Display Module**

This Module particularly presentations the real-time detection photo outcomes and the running time of the goal detection module and also allows you to query the history records of parcel detection and so on with the aid of querying the interface layout.

**Machine Settings Archive Module**

This Module is where the system runs after setting reasonable parameters and shops those affordable parameters so that it will avoid putting reasonable parameters again after the device has been restarted. To keep away from placing reasonable parameters once more after system restart, the archived information is loaded directly.

**Parcel Data Garage Module**

This Module is especially to shop the quantity of parcels recorded at some point of the operation of the gadget, the report is particularly the number of parcels at a positive moment, convenient for the subsequent historical facts question, but it is also to keep away from the loss of information introduced about with the aid of the system strength failure.

**Recognition and Detection Module for Parcels**

The Photograph is analyzed and detected through deep studying target detection counting to attain the position records of the goal within the picture, and then the statistics is transmitted to the tracking module.

**Parcel Movement Tracking Module**

This Module objectives to research the motion facts of the transferring goal and understand the monitoring process of the goal.

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**Strategies**

This Segment is intended to explain the exclusive varieties of techniques. the first method is primarily based on deep learning, which is used to detect the goal. Secondly, the techniques of motion goal tracking are provided. lastly, in the context of large facts, the layout of a logistic inspection machine turned into proposed.

## E-COMMERCE SMART LOGISTICS STATISTICS EVALUATION APPROACH

### E-Trade and Shrewd Logistics

Modern Logistics is a mixture of mechanization, intelligence, and informatization . To this give up, present day logistics makes full use of internet of things generation, cloud computing, radio frequency identity technology, all types of sensors, all varieties of shrewd terminals, wise logistics management structures, and all styles of superior coping with and packaging technologies to constantly improve the first-class of logistics services and reduce logistics charges, so that logistics enterprises can attain more advantages in all stages of logistics.

As Proven in discern 1, each stage of the logistics process needs to attain logistics-associated information in real time. for example, the secondary statistics generated within the information processing technique, the information in the transaction manner, the environmental information, the warehousing data, the stock records, and so forth.; these facts are massive and complicated. The cutting-edge sensing generation led by means of RFID generation has turn out to be the principle way to achieve logistics records. The operating precept of radio frequency identity (RFID) is based on the electromagnetic concept. whilst the radio frequency tag with shipment statistics enters the applicable magnetic discipline region of the reader, the tag receives the signal from the reader, thereby generating an induced current, so that the reader obtains the cargo facts at the tag in a noncontact way. as compared with bar codes and magnetic cards, radio frequency tags have the blessings of huge facts storage, robust anti-interference capability, accurate confidentiality, wi-fi verbal exchange, and comparatively low price. therefore, radio frequency identification technology has end up one of the important technologies within the discipline of IoT perception and is broadly used in warehousing era and packaging generation in logistics generation

### Type and Evaluation of Logistics Data

Because of the speedy increase of logistics statistics, the conventional logistics software and hardware system is lagging in the back of, resulting in a gradual processing speed of logistics information class. The logistics industry and gadget gaining knowledge of may be correctly mixed, and the processing pace of logistics information may be effectively improved via system studying-related algorithms. The support vector system class set of rules in machine studying takes into account the loss feature, which is used to measure the inconsistency among the expected value and the proper value. The smaller the loss function fee, the higher the robustness of the version. we are hoping to discover a feature which can limit the loss feature, however do now not realize the deeds distribution of the records, so whilst modeling statistics classification, we use empirical chance to measure the effect of the training set, this is, the potential to expect unknown examples.

The Processing performance of conventional facts class algorithms is low, and the prevailing records class algorithms are still lacking in the processing of huge logistics records. some algorithms can't fulfill incremental gaining knowledge of and cannot adapt to the type of actual-time facts. some algorithms are extraordinarily complex. despite the fact that they improve the classification impact, they may be susceptible to lag in facts processing. In reaction to those pressing problems, many pupils have advanced the classification algorithm in multiple guidelines and proposed many advanced algorithms, among which the improvement of the SVM set of rules is incredibly popular .

### SVM Type set of Rules Primarily Based on Stochastic Gradient Descent

Mass facts classification is an important research branch inside the subject of statistics mining these days. Faced with the class of large actual-time data, many complex factors need to be taken into consideration, together with a way to lessen the complexity of classification model, how to avoid or lessen records redundancy, and how to improve records processing speed. For this reason, a huge variety of progressed algorithms for data category problems have emerged at domestic and abroad. Below we in short summarize the stepped forward algorithms for SVM. broadly speaking, a aid vector device can be concept of as a linear classifier. The Primary idea is to locate an choicest category floor from numerous multidimensional statistics.

### Forgetting Component

Forgetting Factor can eliminate facts saturation. when classifying facts, we should pay attention to current actual-time information and decrease the affect of historic data on type effects. The records classification set of rules with forgetting element mechanism has speedy convergence velocity and strong tracking potential whilst education the classifier and has little fluctuation for random input.

The Forgetting issue, this is, the weighting aspect in the errors measurement function, is brought into the recursive least squares (RLS) algorithm, in order that the load of the recent input data is larger, whilst the load of the historic input data is smaller.

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# ESTIMATION OF TENOFOVIR BY UV VISIBLE SPECTROSCOPY

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**Article DOI: https://doi.org/10.36713/epra17639**
**DOI No: 10.36713/epra17639**

**ABSTRACT**
*In view of the need for a suitable Spectroscopic method for routine analysis of Tenofovir(antiretroviral medicine) in formulations, attempts were made to develop simple, precise and accurate analytical method for estimation of Tenofovir in formulation. As Validation is a necessary and important step in both framing and documenting the capabilities of the developed method it was done in accordance with USP and ICH guideline for the assay of active ingredient. The method was validated for parameters like linearity, precision, accuracy, specificity, and robustness, limit of detection and limit of quantification. This method provides means to quantify the component. This proposed method was suitable for the analysis of Pharmaceutical dosage forms.The utility of the developed method to determine the content of drug in commercial formulation was also demonstrated.*

**KEY WORDS:** *Tinofovir,Validation,UV Visible spectroscopy.*

**DRUG PROFILE**
**TenofovirDisoproxil Fumarate**
**Drug category** : Antiretroviral
**Structure**

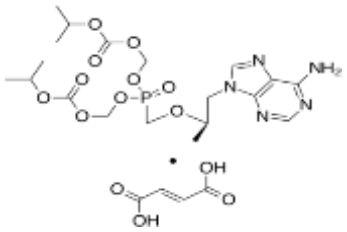

**Fig :1 Structure of Tenofovir**

**IUPACName :** ({[(2R)-1-(6-amino-9H-purin-9 yl)propan2yl]oxy}methyl) phosphonic acid.

**Molecular Formula**: $C_{19}H_{30}N_5O_{10}P \bullet C_4H_4O_4$

**Molecular Weight** : 635.52gm/mole.

**PHYSICOCHEMICAL PROPERTIES**: It is white to off-white crystalline powder
Freely soluble in distilled water at 25°C**.** Having a M.P of 276-280°C Recommended Dose in Adults and Pediatric Patients 12 Years of Age and Older (35 kg or more) For the treatment of HIV-1 or chronic hepatitis B: The dose is one 300 mg VIREAD tablet once daily taken orally, without regard to food. For patients unable to swallow VIREAD tablets, the oral powder formulation (7.5 scoops) may be used. In the treatment of chronic hepatitis B, the optimal duration of treatment is unknown. Safety and efficacy in pediatric patients with chronic hepatitis B weighing less than 35 kg have not been established.

**Mechanism of action:** Tenofovir diphosphate inhibits HIV-1 reverse transcriptase and the Hepatitis B polymerase by direct binding competition with the natural deoxyribonucleotide substrate (deoxyadenosine 5'-triphosphate) and, after integration into DNA, causes viral DNA chain termination [24], [Label].

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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**Materials and Methods**

| S.No | Instruments And Glasswares | Model |
|---|---|---|
| 1 | UV-Visible spectroscopy | Labindia |
| 2 | Weighing machine | Sartorius |
| 3 | Volumetric flasks | Borosil |
| 4 | Pipettes and Burettes | Borosil |
| 5 | Beakers | Borosil |

**Table 1 :List of Instruments and glassware's used**

**CHEMICALS USED**

| S.No | Chemical | Brand names |
|---|---|---|
| 1 | Tenofovir | Sura labs |
| 2 | Methanol LR Grade | Merck |
| 3 | Acetonitrile for Spectroscopy | Merck |

**Table 2 :List of Chemicals**

## METHOD DEVELOPMENT

### SOLUBILITY TEST

The solubility test for drug Tenofovir was performed by using various solvents. Solvents were methanol, chloroform, methanol (100% v/v) was chosen as solvent for developing this method.

### VALIDATION

**Preparation of mobile phase:**

Accurately measured 500 ml (50%) of Acetonitrile and 500 ml of Double distilled water (50%) were mixed in a 1000ml of volumetric flask.

**Diluent Preparation:**

The Mobile phase was used as the diluent.

### VALIDATION PARAMETERS

### SPECIFICITY STUDY OF DRUG

**Preparation of Standard Solution**

Accurately weigh and transfer 10 mg of Tenofovir working standard into a 10ml of clean dry volumetric flasks add about 7ml of diluent .Then sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution)

Further pipette 0.15 ml of the above Tenofovir stock solutions into a 10ml volumetric flask and dilute up to the mark with diluents. Measure the absorbance of standard solution five times and calculate the %RSD for the absorbance was found to be within the specified limits.

**Preparation of Sample Solution**

Take average weight of one Tablet and crush in a mortor by using pestle and weight 10 mg equivalent weight of Tenofovir sample into a 10mL clean dry volumetric flask and add about 7mL of Diluent sonicate to dissolve it completely and make volume up to the mark with the same solvent.

Further pipette 0.15 ml of Tenofovir above stock solution into a 10ml volumetric flask and dilute up to the mark with diluents.

**Procedure**

Measure the absorbance of sample solutions and calculate the assay by using formula:

$$Assay\,\% = \frac{sample\ area}{Standard\ area} \times \frac{dilution\ sample}{dilution\ of\ standard} \times \frac{P}{100} \times \frac{Avg.wt}{Lc} \times 100$$

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## PREPARATION OF DRUG SOLUTIONS FOR LINEARITY

Accurately weigh and transfer 10 mg of Tenofovir working standard into a 10ml of clean dry volumetric flasks add about 7ml of Diluent then sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution)

**Preparation of Level – I (5 ppm of Tenofovir)**

Take 0.05ml of stock solution in to 10ml of volumetric flask and make up the volume up to mark with diluent.

**Preparation of Level – II 10 ppm of Tenofovir)**

Take 0.1ml of stock solution in to 10ml of volumetric flask and make up the volume upto mark with diluent.

**Preparation of Level – III (15 ppm of Tenofovir)**

Take 0.15ml of stock solution in to 10ml of volumetric flask and make up the volume up to mark with diluent.

**Preparation of Level – IV (20 ppm of Tenofovir)**

Take 0.2ml of stock solution in to 10ml of volumetric flask and make up the volume up to mark with diluent.

**Preparation of Level – V (25 ppm of Tenofovir)**

Take 0.25ml of stock solution in to 10ml of volumetric flask and make up the volume up to mark with diluent.

**Procedure:** Check the each level into the spectroscopic system and measure the absorbance.

Plot a graph of absorbance versus concentration (on X-axis concentration and on Y-axis Peak area) and calculate the correlation coefficient.

## PRECISION AND REPEATABILITY

**Preparation of Tenofovir Product Solution for Precision**

Accurately weigh and transfer 10 mg of Tenofovir working standard into a 10ml of clean dry volumetric flasks add about 7ml of diluent then sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution)

Further pipette 0.15ml of the above Tenofovir stock solutions into a 10ml volumetric flask and dilute up to the mark with diluents. Measure the absorbance of standard solution five times and calculate the %RSD for the absorbance was found to be within the specified limits.

## INTERMEDIATE PRECISION

To evaluate the intermediate precision (also known as Ruggedness) of the method, Precision was performed on different days by maintaining same conditions.

**Procedure**

**DAY 1**

Measure the absorbance of standard solution six times and calculate the %RSD for the absorbance was found to be within the specified limits.

**DAY 2**

Measure the absorbance of standard solution six times and calculate the %RSD for the absorbance was found to be within the specified limits.

## Accuracy

**For preparation of 50% Standard stock solution**

Accurately weigh and transfer 10 mg of Tenofovir working standard into a 10ml of clean dry volumetric flasks add about 7mL of diluent. Then sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution)

Further pipette 0.075ml of the above Tenofovir stock solution into a 10ml volumetric flask and dilute up to the mark with diluents.

**For preparation of 100% Standard stock solution**

Accurately weigh and transfer 10 mg of Tenofovir working standard into a 10ml of clean dry volumetric flasks add about 7mL of diluent .Then sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution)

Further pipette 0.15ml of the above Tenofovir stock solution into a 10ml volumetric flask and dilute up to the mark with diluents.

**For preparation of 150% Standard stock solution**

Accurately weigh and transfer 10 mg of Tenofovir working standard into a 10ml of clean dry volumetric flasks add about 7mL of diluent .Then sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution)

Further pipette 0.225ml of the above Tenofovir stock solution into a 10ml volumetric flask and dilute up to the mark with diluents.

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**Procedure**
Check the three replicate absorbance of individual concentrations (50%, 100%, 150%) were made under the optimized conditions. Recorded the chromatograms and measured the absorbance. Calculate the Amount found and Amount added for Tenofovir and calculate the individual recovery and mean recovery values.

**ROBUSTNESS**
The analysis was performed in different conditions to find the variability of test results. The following conditions are checked for variation of results.

**For preparation of Standard solution**
Accurately weigh and transfer 10 mg of Tenofovir working standard into a 10ml of clean dry volumetric flasks add about 7mL of diluent.Then sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution)
Further pipette 0.15ml of the above Tenofovir stock solution into a 10ml volumetric flask and dilute up to the mark with diluents.

**Effect of Variation in wavelength**
The sample was analyzed at 249nm and 251nm instead of 250nm and measures the absorbance at different wavelength.

## RESULTS AND DISCUSSION

**METHOD DEVELOPMENT SOLUBILITY STUDIES**
The solubility test for drug Tenofovir was performed by using various solvents. Solvents were methanol, chloroform, methanol (100% v/v). Methanol (100% v/v) was shows maximum absorbance and solubility to compare with other solvents. So it was chosen as solvent for developing this method.

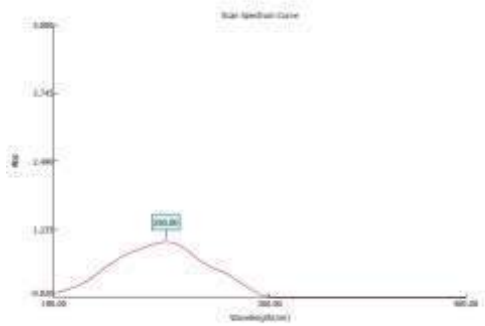

**Fig. 2: Selection of Wavelength**

**Observation:** Above spectrum shows maximum absorbance at 250nm wavelength by using methanol (100% v/v) as diluents

**VALIDATION**
**Blank**

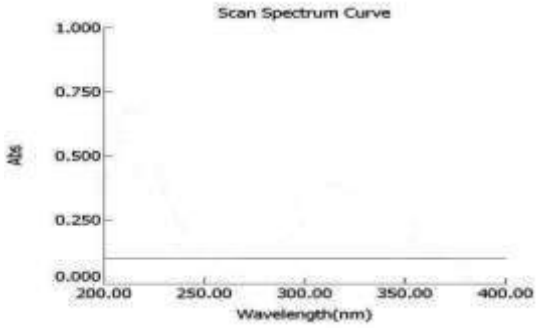


**Fig.10 : UV Scan Spectrum for Blank**

**SPECIFICITY**
The ICH documents define specificity as the ability to assess unequivocally the analyte in the presence of components that may be expected to be present, such as impurities, degradation products, and matrix components.

Analytical method was tested for specificity to measure accurately quantitate Tenofovir in drug product.

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**Assay (Standard):**

| S.no | Drug Name | Absorbance |
|---|---|---|
| 1 | Tenofovir | 0.474 |
| 2 | Tenofovir | 0.475 |
| 3 | Tenofovir | 0.475 |
| 4 | Tenofovir | 0.476 |
| 5 | Tenofovir | 0.475 |
| **Mean** | | 0.475 |
| **Std. Dev.** | | 0.000707 |
| **% RSD** | | 0.148865 |

**Table 3: Assay results for standard**

**Acceptance Criteria**

- %RSD of five different sample solutions should not more than 2
- The %RSD obtained is within the limit, hence the method is suitable.

**Assay (Sample)**

| S.no | Drug Name | Absorbance |
|---|---|---|
| 1 | Tenofovir | 0.474 |
| 2 | Tenofovir | 0.475 |
| 3 | Tenofovir | 0.475 |
| **Mean** | | 0.475 |

**Table 4 : Assay Results for sample**

%Assay = 0.475/0.475×10/15×15/0.0281×99.6/100×0.8452/300×100= 99.8%
The % purity of Tenofovir in pharmaceutical dosage form was found to be 99.8%

**LINEARITY**

| Concentration Level (%) | Concentration µg/ml | Absorbance |
|---|---|---|
| 33 | 5 | 0.168 |
| 66 | 10 | 0.343 |
| 100 | 15 | 0.48 |
| 133 | 20 | 0.642 |
| 166 | 25 | 0.807 |

**Table 5 : CHROMATOGRAPHIC DATA FOR LINEARITY STUDY**

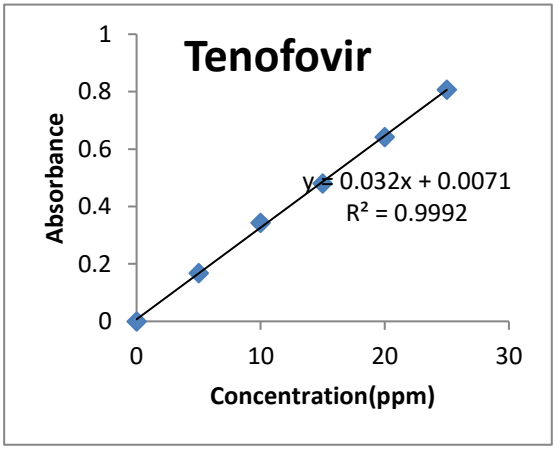


**Fig 11: Linearity graph of Tenofovir**

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**LINEARITY PLOT**

The plot of Concentration (x) versus the Average Peak Area (y) data of Tenofovir is a straight line.

Y = mx + c
Slope (m) = 0.032
Intercept (c) = 0.007
Correlation Coefficient (r) = 0.999

**VALIDATION CRITERIA:** The response linearity is verified if the Correlation Coefficient is 0.99 or greater.

**CONCLUSION:** Correlation Coefficient (r) is 0.99, and the intercept is C 0.007 these values meet the validation criteria.

**PRECISION**

The precision of an analytical procedure expresses the closeness of agreement (degree of scatter) between a series of measurements obtained from multiple sampling of the same homogeneous sample under the prescribed conditions.

**REPEATABILITY**

Obtained five (5) replicates of 100% accuracy solution as per experimental conditions. Recorded the absorbance and calculated % RSD.

| S.no | Drug Name | Absorbance |
|---|---|---|
| 1 | Tenofovir | 0.474 |
| 2 | Tenofovir | 0.475 |
| 3 | Tenofovir | 0.475 |
| 4 | Tenofovir | 0.474 |
| 5 | Tenofovir | 0.474 |
| **Mean** | | 0.4744 |
| **Std. Dev.** | | 0.000548 |
| **% RSD** | | 0.115456 |

**Table 6 : Repeatability results for Tenofovir**

**Acceptance Criteria**

- %RSD for sample should be NMT 2
- The %RSD for the standard solution is below 1, which is within the limits hence method is precise.

**Intermediate Precision**

| | Drug Name | Absorbance |
|---|---|---|
| 1 | Tenofovir | 0.493 |
| 2 | Tenofovir | 0.493 |
| 3 | Tenofovir | 0.494 |
| 4 | Tenofovir | 0.494 |
| 5 | Tenofovir | 0.493 |
| 6 | Tenofovir | 0.493 |
| **Mean** | | 0.493333 |
| **Std. Dev.** | | 0.000548 |
| **% RSD** | | 0.111025 |

**Table 7: Intermediate precision results by analyst 1**

**Acceptance criteria:**

- %RSD of six different sample solutions should not more than 2

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| S.no | Drug Name | Absorbance |
|---|---|---|
| 1 | Tenofovir | 0.454 |
| 2 | Tenofovir | 0.453 |
| 3 | Tenofovir | 0.454 |
| 4 | Tenofovir | 0.454 |
| 5 | Tenofovir | 0.454 |
| 6 | Tenofovir | 0.454 |
| **Mean** | | 0.453833 |
| **Std. Dev.** | | 0.000447 |
| **% RSD** | | 0.098541 |

**Table8 : Intermediate precision results by analyst 2**

**Acceptance criteria:**

- %RSD of five different sample solutions should not more than 2

**ACCURACY:**

Accuracy at different concentrations (50%, 100%, and 150%) was prepared and the % recovery was calculated.

**Accuracy50%**

| S.no | Drug Name | Absorbance |
|---|---|---|
| 1 | Tenofovir | 0.247 |
| 2 | Tenofovir | 0.247 |
| 3 | Tenofovir | 0.247 |
| **Mean** | | 0.247 |

**Table9 : Accuracy results for Tenofovir 50%**

**Accuracy100%**

| S.no | Drug Name | Absorbance |
|---|---|---|
| 1 | Tenofovir | 0.476 |
| 2 | Tenofovir | 0.489 |
| 3 | Tenofovir | 0.485 |
| **Mean** | | 0.483333 |

**Table10 : Accuracy results for Tenofovir 100%**

**Accuracy150%**

| S.no | Drug Name | Absorbance |
|---|---|---|
| 1 | Tenofovir | 0.725 |
| 2 | Tenofovir | 0.726 |
| 3 | Tenofovir | 0.726 |
| **Mean** | | 0.725667 |

**Table11 : Accuracy results for Tenofovir 150%**

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| %Concentration (at specification Level) | Absorbance | Amount Added (ppm) | Amount Found (ppm) | % Recovery | Mean Recovery |
|---|---|---|---|---|---|
| 50% | 0.247 | 7.5 | 7.5 | 100.2 | 100.6% |
| 100% | 0.483 | 15 | 15.1 | 100.1 | |
| 150% | 0.725 | 22.5 | 22.9 | 101.6 | |

**Table12 : The accuracy results for Tenofovir**

**Acceptance Criteria**

The percentage recovery was found to be within the limit (98-102%).
The results obtained for recovery at 50%, 100%, 150% are within the limits. Hence method is accurate.

**LIMIT OF DETECTION**

The detection limit of an individual analytical procedure is the lowest amount of analyte in a sample which can be detected but not necessarily quantitated as an exact value.

$$LOD = 3.3 \times \sigma / s$$

Where
σ = Standard deviation of the response
S = Slope of the calibration curve

**Result**

LOD =3.3×0.009541/0.031
= 1.0µg/ml

**Quantitation limit**

The quantitation limit of an individual analytical procedure is the lowest amount of analyte in a sample which can be quantitatively determined.

$$LOQ=10\times\sigma/S$$

Where
σ = Standard deviation of the response
S = Slope of the calibration curve

**Result:**

LOQ =10×0.009541/0.031
= 3.0µg/ml

**Robustness**

The robustness was performed for the wavelength variations from 249nm to 251nm and mobile phase ratio variation from more organic phase to less organic phase ratio for Tenofovir. The method is robust only in less wavelength condition and the method is robust even by change in the Mobile phase ±5%.

| S.No | Drug Name | Wavelength variation±1 | Absorbance |
|---|---|---|---|
| 1 | Tenofovir | 249(less) | 0.469 |
| 2 | Tenofovir | 250(actual) | 0.478 |
| 3 | Tenofovir | 251(more) | 0.470 |

**Table13 : Variation in wavelength**

## CONCLUSION

In the present investigation, a simple, sensitive, precise and accurate Spectroscopic method was developed for the quantitative estimation of Tenofovir in bulk drug and pharmaceutical dosage forms. This method was simple, since diluted samples are directly used without any preliminary chemical derivatisation or purification steps. Tenofovir was freely soluble in Methanol was chosen as

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the mobile phase. The solvent system used in this method was economical. The %RSD values were within 2 and the method was found to be precise.The results expressed in Tables for Spectroscopic method was promising. The RP-HPLC method is more sensitive, accurate and precise compared to the Spectrophotometric methods. This method can be used for the routine determination of Tenofovir in bulk drug and in Pharmaceutical dosage forms.

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Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# BLOCKCHAIN TECHNOLOGY CONCEPTION AMONG ACCOUNTING PROFESSIONALS

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**Article DOI: https://doi.org/10.36713/epra17965**
**DOI No: 10.36713/epra17965**

## ABSTRACT
*Blockchain is a computer network-based dispersed and decentralized ledger system that keeps track of transactions. It is sometimes used synonymously with cryptocurrencies like Bitcoin. This technology, which offers advantages like transparency, immutability, efficiency, and security, has enormous potential to change many facets of accounting. For the accounting sector, blockchain's capability to offer a single, consensus-based source of facts for financial data is essential. With blockchain, real-time accuracy and transparency are ensured as all authorized participants can access a synchronized version of the ledger. This research aims to study the understanding and perception of the accounting profession regarding blockchain technology. The data of 100 respondents was collected, and the researcher performed factor analysis and regression testing were performed. The finding revealed that accounting professionals have a reasonable understanding of blockchain technology and help to enable real-time information updating to lessen the time and resources needed for reconciliations and audits.*

**KEYWORD:** *Accounting Professionals, Adoption Capacity, Blockchain Technology, Perception change, Understanding.*

## INTRODUCTION
Blockchain, the most hyped technology in the recent decade since established in 2008, was founded by Satoshi Nakamoto (Bonyuet, 2020). The blockchain is a crucial technique for Bitcoin (Zheng et al., 2018). Banks and governments play the middleman in making financial transactions before Bitcoin (Hutt, 2018). A chain comprising blocks is a blockchain. Per block possesses data, a hash, and the prior block's hash. The identification of the block is specified by its hash, a unique combination of letters and numbers. Two hundred fifty-six bits are the standard size of many hashes. Hexadecimal numerals are typically used to represent hashes since they allow for saving some digits. The same 0 to 9 integers used in the decimal system are also used in the hexadecimal system, plus six more digits. The hash of the most recent block references the previous block that makes up the chains of blocks. Using a hashing algorithm, the hashing function produces unexpected results from input (Vujicic et al. 2018). The smart contract verifies that the transaction is valid as per the government's rules connected to the computers and nodes.

A shared ledger called blockchain makes it possible to store verified transaction data in an ineradicable manner. Because a ledger, at its core, constitutes an accurate record of corporate activity, The Economist dubbed blockchain the "trust machine" (Blossey et al., 2019).

The audited information of firms that the auditors' audit escalates people's trust. Auditors are subject to strict regulations, independent of the organizations they audit, professional codes of conduct, and auditing standards. In order to give a reasonable assurance on the absence of significant misstatement in an entity's financial statements and, depending on the engagement, the efficiency of a company's internal controls over financial reporting, they employ impartiality and professional skepticism.

Blockchain technology is seen to be the most core technological advancement that has the potential to alter company operations and business processes fundamentally. Thus, the conventional audit model can also undergo adjustments. According to some research, the decentralized nature of blockchain technology may completely replace the necessity for a publicly certified auditor to audit financial statements (Wang et al., 2020).

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
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## LITERATURE REVIEW

**Wang. K., et al. (2020)** examine the effects of blockchain features on current audit procedures and explore the potential of incorporating immutability, distributed ledgers, and real-time settlement into the auditing industry. A conceptual model for a blockchain-based auditing communication system based on a systematic analysis is proposed in this study. This model offers solutions for implementing blockchain technology in auditing, greatly enhancing auditing efficiency and effectiveness and encouraging the shift from the current auditing paradigm to real-time, ongoing, and smart auditing.

**Bell. L. et al. (2018)** said that several proofs of concept integrate blockchain technology into the healthcare sector, but adoption still faces significant challenges. The healthcare sector's innate aversion to changing its present practices, particularly about organizational, structural, technical, and human elements, will be one of the biggest obstacles.

**Cole. R., et al. (2019)** have focused on the perspective of operations and supply chain management (OSCM) for promoting research into examining blockchain technology, suggesting conceivable use cases, and outlining a research plan for the future. End-to-end supply chain translucency has been hailed as the newest answer, which is additional vital than ever, given worries about the provenance. Blockchain has been promoted as the latest way to achieve this aim. However, a paucity of research connects OSCM to blockchain technology. This report consequently compliments the work of Buyukozkan and Goçer (2018) on digital supply chains, which overlooked blockchain technology. It acts as a general call to action for OSCM scholars to conduct additional research into the prospects that blockchain may offer to OSCM.

**Chang. S. E. et al. 's (2020)** study intends to examine emerging trends, prospective uses and how blockchain technology is used in supply chain management. From a literature review perspective, this analysis contributes to the application of blockchain in supply chain management and suggests a roadmap for these applications. The researcher emphasized future endeavours addressing technological adoption or diffusion, block-supply chain integration, and their social consequences.

**Schmitz. J. et al. (2019)** research, which is pertinent and topical for academics and practitioners in accounting and auditing, examines blockchain technology and its critical effects on those fields. The researcher discovers that the topics most frequently mentioned in academic works and professional sources include intelligent contract applications, blockchain-enabled continuous audits, trust challenges, transparency, governance in the blockchain ecosystem, and the paradigm change in the responsibilities of accountants and auditors. These four themes give concrete recommendations for accountants and auditors on handling blockchain development. Additionally, this paper recommends further investigation into accounting and auditing in the age of blockchain technology.

**Moosavi. J. et al. (2021)** researchers use network analysis and bibliometric to undertake a systematic evaluation to determine how blockchain might benefit supply chain management. It was found that smart contracts and the Internet of Things (IoT) are the key arising technologies in the field. The findings of favourably referenced and co-cited studies show how blockchain might enhance supply chain management's information security, transparency, efficiency, and traceability. The study also showed that there is little empirical research in this area. Consequently, incorporating blockchain into the actual supply chain is a significant area for future research.

**Chang. A. et al. (2022)** provides a detailed examination of BCT's elements, applications, and commercial consequences. This Blockchain-centered study, in particular, discloses the current state and defines future research directions by assessing and analyzing 2265 recent articles that demonstrate the broad application of BCT. Traceability is illustrated to be the main factor direct Blockchain Technology's implementation in supply chain management (SCM), and it is a result of various BCT qualities. Furthermore, we found that while research on BCT has been steadily increasing in government, healthcare, and supply chain management, it has also decreased in cyber security and banking. Geographically, the top three countries with publications on Blockchain Technology are India, the US, and China. The last phrase emphasizes the potential for Blockchain Technology related research in environmental sciences and agricultural.

To identify possible areas for more scientific exploration and to present a framework for influence of blockchain on accounting practices, **Bellucci. M et al (2022)** analyzed the academic literature on using blockchain in accounting practice and research. Blockchain may impact accounting research and practice in a variety of ways. The paper goes over why practitioners are drawn to this technology, including value-chain management, the inalterability of transactions, triple-entry bookkeeping, the automation of monotonous tasks that don't needed conscious decision-making, and the representation of cryptocurrencies in financial statements. It also offers more study areas and cutting-edge accounting research on blockchain.

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The **Garanina. T. et al. (2022)** analyze the future of this emerging field of study, identify current trends, and assess and criticize the primary research subjects. Since blockchain is still a relatively new accounting issue, most publications are normative. The 4 most often conferred aspects of blockchain are the regulation of crypto assets, new problems for auditors, potential and challenges of applying BCT, and roles of accountants changes. There will still be a demand for these positions even if blockchain is expected to disrupt the accounting and auditing industries. Because of the complete amount of data that blockchain records, both professions may transition from lower-profile advisory roles where to verify transactions auditors are called upon ex-ante and even entire ecosystems to higher-profile advisory roles, and to match competitive intelligence with business strategy, accountants are there.

After identifying a typical accounting situation, **Centobellli. P. et al. (2022)** propose and investigate a conceptual framework on blockchain technology related to accounting system. Three scalability levels comprise the framework: 1) A distributed database with peer-to-peer storage is based upon a technological infrastructure. 2) An intermediate level where permissions and validation are used to ensure increasing levels of control. 3) A higher level where the system allows business and security applications to be integrated. This system's deployment depends on a private network of nodes for transaction validation.

**Pimentel. E. et al. (2020)** reviewed both fields of literature and identified places where the two fields have something in common, the essay tries to close the gap between practitioners and academics. Even though academics have started investigating how the accounting profession could alter in reaction to blockchain, current study mostly focuses on the auditing sector. Practitioners, for their part, have widened their focus to give financial reporting and taxes of crypto assets a high priority. Extending the conversation about blockchains and accounting beyond its present focus on audits and accounting information systems.

**Almutairi. K. et al. (2023)** focus on defining the requirements and obstacles for applying blockchain to the supply chains for renewable energy sources. It also rates the identified obstacles according to how likely they are to cause process disruptions. In a case study of Iran's renewable energy supply chain, the recommended structure is applied. The concepts of grey numbers and grey evaluation based on distance from average solution (EDAS-Gray) are integrated into the grey stepwise weight assessment ratio analysis (SWARA-Gray) and grey evaluation to rank the difficulties in this study. The findings are validated using a different set of hybrid approaches, such as the grey-weighted sum method (WSM-Gray), the grey complex proportional assessment (COPRAS-Gray), and the grey methodology for order of preference by similarity to ideal solution (TOPSIS-Gray). The rankings produced by each of these methods exhibit a strong connection. The most significant barrier to adopting blockchain in supply chains for sustainable energy is "high investment cost" among the identified issues.

## CONCEPTUAL FRAMEWORK AND OPERATIONAL DEFINITION

**Readiness level:** One of the initial things one should have concerning new technology is the readiness level, which means understanding or adopting a particular technology. The readiness level will help to know the willingness of auditors and accountants to adopt blockchain technology. The researcher focuses on preparedness to use the technology and tackle the challenges, including what is easy and how quickly auditors and accountants will accept blockchain technology.

**Adoption Capability:** Adoption capability scrutinizes familiarity with and required skills for using blockchain technology. The competence level, efficiency, and effectiveness of using technology among auditors and accountants have been examined.

**Perception Change:** According to the researcher, perception change is a particular way of looking at blockchain technology from the auditors' and accountants' points of view, whether using blockchain technology will provide them with job security. This will help to understand the feelings of auditors and accountants regarding the adoption of blockchain technology. The focus is on the mindset and perspective of auditors and accountants that, with the increased use of blockchain technology, has made their work easier and saves time to concentrate on other work or is just a threat to their job and will replace them.

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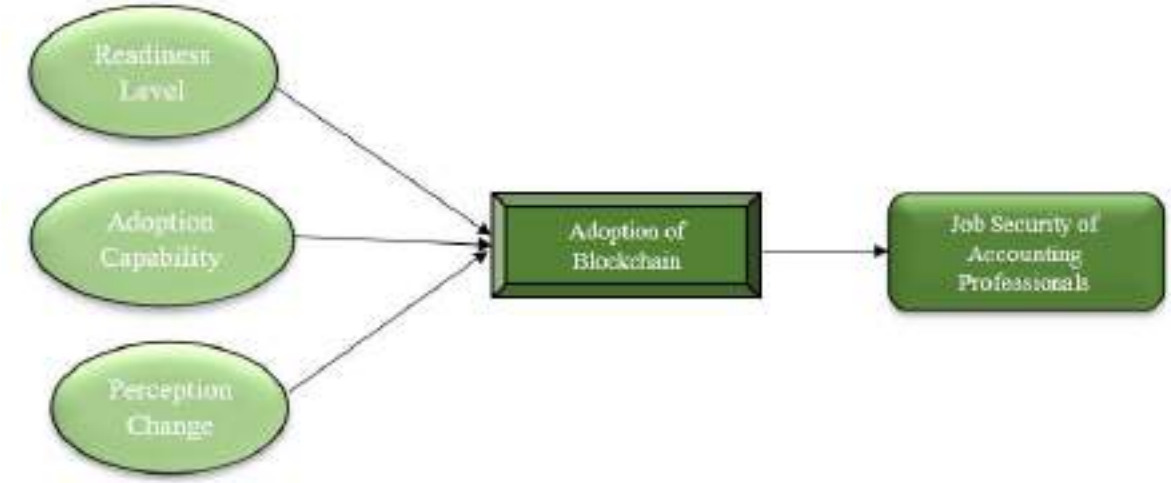
**Figure:1 Conceptual Framework**




**Source: Researcher Compilation**

## OBJECTIVE

1. To analyze the understanding level of blockchain among accounting professionals.
2. To analyze the impact of blockchain technology on job security of accounting professionals.

## HYPOTHESIS

**H01** There is no significant impact of the readiness level of accounting professionals on understanding blockchain technology.
**H02** There is no significant impact of the adoption capacity of accounting professionals on an understanding of blockchain technology.
**H03** Perception change has no significant impact on accounting professionals' understanding of Blockchain technology.
**H04** Blockchain Technology has no impact on the job security of accounting professionals.

## METHODOLOGY

The researcher has employed a survey to collect data on the adoption of blockchain technology. The questionnaire contained questions about readiness level, adoption capability, and accounting professionals' perception of blockchain technology. The sample consists of accounting professionals. The sample size was 100 accounting professionals. The researcher has used various tools and techniques to test the understanding of blockchain technology among accounting professionals. The use of blockchain technology by accounting professionals and its influence on the job security of accounting professionals have been studied using the factor analysis technique and regression analysis.

## RESULTS AND ANALYSIS

Table 1 shows that the male respondents are 54% and female respondents are 46%. Most of the respondents are from the 25-35 years age group, which is 58%, and the least are from 56 and above, i.e., 8%. Most of them have income between 25001-50000. The data shows that most of the respondents are accountants.

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**Table 1: Descriptive Demographic Statistics.**

| Particular | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 54 | 54.0% |
| Female | 46 | 46.0% |
| **Age** | | |
| 25-35 Years | 58 | 58.0% |
| 36-45 Years | 22 | 22.0% |
| 46-55 years | 12 | 12.0% |
| 56 and above Years | 8 | 8.0% |
| **Income** | | |
| Upto 10000 | 18 | 18.0% |
| 10000-25000 | 78 | 12.0% |
| 25001-50000 | 19 | 26.0% |
| 50001-100000 | 15 | 24.0% |
| Above 100000 | 12 | 20.0% |
| **Occupation** | | |
| Accountant | 48 | 48.0% |
| Auditor | 16 | 16.0% |
| CA | 12 | 12.8% |
| CS | 6 | 6.0% |
| CMA | 18 | 18.0% |

**Factor Analysis**

Factor analysis is mainly used in this study to limit the amount of data needed for analysis. Exploratory Factor Analysis is analyzed using the principal component approach in this data analysis. The essential premise of the parametric test, that the data are standard, was verified (Hair et al., 2015). Additionally, EFA is utilized for data analysis using Kaiser-Meyer-Olkin (KMO), and the appropriateness was examined using Bartlett's test of sphericity (Hair et al., 2010).

The acceptable limit of KMO is >0.6. The value of KMO is 0.662 in Table 2, which is slightly higher than the permissible limit, and for factor analysis, the sample is adequate. Bartlett's test of sphericity tests the hypothesis of whether the population correlation matrix is an identity matrix. Bartlett's test of sphericity shows a significant value of 0.001 in Table 2, showing that the factors extracted from the variables are correlated.

***Table 2: KMO and Bartlett's Test***

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | 0.662 |
| Barlett's Test of Sphericity | Chi-Square | 640.606 |
| | df | 153 |
| | Sig. | <.001 |

Source: SPSS

Seven important components with multiple eigenvalues were identified in the Total Variance Explained analysis. As shown in Table 3, these seven components account for 71.88% of the total variance, which is more than 60% (Hair et al., 2010) and suitable for the next steps.

***Table 3: Total Variance Explained***

| Initial Eigenvalues | | | |
|---|---|---|---|
| **Component** | **Total** | **% of Variance** | **Cumulative%** |
| 1 | 4.855 | 26.972 | 26.972 |
| 2 | 1.945 | 10.804 | 37.776 |
| 3 | 1.483 | 8.241 | 46.018 |
| 4 | 1.309 | 7.275 | 53.293 |
| 5 | 1.258 | 6.987 | 60.280 |
| 6 | 1.053 | 5.847 | 66.127 |
| 7 | 1.035 | 5.752 | 71.880 |

Source: SPSS

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The varimax approach was utilized for factor loading in the rotated component matrix. The factor loading for each statement is displayed in Table 4. All of the statements' loading values are more than 0.5, which is regarded as good. Component 1 explains the factor related to the variable perception of accounting professions towards blockchain. All the factors have a loading value of more than 0.5, which displays a good relation and is correlated. Likewise, Component 2 explains the factor related to the variable readiness level of accounting professions to adopt blockchain. All the factors have loading values of more than 0.5, which display a good relation and are correlated. Component 3 explains the factor related to the variable adoption capacity of accounting professions of blockchain. All the factors have a loading value of more than 0.5, which displays a good relation and is correlated to each other. Other components, i.e., 4, 5, 6, 7, are not relevant in this because they are dependent variables.

***Table 4: Rotated Component Matrix***

| Components | 1 | 2 | 3 |
|---|---|---|---|
| P7 (Enhance your career through improving abilities and competencies.) | .800 | | |
| P4 (Blockchain Technology is a revolution in the accounting practices) | .761 | | |
| P6 (Blockchain technology will play significant in long run.) | .698 | | |
| P2 (Easy to learn) | .662 | | |
| P1 (Using blockchain increases performance efficiency and decreases working hours.) | .651 | | |
| P5 (Blockchain Technology is convenient in accounting professionals.) | .579 | | |
| R2 (Understand the use of Blockchain technology.) | | .860 | |
| R1(Knowledge about Blockchain technology.) | | .835 | |
| R3 (Willingness to adopt blockchain chain technology.) | | .590 | |
| R4 (Need time to adopt blockchain technology.) | | .794 | |
| A1 (By upgrading your own skill to use blockchain technology.) | | | .652 |
| A2 (By enhancing IT skill.) | | | .620 |

**Regression Analysis**

The hypothesis tests if the adoption of blockchain technology significantly impacts the job security of accounting professionals. The dependent variable job security of accounting professionals was regressed on the adoption of blockchain technology to test hypothesis H04. The job security of accounting professionals do not significantly predict the adoption of blockchain technology, $F(1,98) = 1.660$, $p<0.001$, which indicates that the adoption of blockchain technology cannot play a significant role in shaping the job security of accounting professionals ($b=.106$, $p<.001$). These results indicate that there is no positive adoption of blockchain technology. Moreover, the $R2=.276$ depicts that the model explains 27.6% of the variance in the job security of accounting professionals. Table 5 shows the summary of findings. The null hypothesis, i.e., H04, is accepted here, which means there is no threat to the job of accounting professionals by adopting blockchain technology.

***Table 5: Regression***

| Hypothesis | Regression Weights | Beta Coefficient | $R^2$ | F | p-value | Hypotheses Supported |
|---|---|---|---|---|---|---|
| $H_{04}$ | Adoption of blockchain technology ⟶ Job security of accounting professionals | .106 | .276 | 1.660 | .201 | Supports null hypotheses |

Note: $p<0.05$

Source: SPSS

## FINDING AND DISCUSSION

As the study shows, accounting professionals' readiness level significantly affects the adoption of blockchain technology. H01 - There is no significant impact of readiness level of accounting professionals on adoption of blockchain technology. This hypothesis has been rejected, and alternate hypotheses have been accepted that show accounting professionals understand and know about

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blockchain technology and also say that they need time to adopt it. This also indicates that they are willing and ready to adopt blockchain technology. This is clear from table 4, where the variable readiness level factors correlate with each other.

H02 There is no significant impact of the adoption capacity of accounting professionals on the adoption of blockchain technology. This hypothesis has also been rejected, and an alternate hypothesis has been accepted that shows accounting professionals are ready to improve their skills by learning about the use of blockchain technology. The variable adoption capability shows a correlation with the adoption of blockchain technology. This is shown in Table 4, where all the factors of variable adoption capability are correlated.

H03 Perception change has no significant impact on accounting professionals' understanding of Blockchain technology. This hypothesis has also been rejected, and an alternate hypothesis has been accepted that shows their perception of blockchain technology. They think that blockchain will increase their performance efficiency and save time. They believe that learning blockchain technology is easy and that improving their abilities will enhance their career. Variable perception change has an influence on the adoption of blockchain technology, as can be seen in Table 4.

H04 Blockchain Technology has no impact on the job security of accounting professionals. This hypothesis has been accepted, and an alternate hypothesis has been rejected that shows the variable adoption of blockchain technology has no impact on the job security of accounting professionals. This is shown in Table 5, where the p-value> 0.05, which indicates that the null hypothesis is accepted. Accounting professionals' jobs are not affected by the adoption of blockchain in companies, industries, institutions, and organizations. Accounting professionals will be required to operate the technology. They just need to enhance their skill according to the requirements of the companies, industries, institutions, and organizations.

This shows that accounting professionals are ready to adopt the blockchain. The adoption capability of accounting professionals also indicates that they want to upgrade their skills to keep track of changing scenarios. The digitalization era changed the way of working from manual to computerization, and advanced tools for accounting are now being used. This study also shows that accounting professionals have changed their perception regarding the use of advanced technology. They have started adopting advanced technology, i.e., blockchain technology, in their field. They have begun understanding blockchain technology and upgrading their skill accordingly, which is helpful for them.

With the advancement in technology, the job of accounting professionals has become easy, and they are upgrading their skills to adapt to the changing scenario. The model explains that the job of accounting professionals is secure. There is no threat to their job with the adoption of blockchain technology. Moreover, technology makes jobs more accessible and saves them time, which they can utilize in other vital jobs.

## CONCLUSION

Since its beginnings in 2008, blockchain technology has become one of the most heralded technologies. Companies are anticipated to invest close to $3 billion in blockchain-related technology in 2019, according to International Data Corporation (IDC), a market intelligence company (International Data Corporation, 2019). According to Atzori (2015), the blockchain can reconstruct politics and society. Blockchain is the underlying technology first used as a public ledger to record all cryptocurrency transactions (Vijai. C. et al., 2019). The NASSCOM Blockchain Report 2019 states that blockchain technology adoption in India is expanding quickly and that over $20 billion has been invested in blockchain-based initiatives across various sectors (Singla, 2019). Blockchain is a definitive source of truth and an indispensable ledger. The conventional method of accounting involves keeping financial records in private ledgers and using accountants to compare them to equivalents held by third parties. The easiest way to describe blockchain is as distributed ledger technology (DLT), another name for it (Vijai, C., 2019). Its high security, cheap cost, and high accessibility are revolutionizing the way that private transactions are recorded. It has a significant potential for spread and adaption (ALSaqa, 2019; Rindasu, 2019). Researcher Ian Grigg created what is thought to be the first blockchain application in accounting in 2005 (Griggs, 2014).

Blockchain has a significant influence on accounting professionals' jobs. The Blockchain has a significant influence on accounting professionals' jobs. The study analyzes the model where the adoption of blockchain was measured with variables. The first variable is the readiness level. The researcher examines whether accounting professionals are ready to adopt blockchain technology, and the study reveals that they are keen to embrace it. This is shown in Table 4, where factors of readiness level show values of 0.860, 0.835, 0.590, & 0.794 in Column 2, indicating a strong relationship between the factors. The second variable is adoption capability. The researcher examines whether accounting professionals are familiar with blockchain technology and have the required skills to operate it. The study indicates that they had upgraded their skill in using technology. This is shown in Table 4, where factors of adoption capability show values 0.652, & 0.620 in Column 3 of the rotated component matrix, indicating that factors are correlated. Perception change is the third variable taken by the researcher to understand the opinion of accounting professionals regarding the

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threat or opportunity they earned. This is shown in Table 4, where factors of perception change show the value 0.800, 0.761, 0.698, 0.662, 0.651, and 0.579 in Column 1, indicating a strong relationship between factors.

In conclusion, the conventional landscape of financial record-keeping and auditing is changing dramatically with the use of blockchain technology by accounting professionals. Blockchain's decentralized and transparent structure improves financial data security and integrity while streamlining operations and lowering the possibility of mistakes and fraudulent activity.

Accounting experts are starting to see how blockchain may completely transform their industry by providing an unchangeable, tamper-proof ledger that guarantees the integrity and accuracy of financial data. Reducing the time and resources needed for reconciliations and audits is made possible by removing intermediaries and the real-time updating of information. The blockchain technology's intelligent contract feature also automates many financial transactional activities, improving accounting procedures even more. Establishing confidence among stakeholders and facilitating regulatory compliance are two benefits of being able to track and validate each transaction transparently and safely.

Cooperation within the sector becomes essential as accounting experts investigate and implement blockchain technologies. Promoting interoperability and facilitating smooth communication between various entities would be made more accessible by establishing common standards and protocols for blockchain deployment. This cooperative strategy will encourage the broader use of blockchain technology in the accounting industry while bolstering its legitimacy.

Professionals in accounting are essentially thinking about blockchain as a paradigm change toward a financial environment that is safer, more transparent, and more efficient. Adopting this technology might ultimately aid auditors, organizations, and other stakeholders in pursuing fast, accurate, and trustworthy financial information by revolutionizing how economic data is maintained.

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# A CRUCIAL ASPECT OF MEDITATION AND YOGA

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**ABSTRACT**
*The subjects of this piece of writing were yoga and meditation. Introductions, Yoga's Benefits, and Meditation are covered. The article also discussed meditation practices in Japan, the US, and India. Over 5000 years ago, the practices of meditation and yogic meditation were first documented. It is believed that yoga and meditation practices originated in northern India since these ancient books, known as the Rig Veda, reference them. It's believed that over 500 million people worldwide routinely practice yoga and meditation physically. Integrating deliberate breathing with the physical components of yoga and meditation is possible. It can be a highly effective strategy to do this while keeping your eyes closed to focus attention. Furthermore, the healing properties of yoga and yoga meditation can help to strengthen the immune system while lessening the severity of some physical conditions like anxiety, insomnia, and hypertension.*
**KEYWORDS:** *Yoga, Meditation, India, Components of Yoga, Benefits of Yoga.*

## I. INTRODUCTION

Another aspect of yoga is meditation, or "dhyana." Like yoga, dhyana involves mental activities that raise your consciousness to a higher level and help you establish a deep connection with the cosmos. This link occurs when you are calm and contemplative in the savasana (Mohammad, 2019). Depending on the practice, you usually perform a yoga meditation after a yoga sequence. This is the main distinction between other forms of meditation and yoga meditation. This is the last pose in yoga when you work your body and then release tension to assist in calming and centering your thoughts.

Once limited to spiritual traditions, meditation has become part of mainstream wellness as a science supported by physical and mental health research. Although its roots date back thousands of years, its significant influence on the human body and brain is only now becoming known in science. Researchers worldwide have been interested in this ancient practice, which has sparked investigations into its impact on physiology, the brain, and general wellness. Yoga is a physical practice that enhances both physical and mental wellbeing via poses, breathing, and meditation. Meditation is a practice that can be done with or without movement. It uses psychological and physical skills to help focus and calm the mind.

Yoga is an age-old discipline that can enhance wellbeing, strength, stamina, peace of mind, and flexibility. Nowadays, yoga is widely practiced worldwide, with most Westerners using it as a form of stress relief or exercise. Yoga meditation helps you feel calm, at ease, and connected to the world through physical exercise, breath control, and postures. Among the advantages of yoga meditation are Enhanced mindfulness and mood: Yoga meditation can elevate your emotional state. Decreased stress: By encouraging both mental and physical relaxation, yoga meditation helps lower stress. By practicing meditation, people might feel more relaxed, less stressed and anxious, and experience mental clarity, emotional stability, and calmness. Numerous meditation techniques include breathing exercises, mantras, and object meditation.

## II. BENEFITS OF YOGA MEDITATION

If something does not genuinely help you in some manner, it does not last for thousands of years as popular culture. Numerous people start the practice for physical, emotional, and spiritual reasons. This is a short list of some of the numerous advantages of yoga.

❖ **Yoga can lower stress and improve your mood.**

Stress may have a profoundly negative impact on your mind and body. Even though it is frequently ignored, if it worsens, it can lead to significant health issues. You can control and even reduce your stress with the help of yoga. Relentlessly working too much can cause headaches, trouble sleeping, and pain in your neck and back. Regular yoga practice allows you to relax and achieve a state of clarity that helps you concentrate better by drawing your attention to the task at hand. Stretching in the morning can help you gain clarity before you start your day, but many people save it for an after-work class. Your body's serotonin levels can rise with frequent yoga practice using a variety of poses and motions. With a general sense of clarity and less stress in your daily life, this alone can significantly lift your spirits.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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❖ **Yoga has several physical benefits**

As yoga is known to help with relaxation, it can also help with headaches and chronic joint pain. Furthermore, studies have demonstrated that yoga helps strengthen your immune system, raise your heart rate, and lower blood pressure. Pro athletes have said that yoga has helped them have longer careers. Professional football players, for instance, have continued to play well into their forties because they incorporate it into their daily regimen.

Yoga may improve your muscular tone, strength, and flexibility. It is also a terrific approach to start exercising if you are a novice. It keeps your metabolism in check, enhances cardiovascular and circulatory health, and may even help you lose weight. The number of advantages of yoga is nearly infinite. By adding this exercise into your daily life, you can become more physically fit, relax, focus, sleep better, and have better posture. Again, it is highly accessible to newcomers and total outsiders. You can take a yoga class at your neighborhood gym or recreation center or practice yoga in the privacy of your own home.

## III. CONCEPTS OF MEDITATION

Similar to yoga, meditation has grown a lot in popularity recently. Many have started practicing general wellbeing as more and more people are looking for a more holistic and healthy way of living. However, it is much more than just spending time in silence or prayer. Many people adopt this type of training as a way of life since it relieves our anxieties and discomforts and aids in our pursuit of a certain degree of serenity and happiness.

## IV. BENEFITS OF MEDITATION

For millennia, meditation has been incredibly popular. As more and more people become aware of the numerous advantages to one's physical, mental, and spiritual wellbeing, the practice is gaining popularity. You should be mindful that you are engaging in the most fundamental types of meditation. Have you ever advised someone to relax and take a deep breath and or asked to complete it on your own? It is a similar beneficial procedure. Similarly, meditation has immediate and long-term advantages, from improving health to fostering serenity. Is it not something that most of us take for granted, seeking to unwind and find a state of calm? However, the next time you feel overworked, think about these advantages.

❖ **Meditation Reduces Stress**

Many of us accept that stress is a part of life and deal with it daily. However, it has the potential to worsen and result in significant health issues. Stress can make it difficult for you to fall asleep, raise your blood pressure, and cause anxiety and even depression. However, there is evidence that meditation is beneficial. In addition to being the co-founder of Breethe, an app that serves as your mindfulness coach, Lynne Goldberg is a meditation coach. With great kindness, Lynne explained how meditation can assist in managing stress: "Meditation is the antidote to stress." Our bodies release adrenaline and cortisol when we are under stress. The "love" hormone, oxytocin, and other feel-good hormones are released during meditation. Both our heart rate and blood pressure return to normal as a result. You can get this mental and physical benefit from our Breathe app in as little as ten minutes daily. We will assist you in beginning your practice by providing guidance and meditation in our user-friendly, straightforward manner.

❖ **Meditation Helps Clear Your Mind.**

Frequently meditating people will tell you how much it has eased their mental clutter. It can erase any bad ideas that have bothered you over the day, making you feel like you have pressed the refresh button. In our conversation, Paul Harrison—a writer and meditation expert with over a decade of experience—emphasized this as the primary advantage. An extensive resource and online meditation course can be found on Paul's site, The Daily Meditation. Paul stated, "There are over 100 scientifically proven benefits of meditation." "The ability of meditation to heal the mind is its most significant feature. The reason is inherently capable of maintaining health. In The Daily Meditation, I talk about how the mind knows how to be healthy by nature. However, the 21st century's relentless barrage of stress and information overload impairs the mind's ability to function. The mind can once again operate in a healthy, productive manner after being cleared of all distractions and cleansed by meditation.

❖ **Meditation and Physical Benefits**

People can gain physical benefits from meditating and an increased sensation of serenity and tranquility. Those deeply committed to meditation will explain how regular practice increases prana (energy) in your body. Furthermore, it has been demonstrated to lower blood pressure and lactate levels in the body, which reduces the risk of anxiety attacks. It can also strengthen your immune system, increase fertility, and help your body eliminate tension-related ailments like headaches and muscle issues. We could discuss the advantages of yoga and meditation for a long time. However, it could appear like another passing health fad that will soon be eclipsed by the newest craze, yoga and meditation, which humans have practiced for thousands of years. Millions worldwide are wholly committed to that lifestyle and will attest to its advantages.

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## V. TRENDS IN MEDITATION

Though meditating daily is an excellent practice, May is a perfect month. May 21st is World Meditation Day, and May is National Meditation Month! The history of meditation itself can be used to determine the roots of World Meditation Day. Meditation has existed almost as long as humans have lived on this earth. The Vedas, a collection of old Hindu texts, contain the first documented accounts of meditation. However, references to meditation have been discovered by historians that reach back to 5,000 BCE—more than 6,000 years ago! Many people believe that meditation originated in Asia. Since its beginnings, however, meditation has become increasingly popular worldwide, with its tenets modified and integrated into regionally specific mindfulness practices. We decided to embark on a *virtual* appreciation tour of various forms of meditation practiced around the globe in observance of World Meditation Day.

### ❖ Meditation in India

Most people agree that India was one of the main sites where meditation originated. Nearly half of Indian adults (48%) meditate at least once a week, according to the Pew Research Center. Based on evidence, meditation and religion are related. Specifically, adults in India who pray daily are more likely to meditate than non-prayers. According to the same data set, the proportion of Indians who meditate varies significantly according to where they reside. For example, only over 19% of South Indians report routinely practicing meditation once a week, while 75% of Central Indians report doing so. (A startling 61% of people in the central region meditate daily!)

### ❖ Meditation in the United States

About 40% of adults in the US meditate at least once a week, according to a 2014 Pew Research Center study of over 35,000 Americans. However, this figure differs according to the source. For example, according to an analysis of the 2012 US National Health Interview Survey (NHIS), 11.8 million adults, or closer to 5% of the population, reported having meditated at some point in their lives.

### ❖ Meditation Practices in Japan

Japan is another country credited with helping establish meditation as we know it today, having used and incorporated mindfulness into its cultural traditions for many years. Take Shinrin-Yoku, for example, a practice that has gained popularity recently. This technique, which translates as "forest bathing," is taking strolls in forests while acknowledging the wonders and attributes of the natural world. These walks are described as reviving, revitalizing, peaceful, and even joyful experiences to assist individuals in connecting with the tranquillity and quiet of the forest.

## CONCLUSION

Yoga and meditation positively affect cognitive and behavioral functions, including better brain function, mental health advantages, decreased anxiety symptoms, and increased focus. Both yoga and meditation help you learn what it is like to be present by requiring an appropriate level of concentration and concentration.

It is this mindfulness of the present moment that helps to clear the mind and reduce anxiety and depressive symptoms. It aids in activating our relaxation and digestion (parasympathetic nervous system), which decreases heart rate and lowers stress levels. Although fostering balance and serenity are similar objectives of yoga and meditation, their methods and points of emphasis differ. Through frequent physical movement and postures, yoga encourages strength, flexibility, and balance. Breathwork and meditation are also included in the practice. However, meditation is a mental exercise. It entails developing an elevated awareness, calming the mind, and concentrating on the breath. It does not always require physical movement and can be done while sitting or lying down.

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# IMPORTANCE OF AMA IN AYURVEDA

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**ABSTRACT**

Ayurveda mainly focuses in maintaining health status by improving the immunity of body and control the diseases. It is a holistic approach through which the prevention and treatment of diseases is only possible. When physician knows the pathogenesis and the causative factor of the disease, it is easier to treat and control the disease prevalence. Among many causative factors Ama is one such pathological factor which causes many diseases. Acharyas of Ayurveda described Ama as biological body factor whose presence disrupts the balance of the three doshas resulting in many pathological and physiological disturbances in our body. It is considered as a toxin product, due to the improper functioning of Agni inside the body. So, Ama is a toxin responsible for formation of all diseases. Ayurvedic practitioners employ various methods, including dietary regulations, herbal remedies, and detoxification techniques, to remove Ama and restore health. Understanding Ama's role provides insight into preventive healthcare and holistic well-being, emphasizing the importance of digestion and metabolism in maintaining overall health.

**KEYWORDS:** Ayurveda, Agni, Ama

## INTRODUCTION

*Ayurveda* described different concepts related to disease pathogenesis and *Ama* is one of them described as toxic product which can trigger diseases pathogenesis. It is believed less-functioning of *Agni* leads to Agnimandya followed by production of *Ama* which can combine with our body's entities and induces various Patho-physiological condition. Ama begins its journey after accumulation in the gastrointestinal tract. Our diet like food intake and unhealthy foods, improper digestion vitiates *Tridoshas, Dhatus and Malas* by combining with them and causes diseases. It blocks nutrient and energy supply to channels leading to depletion and eventually the damage and destruction of healthy tissues. After Utpatti of *Ama*, it hampers in origin the originating factor. *Ama* is the unripe and un-metabolized toxin product of impaired digestion of our body. *Ama* also represents the transition from physiology to pathology. Therefore, it is the precursor of inflammatory, degenerative and infective processes that eventually manifest as full-fledged diseases similarly to those poisons, for this it is also called as *Amavisha.*

**Derivation of the term *Ama***

The word *Ama* is derived from the root ¨Am" *Roga Dhatu* +Dhang *Ptatyaya*. According to Hemachandra "*Am" Dhatu* + "*Nich" Pratyaya*." *A*" means towards and "*ma*" means poison.

**"आममन्नरसं केचित्, केचित्तु मलसञ्चयम्|**

Madhukosh Commentry on M.N 25/1-5

Ama forms: - Ajeerna Ahara or Ajeerna Ahara rasa -> Apakwa Ahara -> Agni Dusti -> Amavisha -> Mala Sanchaya -> Prathama Dushya Dushti -> Avipakwa Dravya -> Amaya

**Defination Of *Ama***

**ऊष्मणोऽल्पबलत्वेन धातुमाद्यमपाचितम्|**
**दुष्टमामाशयगतं रसमामं प्रचक्षते|| (A.H.SU-13/25)**
**अन्ये दोषेभ्य एवाति दुष्टेभ्योऽन्योन्यमूर्छनात्|**
**कोद्रवेभ्यो विषस्येव वदन्त्यामस्य सम्भवम्||(A.S-21/19)**
**दुष्यत्यग्निः स दुष्टोऽन्नं न तत् पचति लघ्वपि|**
**अपच्यमानं शुक्तत्वं यात्यन्नं विषरूपताम् ||(CH-CHI-15/44)**

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- The word *Ama* refers to the undigested food material found in *Amasaya* i.e., due to the improper function of *Jatharagni*, proper digestion of ingested food will not happen and undigested food gets stored in *Amasaya*, which results in the formation of poor *Rasa Dhatu* (the first *dhatu* from the *Anna Rasa*) and this impoperly formed *Rasa Dhatu* is termed as *Ama*. [1]
- The imbalanced and weak *Agni* leads to incomplete or inefficient breakdown of nutrients. Instead of being properly absorbed and assimilated into the body, these partially digested nutrients accumulate and transform into *Ama*.[2][3]
  This substance is characterized by its heaviness, stickiness, and foul smell, and it can obstruct the channels in the body, disrupt normal physiological functions, and contribute to various diseases and imbalances.

***Ama in Relation to Agni***

In *Charaka Sutra* it says "*Aharamatra punar agnibalaaprkshini*" [4]. Thus, digestion of food depends upon our *Agni Bala*.
The three primary Agnis found within the body are *Jatharagni*, *Panchbhutagni*, and *Dhatvagni*. The digestive fire, or *jatharagni*, governs all of the body's digestive functions. Proper digestion is hindered when *Agni* is hypofunctional, which leads to the development of *Ama*. Next, the *Bhutagni* were mentioned. *Bhuta* refers to the physical material sequence of food and body components. After that, *Dhatvagni* was addressed; in this context, *Dhatu* refers to the fundamental components of the body. The metabolism of tissue is included in *Dhatvagni's* functions.

In sum, *Jatharagni* (gastrointestinal metabolism secretion, enzyme), *Bhutagni* (five intermediary metabolism factors) and *Dhatvagni* (tissue metabolism) constitute the thirteen types of *Agni* or metabolic factors of *Ayurveda*. By the *Ayurvedic* literature, the food material is first digested and absorbed by the *Jatharagni* in *Amashaya* and *Grahani*. Then it is transported to the liver for *Bhutagnipaka* and from there, the product of nutrition is processed in the tissues by the Dhatvagni. Normally digestion at all levels and proper functioning of these *Agni* is absolutely necessary. But, whenever *Agnivyapara* took the shape of *Mandagni*, the resultant material will be unripened, undigested formation of food resides in *Amashaya*, term is known as *Ama*. In terms of metabolism, it is defective metabolism.

***Causes of Formation of Ama***

From the above discussion, it is clear that Jatharagni is the root cause of Ama. So, the factors responsible for malfunctioning of Agni are also responsible for Ama.

1. *Aharja- Abhojana* (fasting), *Atibhojana* (Overeating), *Ajirnabhojana* (in state of indigestion), *Vishamashana* (irregular dirt habits), *Asatmyabhojana, Virudhhabhojana* (indulgence in diet) not homologus to body, food qualities like *Guru* (heavy), *Sheeta* (cold), *Shuska* (dry), *Ruksha* (fat deficient food), *Vidahi* (acidic), *bhojana* (incompatible diet) leads to the failure of digestion of even easily digestible food.[5]

Other Causes like - Erroneous inadequate administration of *PanchakarmaVidhi*[6] i.e. *Vaman, Virechana, Basti Karma, Sneha Karma* can also produce *Ama*.
*Desha Vaishamya, Kala Vaishamya, Ritu Vaishamya* and *vegadharana* plays important role in the vitiation of the function of *Agni* and there will be digestive impairment in a person.

2. *Viharaja- Atyambupana* (drinking of water excessively), *Vishamashana*(irregular consumption of food), *Sandharnata* (suppression of natural urges), *Svapna viparyaya* (keeping awakening in night and sleeping in days) may give rise to *Amadosha*.[7]

3. *Mansika-* Consumption of food while afflicted with mental upset due to *Kama* (Lust), *Krodha* (anger), *Lobha* (greed), *Moha* (temptation), *Irshaya* (jealousy), *shoka* (Mental stresses, grief), *Bhaya* (fear), *Lajja* (shame), *Chinta* (worry) are responsible for *Agnimandyajanya Ama*.[8]

***Symptoms of Ama***

General characteristic of *Ama* is, *Srotorodha* (obstruction of channels), *Balabhransha* (loss of strength), *Gaurava* (felling of heaviness), *Anilamudhata* (obstruction of *vayu*), *Alasya* (laziness), *Apakti* (indigestion), *Nisthiva* (excessive salivation), *Malasanga* (constipation), *Aruchi* (anorexia), and *Klama* (fatigueness).[9]

*Ama lakshana* such as- [10]-  ***Jwara* (Fever)**: *Ama* can cause low-grade, chronic fever.
-  ***Aruchi* (Loss of appetite)**: A person with *Ama* may experience a lack of interest in food.
-  ***Angamarda* (Body aches)**: Generalized body pain and stiffness are common.
-  ***Alasya* (Lethargy)**: *Ama* leads to a feeling of heaviness and lack of enthusiasm.
-  **Nausea and indigestion**: The person may feel queasy and have difficulty digesting food.
-  **Malodorous breath and body odour**: *Ama* produces an unpleasant smell.
-  **Coated tongue (*Jihva* Lepa)**: The tongue often appears thickly coated, typically white or yellow.
-  **Heaviness in the body**: A sensation of weight and dullness in the body.
-  ***Avipaka* (Indigestion)**: A feeling of incomplete digestion with a sense of bloating.

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- ***Praseka* (Excessive salivation)**: *Ama* can cause excessive salivation.
- **Stiffness and pain in the joints**: *Ama* often leads to stiffness and joint pain, especially in the morning.

***Samprapti:***

*Nidana Sevana*

(Excess consumption of liquid or irregular amount of food intake)

↓

*Dosha Prakopa*

↓

Reduced function of *Jatharagni* (due to reduced quality of *Ushna*)

↓

Improperly Formed *Ahara Rasa*

↓

Formation of poor *Rasa Dhatu* i.e., Sanchaya of *Ā*ma

↓

Prakopa of *Ā*ma i.e., *Ā*mavisha formed in *Kostha*

↓

*Sthanasansraya* of *Ā*ma in *Khavaigunya*

↓

Manifestation of disease

***Samprapti Chakra***
*Hetu: Agnidusti, Agnimandhyakarak*
*Adhisthan: Mahasrotas (Grahani)*
*Dosa: Tridosha*
*Srotas: Annavaha, Purisavaha*
*Dusya: Anna, Rasa*

**Role of *Ama* in Disease Progression**

- **Pathogenesis:** *Ama* is often considered the root cause of many diseases in Ayurveda. It acts as a trigger for disease progression by disturbing the normal function of the *Doshas* (*Vata, Pitta*, and *Kapha*). For instance:
  - ***Vata* Dosha** [11]: When combined with *Ama*, it can lead to conditions like joint pain, stiffness, and neurological disorders.
  - ***Pitta* Dosha** [12]**:** *Ama* mixed with *Pitta* can cause inflammatory conditions such as skin disorders, acidity, and fevers.
  - ***Kapha* Dosha** [13]**:** When *Ama* is associated with *Kapha*, it leads to conditions such as respiratory disorders, lethargy, and obesity.
- **Interference with Cellular Functions [14]:** *Ama* obstructs the micro-channels (*Srotas*) responsible for transporting nutrients and energy to the cells. This obstruction leads to cellular dysfunction, which can manifest as various chronic diseases.

**Addressing *Āma* through *Ayurvedic* Interventions:***[15]***
*Ayurveda* emphasizes early intervention to neutralize and eliminate *Āma*. Depending on the severity, quantity, and type of *Āma*, Ayurvedic treatments aim to eliminate Ama from the body through detoxification methods such as:[16]

1.***Laṇghana***: Restricting nutritional intake, including fasting, to give the digestive and metabolic systems rest. Controlled fasting helps in burning Ama by stimulating Agni and allowing the body to cleanse itself.

2.***Langhana Pachana***: Prescribing specific medications to digest and metabolize *Āma*, rendering it inactive such as *Haritaki, Amalaki, Chitrak*, etc can be given.

3.***Dosha abasechan (Sodhana***-Detoxification Therapies*)*: A purification process to completely remove *Āma* from the body e.g., adequate administration of *Panchakarma* - a series of five therapies (*Vamana, Virechana, Basti, Nasya*, and *Raktamokshana*) that cleanse the body and expel toxins.

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**Dietary Interventions**

- **Light and Easily Digestible Foods:** Consuming foods that are easy to digest helps in preventing the formation of *Ama*. These include soups, broths, and cooked vegetables.
- **Avoidance of *Ama*-Forming Foods [17]:** Heavy, cold, and oily foods, as well as incompatible food combinations (*Viruddha Ahara*), are avoided as they contribute to the formation of *Ama*.

**Lifestyle Modifications[18]**

- **Regular Exercise [19]:** Physical activity helps stimulate *Agni* and prevents the accumulation of *Ama* by promoting healthy digestion and metabolism.
- **Proper Sleep Routine [20]:** Maintaining a regular sleep schedule and avoiding late-night eating can help in keeping *Agni* strong and preventing *Ama* formation.
- **Stress Management [21]:** Practices such as *yoga*, meditation, and *Pranayama* are recommended to balance the mind and reduce stress-induced *Agnimandya*.

**Preventive Measures**

- **Seasonal Cleansing [22]:** *Ayurveda* recommends undergoing seasonal detoxification practices to remove any *Ama* accumulated during the transition of seasons, especially during the spring (*Vasant*) season when *Ama* tends to accumulate more due to *Kapha* dominance.
- ***Dinacharya* (Daily Routine) [23]:** Following a consistent daily routine, including morning cleansing rituals, regular meal times, and appropriate sleep patterns, supports strong *Agni* and prevents *Ama* accumulation.

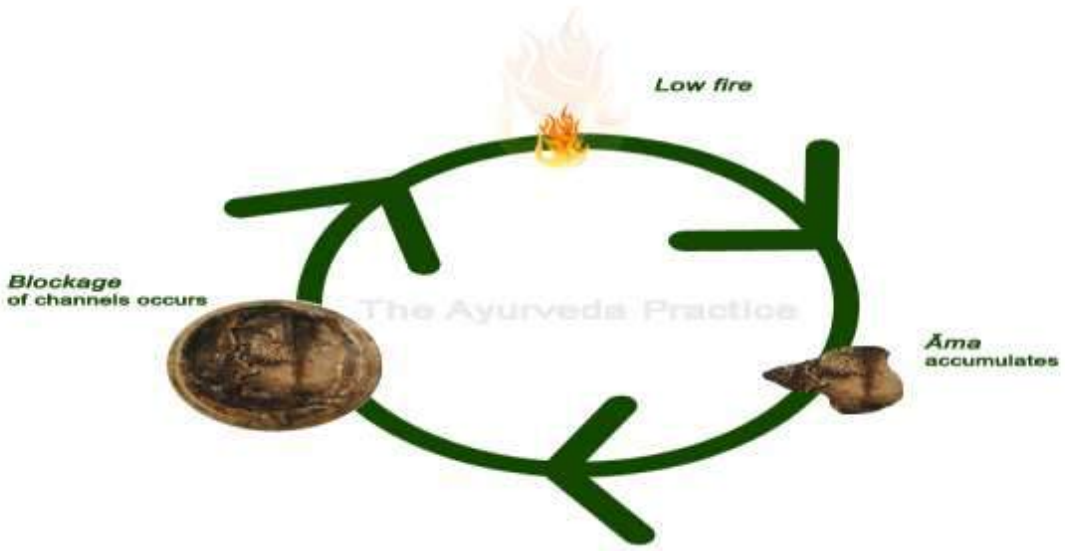
***Āma in relation to Modern View:[24]***

*Ā*ma can only exist if key metabolic processes are not functioning properly. We refer to these processes in *Ayurveda* as types of fire. There are three main types of these fires;

1. The digestive tract, which simplifies food so that the body can absorb it.
2. The mechanisms in the liver and bloodstream that convert food particles into nutrients that can be used and trash which can be eliminated
3. The transformational processes that yield tissues and give them energy by using these nutrients.

*Ama* is created in the body if any of these functions aren't functioning properly.

Conversations pertaining to an unsuitable diet, unclean food, intense emotions, stress, and the suppression of impulses (such as bowel motions, flatulence, or urination) can reduce these fires and thereby facilitate the formation of *Āma*. Once created, *Āma* can further reduce metabolic fires by blocking the channels. decrease in flames caused by metabolism. Therefore, a vicious cycle could start.




If *Ama* is only the result of insufficient stomach acid production, it might just stay in the digestive tract and contaminate "food essence," which is the meal's fluids solidified by the digestive system and utilised to form the body's tissues. Constipation, loss of taste and appetite, and indigestion are among the digestive symptoms caused due to this. It can also result in mucus and thready saliva as well as a coating on the tongue that is challenging to get off. The fatigue, heaviness, and lethargic feeling that result from

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the "food essence" circulation are systemic symptoms. Chronic digestive problems can develop over time. It is possible to digest this and then expel it from the body by increasing the digestive fire.

## CONCLUSION

In *Ayurvedic* medicine, the concept of *Ama* is integral to understanding disease causation and treatment. *Ama*, the toxic byproduct of improper digestion, is considered a root cause of many diseases. It arises when the digestive fire (*Agni*) is weakened, leading to incomplete digestion and the accumulation of toxins in the body. Recognizing and managing *Ama* is crucial in *Ayurveda*, as it disrupts the balance of the *Doshas* (*Vata, Pitta, Kapha*) and impairs the proper functioning of bodily tissues and channels (*Srotas*). *Ama* is characterized by qualities such as heaviness, stickiness, coldness, and a foul smell, reflecting its obstructive nature. These properties hinder digestion, block nutrient absorption, and prevent the effective elimination of waste, resulting in systemic toxicity. Different *Ayurvedic* texts emphasizes that *Ama* obstructs the body's channels, leading to stagnation and the development of diseases. This contrasts with modern biomedical models that often focus on pathogens or genetics, showcasing *Ayurveda's* holistic and preventive approach.

Diagnostically, the presence of *Ama* is identified through symptoms like a coated tongue, loss of appetite, body aches, and lethargy. These signs guide practitioners in deciding the need for detoxification therapies, such as *Panchakarma*. The early detection of *Ama* allows for timely intervention, preventing the progression to more severe health issues. *Ayurveda's* personalized approach, considering each individual's constitution (*Prakriti*) and current imbalance (*Vikriti*), ensures that treatments are tailored to effectively eliminate *Ama* and restore health.

Therapeutically, the focus is on eliminating *Ama* through dietary adjustments, lifestyle changes, and detoxification procedures. *Panchakarma*, including *Vamana* (emesis) and *Virechana* (purgation), is designed to cleanse the body of *Ama*, purify the channels, and rebalance the *Doshas*. Dietary strategies aim to enhance *Agni*, using warming spices and light foods while avoiding heavy, oily, and cold substances that contribute to *Ama's* formation.

In today's healthcare, the idea of *Ama* is becoming more and more important, particularly when it comes to treating chronic illnesses linked to metabolic disturbances and systemic inflammation. *Ayurvedic* concepts can be incorporated into modern techniques to provide a comprehensive approach to health that emphasises prevention and addresses the underlying causes of illness. With increasing interest in *Ayurvedic* treatment, the idea of *Ama* offers important insights for attaining the best possible health and well-being in the modern world.

Thus, *Ā*ma formed at the levels of *Jatharagni*, *Bhutaagni* & *Dhatvagni* and initiated many pathological events inside the body. *Ā*ma further deteriorates digestive and metabolic activities, blocks *Strotas*, vitiated *Dhatus* and *Rakta* therefore causes various diseases including auto-immune disorders. Avoidance of *Virrudha Aahara*, fear, anxiety, restoring disciplinary daily regimen, *Ayurveda drugs*, detoxification measures, *Yoga* and considerations of concept of *Pathya* and *Apathya* helps to avoid prevalence of diseases associated with excessive production of *Ama*.

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EPRA International Journal of Research and Development (IJRD)
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# ON THE NAMING MOTIVES OF KHOREZM HYDRONYMICS

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**Article DOI:** https://doi.org/10.36713/epra18005
**DOI No: 10.36713/epra18005**

**ABSTRACT**

*This article deals with the semantic classification of hydronyms, naming motives, important factors in their emergence. The main types of naming motives of Khorezm hydronymics are analyzed.*

**KEY WORDS:** *toponym, hydronym, hydronymics, anthroponym, ethnonym, nicknames, nomination, motive, ethnohydronyms, anthropohydronyms.*

## INTRODUCTION

Hydronyms arise in connection with various changes in society. The creation of place names is related to social factors such as customs, language, history of development and cultural development of people in a certain area. According to N.Ulukov, the nominator uses some feature, aspect specific to water objects and structures as a naming motive. In this process, the location, structure, shape of water objects and waterworks, the names of the people who created them, the plants, trees that grow around this area, animals and creatures living there, or the characteristics of water serve as motives [7.45.]. Accordingly, in this study, we tried to analyze the names of water facilities formed on the basis of some proper nouns according to the naming motives of hydronyms.

## LITERATURE REVIEW

In world and Uzbek linguistics, a number of studies have been carried out on toponyms, their semantic groups, semantic classifications and naming motives. However, the works dedicated to hydronyms are limited in numbers among them. The first research on the classification of Turkic hydronyms is observed in the research of O.Molchanova. A.Kamolova divides hydronyms into eighteen thematic groups according to their lexico-semantic features, taking into account that the water bodies are named based on its characteristic features, water properties, natural and biological processes related to them. The Turkmen toponymist S.Ataniyazov divides hydronyms into semantic groups taking into account the characteristics of water color, taste, smell, flow speed, direction and noise level, water temperature, water quantity, and the shape of the object. Regarding the lexical-semantic classification of hydronyms, the researches of N.Okhunov and N.Begaliyev are particularly important due to their excellence [7.58.]. It is worth noting that these studies are considered separate researches on hydronymy of different regions, and the names that appeared on the basis of the internal possibilities and laws of a specific region. In addition, Khorezm hydronymy also requires specific individual classifications.

## RESEARCH METHODOLOGY

The emergence of names is the result of the need and necessity at a certain stage of people's life. Investigating the naming motives of hydronyms is the first step in studying the etymology of names. Learning hydronyms, especially river names, has its own difficulties. This is explained, first of all, by the fact that the rivers flow from a very long distance. Different peoples who are linguistically far from each other lived on the banks of this river, and they gave a special name to this water body. For example, Amudarya, which flows through the Khorezm region, has different names. Amudarya is the most water-rich river in Central Asia and Uzbekistan. In the written sources of the Timurid era, the Amudarya is named as "Jayhun" in most cases and sometimes as "Obi Omuya", the part near the city of Gurganj in the Khorezm region is called "Obi Gurlan" (Gurlan river) and "Joyi Gurlan" (Gurlan stream), in the upper reaches as "Punjab". Its tributaries "Obi Vakhsh" (now Vakhsh River), "Surkhab", "Gund", "Hisar" and "Chagonrud" (now Surkhan River) are also mentioned.

The Greeks and Romans called the river Oxus or Oxos, the Arabs called it Jayhun, and the local peoples called it Okuz, Vakhsh, and then Amul. In "Avesto" and other historical sources, historical names of the river such as Arang, Rakha, Rankha, Arankha were also found. Some experts say that the current name of Amudarya is related to the name of the city of Amul, which existed in the Middle Ages [3.18.].

The naming motive of any proper noun, as well as common nouns, is based on a certain sign and characteristic of the object at the initial nomination stage. For naming motive of hydronyms, words reflecting the different character of a water body are important.

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## ANALYSIS AND RESULTS

Most of the hydronyms in Khorezm have existed for a long time and are preserved as terms of changes, historical processes, and events in the life of the people. There are many hydronyms named after clans, tribes and peoples in Khorezm. Most of the hydronyms contain the names of historical figures, as well as terms related to people's profession, occupation and way of life. Also, other names are related to natural phenomena, animal world. Hydronyms differ from other names according to their character and motives. Khorezm hydronyms are different according to their naming motive, below we will consider ethnohydronymic and anthropohydronymic types.

**Ethnohydronyms** are the names that appear among the evidences that indicate the ethnographic characteristics of people related to a certain water body. Hydronyms of this type form the oldest layer of names. The territory of Khorezm has been a place of collision and mixing of different ethnic groups since time immemorial. During its rich and colorful history, the historical traces of the peoples speaking genetically different languages are reflected in the current lexicon of Khorezm dialects, in particular, in hydronymy. Examples of such hydronyms are *Kirgizyap, Mangityap, Naiman uzak, Bashkird lake, Uyghur collector, Kenagas channel.*

Although some hydronyms related to the names of ethnic groups do not mean the name of a clan or a historically formed nation, ethnohydronyms were created under the influence of factors related to their bringing to Khorezm. Hydronyms such as *Qullar, Jamshid* can be examples for such names. The hydronym of *Qirkyap*, located in Yangiarik District, Khorezm Region, is also considered an ethnonym, and at first glance, it does not have an ethnonym feature. According to H.Donyorov, this name is considered "the stream of the Qirq clan", and the Qirq (in Uzbek –forty) is the third largest tribe after Ming (in Uzbek –thousand) and Yuz (in Uzbek – one hundred) among the clans and tribes of the Uzbek people [6.154.].

**Anthopohydronyms** are names motivated by people's relationship with a water body, its ownership, residence, construction, etc. The transformation of personal names into geographical names is a common linguistic phenomenon. Anthropohydronyms, like toponyms, are not only socio-linguistic signs that individualize objects and distinguish them from each other, but at the same time, they are also signs that indicate people's ethnic character, national character, and socio-political views. For this reason, the relationship between them began very long ago. The fact that many anthroponyms have become hydronyms is explained by the same factor [5.9.]. Anthropohydronyms perform the function of distinguishing an object from others. The relationship between person and object plays an important role in this. First of all, the role of people in a region or some individuals in society serves as an important sign. These signs can be expressed in different ways. It is reflected in a number of individual types, such as people's profession, occupation, career, ethnic type, and nickname. Most of these symbols do not automatically become the name of a body of water. They are first used together with a person's name. Over time, it is considered a hydronym based on various factors.

The transformation of personal names into the names of water structures is also reflected in Khorezm hydronymy. Names formed by adding the word *arna* to personal names: *Qilichboy arna, Korakoz arna*. These two objects, which were of great importance in the 19th century Khorezm agriculture, were built by Qilichniyozboy and Davlat Karakoz, who were two army chiefs of Muhammad Rahimkhan [10.81.]. About the Khorezmian word "arna", V.V.Bartold said: Even in the 10th century, the people of Khorezm spoke their native language, which was not understood by other Iranians and was even used in written documents [1.162]. It seems that this language was later replaced by the Turkic language and not by the Persian language. Some terms in the field of irrigation (arna – "big canal", yap – "small canal") are undoubtedly remnants of the Khorezm language. The word arna is also known in other regions: "jar", "dry stream" in Jizzakh and Syrdarya regions; "daryo" (river) in North Kazakhstan, "dara" in South Uzbekistan, "buloq" in the North Caucasus [2.157.].

Names formed by adding words *yap, solma, kol* to personal names: *Bagnazarvoy yap, Shirin yap, Palvan yap, Zavra-Toyir yap, Obdol yap, Rozim yap; Jamshid solma, Marks solma; Berdining koli (Berdi's Lake), Mullabaydokning koli (Mullabaydok's Lake), Davlatbuvaning koli (Davlatbuva's Lake), Koklanning koli (Koklan's Lake)*.

**Hydronyms related to people's nicknames**. A nickname is a name given to a person according to a certain feature of his appearance or character, according to his social status or lineage [4.50.]. *Uzunning koli (Tall man's Lake), Mankaning koli (Lake of a man who speak nasal speech), Soqqol yap (Beard Lake), Mallaning koli (Yellow's Lake), and Sopoqkol* are hydronyms based on nicknames in Khorezm region. Acording to academician Yakhyo Gulomov, who researched one of the most famous canals Ghazavot, the name of the person who built the canal is often used in Khorezm to name a canal. Undoubtedly, Abulghozi took the initiative in restoring the Madra Canal or the Nasiri Canal (the previous names of the Ghazavot Canal). The original name of the channel is Ghaziabad, and it is used in the folk language as Ghazavot [6.154.].

**Anthropohydronyms related to religious concepts**. The religious belief of the population living in a certain area is also important in the creation of place names. Such types of anthropohydronyms are often associated with the name of a holy man and are

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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represented by the fact that he was buried in areas close to this body of water. *Eshon Yap, Abdol Yap, Khoja Solma, Siyit Kol, and Sheikh Yap* are among the hydronymys of Khorezm.

## CONCLUSION

The naming motive of hydronyms is based on various arguments. These arguments arise as a result of the need to distinguish an object from another object of the same type. In the naming motive of hydronyms, various factors play an important role, such as the relationship of a certain place with a person or ethnic groups in this area, their worldview, ethnographic signs or events related to this object. In this article, we focused only on some of the naming motives of Khorezm hydronyms. Basically, it is possible to analyze dozens more naming motives of hydronyms of this region, where agriculture and water management are developed.

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EPRA International Journal of Research and Development (IJRD)
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# FACTORS PREDICTION ON WORK LIFE BALANCE OF PRISON OFFICERS

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**ABSTRACT**
*Work life balance is concerned with individuals having a gauge of control over when, where and how they work. Thus, its achievement is indicated when the fulfilment of an individual's right to a content life in work as well as non-work domain is accepted and respected as the norm to the shared benefit of individuals, business and society as a whole. The objective of the study was to factors prediction on work life balance of prison officers in Tamil Nadu made up the population, and a sample of 127 prison officers (both male and female) was taken using a stratified random sampling technique. The survey method used in the study. Work life balance was the tool used in this study to gather data. SPSS data analysis utilizing percentage analysis and regression analysis statistical methods. The findings demonstrated that the level of work life balance of prison officers was moderate. Hence the hypothesis is accepted. The results also indicated that the predicted values are obtained as a linear combination of work interference with personal life, personal life enhancement, family support and job commitment, the coefficient value of indicates that the relationship between the work life balance and the four independent variables is quite strong and positive.*

**KEYWORDS:** *work life balance, prison officers, performance, commitment.*

## INTRODUCTION

Work and family constitute the dominant life roles for most officers in contemporary society. Thus, employed men and women are increasingly concerned about managing the conflicts experienced in fulfilling the dual demands and responsibilities of work and family roles. The unfolding changes in the composition of the workforce together with the growing proportion of workers in non-traditional family forms have focused heightened attention on the conflicts faced by officers' men and women in balancing the competing demands and responsibilities of work and family roles (Parasuraman & Greenhaus, 1999). Work-life balance was graded among the most important factor considered by individuals in accepting a new position (Galinsky, Bond & Friedman, 1993). Work-life Balance (WLB) is essential for the wellbeing of individuals and the performance of organizations and society (Grady et al., 2008). Varied viewpoints have been put forth regarding the definition, measurement and carrying out research on work-life balance. (Grzywacz & Carlson, 2007). Work life balance is concerned with individuals having a gauge of control over when, where and how they work. Thus, its achievement is indicated when the fulfilment of an individual's right to a content life in work as well as non-work domain is accepted and respected as the norm to the shared benefit of individuals, business and society as a whole. Work life balance is a method which helps officers of a prisons to balance their personal and professional lives (Matto Saba Mushtaq, 2020). Work life balance encourages prison officers to divide their time on the basis on priorities and maintain a balance by devoting time to family, health, vacations etc. along with making a career, travel etc. It is an important concept in the world of work as it helps to motivate the officers and increases their loyalty towards the prison.

## REVIEW OF LITERATURE

Erin Stephen (2024) studied perceiving balance exploring work-life balance in school administrators through resource drain theory. The results of the study female respondents reported lower levels of work-life balance, higher levels of stress related to administrative constraints, and higher levels of emotional exhaustion. Results also showed that the there were no statistically significant differences among the building levels regarding their work-life balance. Kurtulus (2024) The findings of the study effect of social support on work-life balance the role of psychological well-being. psychological well-being had a mediating effect on the relationship between social

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support and work-life balance. The bootstrap method was used to determine whether the mediation analysis was significant. Kurtulus (2023) analyzed effect of social support on work-life balance the role of psychological well-being. Results revealed that the work-life balance is negatively related to social support and, positively related to psychological well-being. Hatane et.al. (2022) compared accounting students' perceptions of work-life balance, accounting career image and intention to pursue accounting careers. Findings of the study there are positive and significant influences between work-life balance and the intention to pursue accounting career when supported by accounting career image.

## OBJECTIVES OF THE STUDY

The objectives of the present study are:

- To find out the level of work life balance of prison officers
- To find out the prediction of work life balance on work interference with personal life, personal life enhancement, family support and job commitment of prison officers

## HYPOTHESES OF THE STUDY

- The level of work life balance of prison officers is moderate.
- There is no prediction of work life balance on work interference with personal life, personal life enhancement, family support and job commitment of prison officers

## METHODOLOGY

The present study aims at studying work life balance of prison officers. Survey method was found appropriate. The sample of the study was the investigator selected prisons from Tamil Nadu. The present study was conducted on 127 prison officers of selected randomly from Tamil Nadu. Data was collected by applying the Stratified random sampling technique method. The data was collected from male and female of prisons.

## RESEARCH INSTRUMENT

The work life balance scale was developed by the investigator of prison officers containing fifty items about the work life balance scale and nine dimensions viz, work interference with personal life, personal life enhancement, family support and job commitment. Further, the investigator also added few more items in the tool as adding the items were most appropriate, suiting the present situation of the education system and the maximum scale value: 300, Minimum value: 60. The estimated reliability of the scale in the present study is very high (Cronbach's alpha 0.853).

## DATA ANALYSIS

### [A] Percentage Analysis

- Frequency of respondents with respect to level of work life balance of prison officers

**Table-4.1 Level of Work Life Balance of Prison Officers**

| Level of Work Life Balance | N | Percentage |
|---|---|---|
| **High** | 45 | 35.43% |
| **Moderate** | 53 | 41.73% |
| **Low** | 29 | 22.83% |

**Interpretation**

The table 4.1 depicts the sample distribution according to level of work life balance of prison officers. High level work life balance was seen among 45 (35.43%) prison officers, moderate level work life balance was seen among 53 (41.73%) prison officers and low-level work life balance was seen among 29 (22.83%) prison officers.

**Conclusion**

The level of work life balance of prison officers was moderate. Hence the hypothesis is accepted.

### [B] Regression Analysis Work Life Balance of Prison Officers and Its Dimensions

Regression is the determination of statistical relationship between two or more variables. In simple regression two variables are used. One variable (independent) is the cause of the behavior of another one (dependent). When there are more than two independent variables the analysis concerning relationship is known as multiple correlations and the equation describing such relationship is called as the multiple regression equation. Regression analysis is used to explain the variation in one variable based on the variation in one or more

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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other variables. The regression equation is judged for its usefulness based on the overall t test for the model and in order to decide which variables in the model are good explanatory variables of the dependent, the individual t test for each variable needs to be analyzed. The R-square value of a model explains by what percentage of the variations in the dependent variable surpasses the independent variables in the model, Sakthivel Rani (2011).

Regression analysis is concerned with the derivation of an appropriate mathematical expression is derived for finding values of a dependent variable on the basis of independent variable. It is thus designed to examine the relationship of a variable Y to a set of other variables X1, X2, X3…….Xn. the most commonly used linear equation in Y=b1 X1 + b2 X2 +……+ bn Xn + b0.

Here Y is the dependent variable, which is to be found. X1 , X2 ,… and Xn are the known variables with which predictions are to be made and b1, b2 ,….bn are coefficient of the variables.

In this study, the dependent variable is work life balance, independent variables are work interference with personal life, personal life enhancement, family support and job commitment and analysis are discussed as follows:
Dependent variable: Work life balance (Y)
Independent variables: 1. Work interference with personal life (X1)
2. Personal life enhancement (X2)
3. Family support (X3)
4. Job commitment (X4)

**Table 4.2 Variables in the Multiple Regression Analysis**

| Variables | Unstandardized co-efficient | SE of B | Standardized co-efficient | t value | P value |
|---|---|---|---|---|---|
| Constant | 14.102 | 1.301 | - | 10.839 | <0.001** |
| X1 | -0.049 | 0.009 | -0.217 | 5.743 | <0.001** |
| X2 | 0.006 | 0.019 | 0.013 | 0.280 | 0.789 |
| X3 | 0.068 | 0.072 | 0.108 | 2.159 | 0.033* |
| X4 | -0.067 | 0.016 | -0.229 | 5.094 | <0.001** |

**Note: **** Denotes significant at 1% level
The multiple regression coefficient is 0.450 measures the degree of relationship between the actual values and the predicted values of the work life balance. Because the predicted values are obtained as a linear combination of work interference with personal life (X1), personal life enhancement (X2), family support (X3) and job commitment (X4), the coefficient value of 0.450 indicates that the relationship between the work life balance and the four independent variables is quite strong and positive.

The Coefficient of Determination R-square measures the goodness-of-fit of the estimated Sample Regression Plan (SRP) in terms of the proportion of the variation in the dependent variables explained by the fitted sample regression equation. Thus, the value of R square is 0.202 simply means that about 20.2% of the variation in impact on turnover intention is explained by the estimated SRP that uses work interference with personal life, personal life enhancement, family support and job commitment as the independent variables and R square value is significant at 1 % level. The multiple regression equation is

Y = 14.102- 0.049 X1 + 0.006X2 +0.068X3 -0.067 X4

Here, the coefficient of X1 is -0.049 represents the partial effect of work interference with personal life on work life balance, holding the other variables as constant. The estimated negative sign implies that such effect is negative that work life balance would decrease by 0.049 for every unit increase in work interference with personal life and this coefficient value is significant at 1% level. The coefficient of X2 is 0.006 represents the partial effect of personal life enhancement on work life balance, holding the other variables as constant. The estimated positive sign implies that such effect is positive that work life balance would increase by 0.006 for every unit increase in personal life enhancement and this coefficient value is not significant at 5% level.

The coefficient of X3 is 0.068 represents the partial effect of family support on work life balance, holding the other variables as constant. The estimated positive sign implies that such effect is positive that impact on work life balance would increase by 0.068 for every unit increase in family support and this coefficient value is significant at 5% level. The coefficient of X4 is -0.067 represents the partial effect of job commitment on work life balance, holding the other variables as constant. The estimated negative sign implies that such effect is

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negative that work life balance would decrease by 0.067 for every unit increase in job commitment and this coefficient value is significant at 1% level.

Multiple regression analysis is used to find, at what extent the work life balance of the prison officers is determined by work interference with personal life, personal life enhancement, family support and job commitment. The result is given in the table reveals that, work life balance has positive relationship with personal life enhancement and family support and negatively associated work interference with personal life and job commitment. The statistical significance of the model is given in the table and the R2 value is 0.202. work interference with personal life and job commitment are statistically significant at a confidence level of 0.01, family support is statistically significant at a confidence level of .05 and personal life enhancement is not significant at 5 % level. This indicates that the model is statistically significant at a confidence level of 0.01. Therefore, it is concluded that based on the standardized coefficient of job commitment (0.218) is the most important factor for extracting the work life balance, followed by work-life balance (0.229) and family support (0.108).

## EDUCATIONAL IMPLICATIONS

- Prison officers face high levels of stress due to the nature of their work. Ensuring a proper work-life balance can help mitigate stress, but training programs should also include stress management techniques, mindfulness, and resilience building.
- Education about mental health awareness and access to counseling services can support prison officers in managing the emotional toll of their job.
- Work-life balance challenges might make it difficult for prison officers to engage in traditional, time-intensive training programs. Offering online courses, modular training, and flexible learning schedules can help officers pursue professional development without compromising their personal lives.
- Educational programs that foster a culture of support within the prison system can help officers achieve a better work-life balance. This might include training for supervisors on recognizing burnout and promoting a healthy work environment.
- Improved work-life balance through targeted educational programs can reduce burnout and turnover among prison officers, leading to a more experienced and stable workforce.
- A balanced life can enhance the ethical decision-making of prison officers. Training that integrates ethical practices with personal well-being can lead to more humane and effective management of inmates.
- Education for prison officers should include resources and programs that support their families, helping them understand the demands of the job and offering strategies to maintain a healthy family life.
- work-life balance of prison officers has far-reaching implications for their professional development, mental health, job satisfaction, and overall effectiveness. Educational programs that address these areas can lead to a healthier, more stable, and more effective workforce.

## CONCLUSION

According to the findings of this study, work life balance of prison officers was moderate. It is found out that the predicted values are obtained as a linear combination of work interference with personal life, personal life enhancement, family support and job commitment, the coefficient value of 0.450 indicates that the relationship between the work life balance and the four independent variables is quite strong and positive. The results also revealed that the coefficient of determination r-square measures the goodness-of-fit of the estimated sample regression plan in terms of the proportion of the variation in the dependent variables explained by the fitted sample regression equation. Thus, the value of R square is 0.202 simply means that about 20.2% of the variation in impact on turnover intention is explained by the estimated SRP that uses work interference with personal life, personal life enhancement, family support and job commitment as the independent variables and R square value is significant at 1 % level. The work-life balance of prison officers is a critical issue that significantly impacts their well-being, job performance, and the overall effectiveness of correctional facilities. This study has highlighted the unique challenges prison officers face, including high levels of stress, exposure to potentially traumatic situations, and demanding work schedules. These challenges can lead to burnout, reduced job satisfaction, and higher turnover rates, which in turn affect the safety and efficiency of the prison environment.

Improving work-life balance for prison officers is not only essential for their mental and physical health but also crucial for maintaining a stable and effective workforce. By fostering a work environment that prioritizes the well-being of officers through flexible work arrangements, mental health support, and a positive workplace culture correctional institutions can enhance officer performance, reduce errors and incidents, and promote ethical and humane treatment of inmates. Moreover, the study underscores the need for organizational and policy changes that support work-life balance, which could lead to better recruitment and retention of officers. A balanced work life

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enables officers to perform their duties more effectively, contributing to the safety of the institution and the successful rehabilitation of inmates, ultimately benefiting society as a whole the work-life balance of prison officers is a vital step toward creating a healthier, more sustainable workforce and a more just and effective correctional system. Future research and policy initiatives should continue to explore ways to support prison officers in achieving a balance between their professional and personal lives, recognizing the importance of this balance in the broader context of public safety and rehabilitation efforts.

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EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# TAX DESIGN AND DOMESTIC REVENUE MOBILIZATION IN NIGERIA

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**ABSTRACT**
*This study examines tax design and domestic revenue mobilization in Nigeria: a comparative study. A regressions analysis was used for the analysis of the data and pre-estimation tests were carried out. Variables having connection with tax design and domestic revenue mobilization as well as economic growth and development were used to represent their interests. Data were obtained from the yearly financial reports of the Central Bank of Nigeria (CBN) bulletin on the Real Gross Domestic Product (RGDP), Internally Generated Revenue (IGR) and Value Added Tax (VAT) covering a period of 24 year, from 1997-2020 to test for effects of tax design and domestic revenue mobilization on sustainable economic growth and development in Nigeria, and comparing the effects of tax design and domestic revenue mobilization on economic growth and development in Nigeria between pre and during recent tax design and domestic revenue mobilization awareness periods. The findings of this study showed that all the explanatory variables (IGR and VAT) in both pre and during periods have significant positive effects on dependent variable (RGDP) but the effects of tax design and domestic revenue mobilization on economic growth and development in Nigeria between 2009 and 2020 are more than the effects before 1997 and 2008 periods. The study concludes that effects of tax design and domestic revenue mobilization in Nigeria are invaluable and no amount of money spent on its full institution and execution is in vain. The study therefore recommends that every level of government should consider its full implementation as well as comply with tax design standards in order to improve quality of tax policies and promote sustainable economic growth and development in Nigeria.*

**KEY WORDS**: *Tax design; domestic revenue mobilization; sustainable economic development*

## 1.0 INTRODUCTION

The inordinate sorting for external funds outside the country, usually known as external debts or grants, and its negative effects on the sustainable funding of economic growth in developing countries has made it imperative that these countries now seek inward to domestic revenues as one of consistent and sustainable means of funding economic growth and development as well as attaining sustainable economic growth. Nigeria as a developing country considered this design option and has introduced diverse policies and strategies towards promoting her domestic revenue mobilization via enhanced taxation and non-taxation revenues (Obi & Ifelunini, 2019).

Issue of domestic revenue mobilization has been discussed in several international conferences over the years. The call for raising domestic revenue via resourceful and efficient tax systems was one of the basic goals of "the 2002 Monterrey Consensus on Financing for Development" follow up to 2008 forum in Doha which harassed the necessity for openness of public finance management and further proficient tax collection, a broader tax. In 2012, Rio+20 conferences were organized together with the Addis Ababa forum in 2015 also stressed the need for domestic revenue mobilization as a pinnacle precedence in the perspective of the post-2015 development agenda (European Union, 2017; Organization for Economic Cooperation and Development (OECD), 2008).

Increases in domestic revenue mobilization reduce dependence on foreign aid as well as national debts and lead to development in public control, because taxpayers are likely to hold the governments responsible. The entire government revenue as proportion of GDP serves as one of the key performance indicators (KPI) for tracking domestic revenue mobilization attempts. Therefore, domestic revenue mobilization can be considered as a tool used by government to generate revenue and expense expenditure to control economic growth and development (International Monetary Fund World Bank Group, 2016). It is the tool that hubs on revenues from taxation, identifying that there are various other non-tax government revenues, such as dividends as well as profits received from the quoted firms, interest receipts received from loans provided by the government and tariffs.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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However, from extant literature not many studies have been carried out in this area in Nigeria. Although, the few studies conducted were done outside the country yet there still need for more studies. According to International Monetary Fund World Bank Group (IMFWBG) (2016), domestic revenues are the biggest untapped supply of financing to finance national growth and development plans; without efficient mobilization of domestic revenues, the sustainable national development cannot be attained. According to World Bank (2021), rendering the financing condition of attaining the ambitious sustainable development goals adopted in 2016, the global community has recognized domestic revenue mobilization as a strategic precedence. The absence of significant advancement on domestic revenue mobilization in the previous decade indicated the need for renewed attention to the issue. Therefore, this study is motivated to examine effects of tax design and domestic revenue mobilization on sustainable economic growth and development.

In order to achieve this goal, this study will respond to question: whether tax design and domestic revenue mobilization has positive effects on sustainable economic growth and development in Nigeria or not? Whether past contributions of tax design and domestic revenue mobilization to economic growth and development were greater than contributions provided when full attention is given to the policies and scheme? The rest of this study covers literature review, methodology, analysis of results obtained and conclusion as well as recommendation.

## 2.0 LITERATURE REVIEW

### 2.1 Conceptual Review

#### 2.1.1 Domestic Revenue Mobilization

Domestic revenue mobilization is the generation of resources from domestic revenues and their distributions to reasonably and economically viable projects that are key pivots to attaining the desirable sustainable economic growth and development objectives (World Bank, 2016; Soyinka, 2021; Fakile et al., 2014). According to World Bank (2021), the description of domestic revenue mobilization was reasserted by the 2015 Addis Ababa action program that mobilization and efficient employment of domestic revenues, underlined by the standard of national ownership, are fundamental to accomplishing the sustainable growth and development targets (Obi & Ifelunini, 2019). Funding development has been a main focus of discussion at the global dome; by developed and developing economies similar. This is the attempt instituted by government through its spending to accomplish its developmental estimates. It is the procedure of giving to the course of an investment such as project for the interests of its citizens (Soyinka, 2021; Obi & Ifelunini, 2019).

According to International Monetary Fund (IMF) (2011), domestic revenue mobilization strategy involves integrating policy and revenue generation from natural resources into the tax system; Ensuring stability of domestic and global tax laws, which indicates, among other things, that various countries must painstakingly review the interpretations of tax treaties and diverse negotiation plans prior to countries engage in novel treaty agreements or revise present treaties; employing tax design as an instrument to promote or deject particular operations only when strategy principles and local limitations deserve it. IMFWBG (2016) asserts that an instance is the design of investment tax incentives, which ought to give attention to market imperfections, tax administration limitations in policing incentives to check abuse, as well as the usefulness of incentives in reaching their goals. Appropriate monitoring of the charges and efficiency of such tax design should be established, so policymakers can make suitable policy modifies when required; and integrating diverse areas of the estimation of tax policies. Although it is only about revenue, yet also about equity, effectiveness, and other feasible implications that is how policies alter prospects or inducements for tax evasion and avoidance.

European Union (2017) is of the opinion that the improvement of a rational and sustainable revenue mobilization approach should really develop into a sum-of-the-government attempt, assuring consistency of the domestic tax design with broader national targets; incorporating into the national development policy. Revenue mobilization ought to be developed by the government, so that an efficient cooperation of the different government organs can guarantee a coherent and all-inclusive design, and productive alliance with external collaborators and donors. A line of studies from international firms are an excellent starting point for understanding the major encounters that developing countries confront in tax design and administration, as well as constructing potential options for restructuring.

World Bank (2021) discloses that the developed countries are interested on how to help developing countries to accomplish national and global growth and development targets and goals through aids, loans, grants, so on. On the other hand, over the years, developing countries are encountered with huge development tasks and have thus established to build capacity to attain reliable growth in their amenities, fight corruption, and call for foreign direct investment and build up transparent financial mechanisms as a practical means of attaining national economic targets and global development objectives (OECD, 2009). To attain sustainable national economic growth and development, financial strategies and tax policies designed by developing countries should be carried out to be in agreement with local and global plans. Fund plays an important role in accomplishment of these economic targets particularly for developing countries.

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According to Soyinka (2021) there are diverse sources of development funds such as debt (domestic and foreign), taxation, revenue from export sales, savings by individuals, firms and government, aids and grants within and outside the countries (ICAN, 2020; Adams, 2018). Conversely, of the entire sources of domestic revenue, taxation has been acknowledged as fundamental to attaining the desirable interconnected or incorporated development targets as predetermined by developing countries. This may be because taxation offers governments with the capitals required to fund development and in the long run, provides a remedy to assist reliance on the poorest nations and expected fiscal environment to encourage growth. Furthermore, apart from creating an enabling environment for economic growth and development, taxation is vital to the sound governance system. This exists through the stimulus of procedure of conciliation and bargaining between the levels of government and their citizens so playing pivotal role to further successful and accountable government (OECD, 2009; Soyinka, 2021)

According to Kuada (2013), many countries in Africa particularly Sub-Saharan countries depend majorly on external sources of funds than domestic sources of funds to the desert of developing national revenue means. Gutman et al. (2015) argue that every country in Sub-Saharan Africa needs to generate domestic revenues to supplement the development attained in fiscal proceeds. It thus implies that government of these nations should examine inward for other sources of funds to finance various projects as there are different means of raising capital for developmental targets. Other avenues of mobilizing revenue should be found out by governments and not depending on foreign means. Nigeria's experience is not far from this situation. According to Obi and Ifelunini (2019), Nigeria over depends on external sources, revenue from oil exploration among other means to fund its developmental investments and strategies. In recent periods, Nigeria has encountered a line of challenges in funding its estimates given the revenue shock occasioned by fall in global oil price in 2016 and recent periods. This has bought a fall in government development spending. This has raised government shortage in funding with external debt report. To overturn this negative effect trend, Nigeria government has introduced some guidelines and mechanisms geared towards promoting domestic revenue mobilization. According to Junquera,-Varela *et al.* (2017), the only consistent and sustained avenues of government revenue are taxes and some non-tax revenue tools like royalties as well as resource rents from extractive industries.

**2.1.2 Tax Design in Nigeria**

The Nigerian tax design has passed through several revolutions geared in the direction of improving tax collection and supervision with minimum administrative costs, the main task encountered by the Nigerian economy is the tax design currently in activities. This also contributed to the non-voluntary conformity of the taxpayers which leads to a wide involvement in tax evasion and avoidance. It has been a key setback to economic growth and development, which makes tax evasion as well as avoidance are now common practices (Ezeoha & Ogamba, 2010). Nigerian government has not been at rest, recently diverse policies and tax design have been established by her to address these identified impediments of tax administration. These include: the institution of Taxpayer Identification Number (TIN), Automated Tax System (ATS) that enhances tracking of tax positions as well as individual taxpayer, E- payment system (EPS) which facilitates sound payment process and minimizes the occurrence of tax touts, Implementation of scheme (Odusola, 2016). All these are established to raise enough domestic revenue to meet up with national demands and for improving the total welfare of every Nigerian as well encourage economic growth and development; therefore, it is imperative to estimate the level of economic growth and development in Nigeria.

According to World Bank (2021), the role of taxation in generating funds for investments cannot be over emphasized; For instance, taxation can stimulate complete and sustainable growth and development in other means. More gender responsive tax design may assist in achieving sustainable domestic objectives; on gender equality as well as the empowerment of entire women and girls. The study argues that one of tools to influence gender equality via taxation are tax policies connected to small and medium-sized enterprises, because a large number of developing countries women are overrepresented as workers in small and medium-sized firms and at the lowest wage levels. Tax design may have effects on other parts in sustainable growth and development like infrastructure investment national and global tax incentives, environmental sustainability like carbon taxes, and taxes on harmful and unhealthy goods and services. According to Committee of Experts on International Cooperation in Tax Matters (2018), tax design and policies are helpful in sustaining healthy economic growth and development if they assist appreciate one or more sustainable growth and development without jeopardizing each other. For instance, although tax incentives for significant investments by multinational firms may increase their projects into domestic infrastructure yet will bring about foregone tax revenues. Those deficits are usually rewarded for by increasing taxes on products.

**2.1.3 Sustainable Economic Growth and Development**

According to Committee of Experts on International Cooperation in Tax Matters (2018), the mobilization and efficient use of domestic revenues are fundamental in the pursuit of sustainable economic growth and development. Sound tax design serves as a powerful

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instrument to aid finance attainments of the sustainable economic growth and development. Sufficient domestic and international fiscal policies can also play a significant role in minimizing inequalities and encouraging optimistic sustainable economic development guides. The committee argues that government should recognize the significant role to be played by development-oriented tax design, restructured and progressive tax systems as well as further efficient tax collection process. OECD (2011) also asserts that taxation serves as one of the most imperative means in which developing countries can mobilize domestic revenues for investment in sustainable development. World Bank (2021) argues that effective domestic revenue mobilization is an indispensable tool for developing nations' capacities to fund their development targets in a sustainable and equitable conduct (World Bank, 2020). This assessment centers on the World Bank Group's collaboration to its clients to advance essential government domestic revenue mobilization, such as revenue from direct taxes, VAT, excises and customs and non-tax collections like royalties from extractives.

Economic growth is evaluated by changes in revenues realized periodically, productivity recorded, economic diversification and creation of employments. According to Adebowale (2019), economic growth creates 'resources which are potentially available for development in all ramifications. Soyinka (2021) is of the opinion that one of the ways of increasing government' revenue is through tax of recent times. Richards and Ekhator (2019) explain that in Nigeria, taxation for several years was not a key source of the revenue in any tier of government, but since the over dependence on revenue from oil in recent times has landed Nigeria' government into untold hardship and challenges, government at every level has been coerced by these unavoidable challenges to search for non-oil revenue via taxation because the unpredictability of the global oil market. Adversely, the transformed interest in the creation of tax revenue has brought about the proliferation of taxes as well as ill-treatment of taxing authorities. To deal with these challenges, the call for formulating a National Tax Policy was considered to state the aims of taxation together with setting up basic principles for the running of the Nigerian tax system.

### 2.2 Theoretical Review

#### 2.2.1Theory of Change for Domestic Revenue Mobilization

This study anchored on theory of change for domestic revenue mobilization demonstrated by World Bank (2021) in a study on World Bank group support for domestic revenue mobilization. The study states that the theory consists of four stages which are: inputs or activities, outputs, intermediate outcomes and outcomes. Activities have four branches which are domestic revenue mobilization includes tax revenues, tax efficiency, tax equity and royalties' management. Once tax revenue activities are carried out, the theory argues that the outputs will be improved and modernized tax approach, database and identification; reduction in the cost of compliance which is established by advancement in control as well as audit arrears improvement; improvement in institutional structure and capacity; and increase in communication, information campaigns and survey and tax education. Its intermediate outcome will strengthen revenue system as well as inter-agency coordination.

The next activity is tax efficiency which leads to reduction in tax exemptions, simplifying tax and elimination of distorting taxes, based erosion and profits shifting regulation, reduction in stamp duties as well as nuisance taxes. Its outputs include identification of entities that are taxable; determination of tax liability and educating tax payers. Its associated intermediate outcomes include enhancement of tax bases, tax system efficiency, and tax equity. The third activity is tax equity. The theory believes that tax equity involves introduction of equity in tax schedule and value added tax exemption for those who engage in social transfers. Output of tax equity includes facilitation of voluntary compliance, representation in tax arguments; and novel or revised tax classification and brackets. World Bank (2021) argues that tax equity has intermediate outcome which includes advancement in extractive sector fiscal stance. The fourth input is royalties' management. It involves support to tariff rationalization as well as tariff management, and adoption of tariff and subsidy strategy guidelines. Its output includes better exploit of workers and revenues, effective coordination with the rest of tax division, increase in tax compliance and improvement in taxpayers' data in database. Finally, the theorist asserts that all these activities or inputs produce the following outcomes: increase in taxpayers' compliance, trust and enforcement; broaden the tax base, increase in government revenue realized and advancements in investment climates associated to taxation.

#### 2.2.3 Empirical Review

Qbi and Ifelunini (2019) examine mobilization of domestic resources for economic development financing in Nigeria: Does tax matter? The study investigates the flow of external debts and its negative impact on the sustainable financing of development in developing countries. It uses time series data employing Autoregressive Distributed Lag Model and Error Correction Model to evaluate the level of relationship subsists between the explanatory variables and dependent variable. The study finds that lagged values of tax and total export matter in domestic resource mobilization. It also discovers that particular lagged figures of taxation showed an inverse connection with development which indicates some percentage of frail administrative tax design, tax evasion and bureaucrat corruption.

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Morrissey (2015) studies aid and domestic resource mobilization with a focus on Sub-Saharan Africa. The study's theory reveals that there are diverse means in which aid can have inverse influences on tax revenue while direct impacts arise since aid and tax are substitute avenues of revenue. Political economy factors affect the selections made by government. Study also shows that aid may deject tax attempt if disclosed as a politically low costly means of revenue. It argues that diverse circumstances, the policies as well as reforms connected with aid possibly will raise revenue, via encouraging growth, promoting further proficient tax structures, or sustaining reforms to tax administration. Cross-country proof shows no systematic model, country research works indicate that aid can be related to administrative and competent reforms to raise tax revenue.

Mascagni (2016) studies aid and taxation in Ethiopia using pre-estimation test and a regression to evaluate the relationship between aid and taxation. The finding of study reveals that aid has significant positive relationship aid and tax revenue. Ayoki et al. (2005) investigates tax reforms and domestic revenue mobilization in Uganda employing a statistical tool and the study's finding indicates that domestic revenue mobilization has positive relationship with tax, on the other hand has perceptive coefficients between indirect and direct taxes. Fakile *et al*. (2014) examine mobilizing domestic revenue for sustainable development in Africa, using comparative analysis to appraise the level of domestic revenue mobilization in African countries. The study's finding indicates that tax revenue has positive relationship with domestic revenue mobilization because tax revenue contributes positively to domestic revenue mobilization.

Ohemeng and Owusu (2013) examine implementing a revenue authority model of tax administration in Ghana: An organizational learning perspective, adopting social learning theory as well as revenue authority model. The study's finding shows that the mission of domestic revenue mobilization occasioned initiation of several tax reforms in Ghana. Smith and Wahba (1995) conduct a study on the role of public finance in economic development: an empirical investigation using statistical tool to evaluate the relationship that exists between government tax and economic development. The study focuses on function played by government in financing economic development of many developing nations. The empirical finding shows that tax plays a significant function in the development of these nations.

## 3.0 METHODOLOGY

This work used a regression analysis to investigate the effect of tax design and domestic revenue mobilization on sustainable economic growth and development. Internally Generated Revenue (IGR) and Value Added Tax (VAT) are used as proxies for tax design and domestic revenue mobilization while Real Gross Domestic Product (RGDP) is used as an index for sustainable economic growth and development. The study used the panel data econometric technique to test the significance of various explanatory variables (IGR and VAT). The study formulated a model for the purpose of the panel data analysis in this study. The model is specified as follows:

RGDP = f (IGR and VAT) …….(3.1)

$RGDP = \beta_0 + \beta_1 IGR + \beta_3 VAT + \varepsilon_t$ ……...……..… (3.2)

Where:

RGDP = Real Gross Domestic Product; IGR = Internally Generated Revenue; VAT = Value Added Tax; $\varepsilon_t$ = Stochastic error term; $\beta_0$ = Constant/Intercept; $\beta_1$….. $\beta_3$ = Regression coefficients

### 3.2 Measurement of Variables

| S/N | Variable | Definitions | Capacity of Variables | Measurements/Proxies | Aprior Expectation |
|---|---|---|---|---|---|
| 1 | RGDP | Real Gross Domestic Product | Dependent | Disclosure | NA |
| 2 | IGR | Internally Generated Revenue | Independent | Disclosure | +ve |
| 3 | VAT | Value Added Tax | Independent | Disclosure | +ve |

***Source: Researcher's Compilations (2021)***

### 3.3 Sources of Data

The data employed in this study are from secondary sources. This study used the periodic data of RGDP, IGR and VAT on the Central Bank of Nigeria database and other relevant books spanning a 24-year period (1997 to 2020). From 1997 to 2008 stood for pre- domestic revenue mobilization crusade and 2009 to 2020 stood for during. The choice of variables and periods was based on nature of the subject matter and period domestic revenue mobilization relatively generally accepted among developing countries and data availability in the Central Bank of Nigeria annual statistical bulletin as well as for convenience (OECD, 2019).

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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## 4.0 RESULTS

The pre-estimate test of the data is first carried out which are descriptive and correlation analysis, and thereafter the regression panel analysis is employed. The outcomes and findings are presented and interpreted as follows;

**Table 1: Descriptive statistics of Pre and during Domestic Revenue Mobilization in Nigeria**

| During 2009-2020 | Mean | Median | Maximum | Minimum | Std. Dev. | Jarque-Bera | Probability | Observations |
|---|---|---|---|---|---|---|---|---|
| RGDP | 3.617083 | 3.496144 | 9.539786 | -1.92 | 3.592002 | 0.394630 | 0.000932 | 12 |
| IGR | 30.77742 | 30.46888 | 38.21168 | 24.03051 | 4.638369 | 0.780668 | 0.000031 | 12 |
| VAT | 286.5061 | 267.0904 | 479.9616 | 157.3786 | 91.33913 | 0.972241 | 0.005008 | 12 |
| **Pre 1997 to 2008** | **Mean** | **Median** | **Maximum** | **Minimum** | **Std. Dev.** | **Jarque-Bera** | **Probability** | **Observations** |
| RGDP | 6.740792 | 6.867216 | 14.60438 | 0.521844 | 3.775934 | 0.206672 | 0.001824 | 12 |
| IGR | 14.05070 | 15.29815 | 24.04250 | 2.734000 | 8.954447 | 1.665834 | 0.004779 | 12 |
| VAT | 44.80505 | 29.87555 | 135.9181 | 6.826100 | 41.76008 | 2.202774 | 0.002410 | 12 |

**Source: Researchers Compilation (2021)**

From the descriptive statistics of the variables as revealed in table1 above, it was discovered that before acceptance of crusade for domestic revenue mobilization (1997 to 2008) by most of developing countries, the mean of RGDP stood at 3.6171 while minimum and maximum values stood at -1.92 and 9.5398 respectively. The mean for IGR stood at 30.7774 with minimum and maximum values of 24.0305 and 38.2117 respectively. VAT had a mean value stood at 286.5061 with minimum of 157.3786 and maximum value of 479.9616. The matching estimates for pre- crusade for domestic revenue mobilization (1997-2008) showed that the mean RGDP, IGR and VAT values stood at 6.7408, 14.051 and 44.8051 were lesser than those values of the during domestic revenue mobilization except for RGDP because of impact of oil revenue on RGDP as at those periods. This analysis shows that the during domestic revenue mobilization explanatory variables have greater means than pre domestic revenue mobilization crusade. The Jarque-bera statistics indicated that the data were significantly normal in the both sectors.

**Table 2: Comparative Correlation Matrix of Pre and during Domestic Revenue Mobilization in Nigeria**

| 2009-2020 | RGDP | IGR | VAT |
|---|---|---|---|
| RGDP | 1.000000 | | |
| IGR | 0.537434 | 1.000000 | |
| VAT | 0.602328 | 0.331962 | 1.000000 |
| 1997- 2008 | RGDP | IGR | VAT |
| RGDP | 1.000000 | | |
| IGR | 0.501681 | 1.000000 | |
| VAT | 0.240030 | 0.795889 | 1.000000 |

**Source: Researchers Compilation (2021)**

Table 2 above shows the Pearson correlation coefficient outcome for the variables. The table revealed that during Domestic Revenue Mobilization in Nigeria (IGR and VAT) showed to be positively correlated with RGDP as depicted by the correlation coefficient of 0.5374 and 0.6023 respectively. For the Pre-Domestic Revenue Mobilization in Nigeria all explanatory variables showed positive correlations with RGDP as depicted by the correlation coefficient of 0.5017 and 0.2400. It was discovered that the correlation coefficients of the variables with RGDP for during Domestic Revenue Mobilization in Nigeria were higher than those coefficients with RGDP in the Pre-Domestic Revenue Mobilization in Nigeria. On the other hand, this does not inevitably propose causality. The coefficients of correlation also do not stimulate grave notion of multicollinearity between the explanatory variables and dependent variable.

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**Table 3: Regression Analysis**

| Domestic Revenue Mobilization in Nigeria | DURING | | PRE | |
|---|---|---|---|---|
| Variables | Coefficient | Prob. | Coefficient | Prob. |
| IGR | 0.0759 | 0.0428 | 0.3574 | 0.0191 |
| VAT | 0.0220 | 0.0011 | 0.0392 | 0.0037 |
| C | 14.8750 | 0.0051 | 3.4797 | 0.0100 |
| R-squared | 0.90520 | | 0.52081 | |
| Adjusted R-squared | 086965 | | 0.5099 | |
| S.E. of regression | 1.29684 | | 3.4401 | |
| Sum squared resid | 13.4545 | | 106.511 | |
| Log likelihood | -17.7137 | | -30.127 | |
| F-statistic | 25.4631 | | 2.1261 | |
| Prob(F-statistic) | 0.0000 | | 0.0017 | |
| Durbin-Watson stat | 1.9257 | | 1.8118 | |

**Source: Researchers Compilation (2021).**

The table 3 reveals the regression result carried out using Eviews 8.0. The norm in numerous studies in evaluating tax design and domestic revenue mobilization on sustainable economic growth and development has been to investigate the competence of the coefficient of determination or else known as the $R^2$. The estimation indicates that for the pre domestic revenue mobilization in Nigeria with the $R^2$ is 0. 52 and reveals that tax design and domestic revenue mobilization i.e. IGR and VAT were able to explain about 52 % of the systematic variations in RGDP which was lesser than the $R^2$ of 0.90 found for data during periods of domestic revenue mobilization in Nigeria. Furthermore, the F-statistics shows that the null hypothesis of no significant linear relationship between the endogenous and exogenous variables is rejected for during domestic revenue mobilization while the F-statistics shows that null hypothesis of no significant linear relationship between the endogenous and exogenous variables is rejected for pre domestic revenue mobilization in Nigeria but less than the former. Particularly, this study discovers that all the explanatory variables have a statistically significant positive relationship with RGDP for both pre and during domestic revenue mobilization in Nigeria.

### 4.1 Discussion of Findings

The data analyses carried out in the study reveal that government has more revenue generated through tax design and domestic revenue mobilization after 2008 when the policies were in operations. The findings of this study depict that tax design and domestic revenue mobilization has statistically significant positive relationship with RGDP of both periods. This is constant with OECD (2009) when it observed that there had been improvements in revenue raising attempt of Sub-Saharan African countries; Smith and Wahba (1995); Fakile *et al*. (2014) but not in agreement with work of Qbi and Ifelunini (2019).

The regression analysis among others proposes that all the explanatory variables were considered in this study, to be more relevant, due to the fact that all of them have a significant positive relationship with the RGDP. In addition, this study discovered that the contributions of domestic's revenue mobilization in Nigeria were more within 2009 to 2020 than the revenue collected when more attention was not given to domestic revenue mobilization represented by 1997 to 2008 revenue obtained through VAT and IGR. This implies that more attention should be given to tax design and domestic revenue mobilization.

## 5.0 CONCLUSION AND RECOMMENDATION

The tax design and domestic revenue mobilization serve as one of the potential avenues for generating revenue. This study examines the effect of tax design and domestic revenue mobilization on Nigerian sustainable economic growth and development. Extant studies evaluated the dependent variable employing $R^2$ statistics of the regression product; showing that the higher the $R^2$ statistics the more relevant the tax designs and domestic revenue mobilization are. This study, being a comparative study of tax design and domestic

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revenue mobilization between the period the policies were not given attention and periods relatively attention was given in the Nigerian economy, discovers that the tax design and domestic revenue mobilization in these periods are very vital; although the contributions of tax design and domestic revenue mobilization when attention was given is more relevant and thus can affect the sustainable economic growth and development in Nigeria. This study therefore recommends that more efforts should be put on the tax design and domestic revenue mobilization in Nigeria by those who are charged with responsibilities to regulate and ensure international standards are complied with and maintain its qualitative characteristics. This is one of the avenues through which the tax design and domestic revenue mobilization be improved over the period of time.

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
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# SPECIFIC ASPECTS OF IDEOLOGICAL EDUCATION IN IMPROVING THE SPIRITUAL IMAGE OF THE FUTURE CIVIL SERVANT

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**Article DOI: https://doi.org/10.36713/epra18067**
**DOI No: 10.36713/epra18067**

**ABSTRACT**
*This article explores the crucial role of spiritual and educational work in building a stable and prosperous society, particularly within the context of Uzbekistan. It highlights the importance of cultivating a mature generation and ensuring justice, rule of law, and security through effective public service. The article analyzes the recent "Concept of organizing spiritual and educational work in the prosecutor's office" in Uzbekistan, emphasizing its significance in achieving the nation's goals. Drawing upon the President's emphasis on the importance of "spiritual sustenance," the article identifies key tasks for fostering a highly spiritual society, including promoting patriotism, social cohesion, and individual initiative.*
**KEY WORDS:** *spiritual and educational work, public service, prosecutor's office, rule of law, security, stability, patriotism, social cohesion, religious tolerance, ideology, nationalism, chauvinism, political culture.*

## INTRODUCTION

It is clear to everyone how complex the development stage of today's era is. In the presence of external influences and geopolitical targets, any developing society must ensure its internal and external stability. One of the main factors that make this happen is the effective implementation of spiritual and educational work. This is a complex process that serves the whole society to strive towards a common goal.

According to the priority tasks aimed at building a new Uzbekistan, It is necessary to develop and implement a completely new approach and principles in order to raise a mature generation and guarantee justice, rule of law, security and stability in society. Such important work should first of all begin with the development of targeted measures that change the worldview of every civil servant.

## THE MAIN PART

The progress or crisis of any society is primarily related to the issue of personnel, i.e. public service. We must not forget that the scientific potential, professional skills, moral rules, and high moral image of the public service employees trained by the state and entrusted with the authority of service will determine not only the society but also the future fate of the country.

In this regard, by the President of the Republic of Uzbekistan Shavkat Mirziyoyev on May 31, 2023, Resolution **No. PR-170 "On additional measures to increase the moral and intellectual potential of employees in ensuring the rule of law and closer cooperation of prosecution bodies with the population in our country"** was adopted [1]. Based on this resolution, the **"Concept of organizing spiritual and educational work in the prosecutor's office"** and the **"Roadmap"** for its implementation were approved. At the moment, this guiding regulatory document, which determines the effectiveness of spiritual and educational work in the system of the Prosecutor's Office, is of great importance in the implementation of the priority goals and objectives of the state.

Therefore, the main driving force of ideology in our society is "Spirituality", and it is everyone's duty to serve to elevate it. In this sense, as stated by the head of state Shavkat Mirziyoyev, "There will never be space in the field of ideology. Because a person's heart, brain, and thoughts never stop receiving information, thinking, and being influenced. So, a person always needs spiritual sustenance. Tell me, what will happen if this sustenance is not obtained from the existing environment or is not satisfied with this environment? People gradually look for such food elsewhere. We should not allow this. Here's what it's all about! For this, all people (whether it be neighborhood or religious organizations, law enforcement officers, or influential creative intellectuals) who consider themselves responsible for the spiritual, ideological and ideological education of our youth in our society should be active" [2].

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Therefore, today all members of the society are able to be highly spiritual, the main factor of the country's development, and there are a number of tasks that experts in this direction must know and apply in life. These include:

- Formation of the spirit of unlimited love for the Motherland and the nation in citizens, to explain that the sanctity of the homeland is a blessed place that gives meaning to one's life;
- Development and expansion of universal qualities in people, such as social cooperation, interethnic harmony, religious tolerance, to explain that aggressive nationalism and chauvinism are the evils that lead to inter-ethnic harmony;
- Strengthening initiative for the development of the country;
- Creating a creative environment in society, instilling in every employee a sense of courage in relation to the events happening around him, eliminating negative situations such as indifference;
- Increasing the political culture of people, to increase the level of understanding of the priority goals and tasks facing the state and society;
- Formation of the ability to analyze the events taking place in the political life of our country;
- Forming the spiritual world and outlook of society members;
- It is aimed at increasing the social activity of citizens, raising the level of political and legal knowledge, forming the ability to evaluate the events taking place in the world, and helping them to consciously understand ideological and ideological processes.

In this sense, it is necessary to pay special attention to imparting ideological knowledge in order to form ideological immunity in young people. When it comes to imparting ideological knowledge, the historical works, which are written about the events of the past, reflect the priority of imparting ideological knowledge to young people. For example, Nizamulmulk's (11th century) work "Politics" puts forward the idea of educating young people to be useful for the state, society and people's work. For this, it is necessary to give young people the following ideological knowledge:

- ✓ Active participation in state affairs;
- ✓ Protecting the homeland from the enemy;
- ✓ Being at the service of the people;
- ✓ Relying on the power of knowledge in activities;
- ✓ Learning from the good and avoiding the bad [3].

These recommendations of Nizamulmulk are relevant even after thousands of years. In the process of ideological education of young people, it is appropriate to take into account these recommendations. With this, characteristics such as patriotism and self-sacrifice will be strengthened in the minds of young people, and they will become socially active.

It is necessary not to forget that spirituality is the force that shapes ideological education in society and sets it in motion. Also, in cases where that society or nation has not yet understood its interests, has not yet formed its ideology, and is not mobilized towards its stated goals, the possibility of being influenced by foreign and harmful ideas increases.

We can say that the legal awareness and literacy of society members is growing year by year as a result of the large-scale reforms implemented in Uzbekistan today in the systematic implementation of the activities of the Prosecutor's Office and law enforcement agencies. In this regard, improving the moral image of not only certain employees working in the system of prosecutor's offices, but also civil service workers can be a solution to today's current problems.

As a result of research, we would like to give the definition of *"the spiritual image of a civil servant is the development of spiritual and moral qualities of an employee during the period of service activity, along with political and legal knowledge, professional skills and abilities, education of conscience, education of thought, spiritual competence"*.

This means that the Russian scientist E.V.Okhotsky's opinion that "civil servants are the accumulators of the unity of public administration, law and public morality" [4] indicates civil servants are the accumulators of the state.

Al-Farabi, an encyclopedic sociologist, explained his views on the qualities of the ruler, the qualities of citizens and the qualities of civil servants, what are the characteristics of the city of virtuous people and the city of ignorant people, distinguishing features one by one in his work "The City of Virtuous People". He "mainly focused on the concepts of society, individual, citizen and state. He also expressed his views on what virtues and emotions the ruler, officials, and servants of the country should have, what the common people should expect from the ruler of the country"[5], and the need to always have moral virtues in state power.

Ideas that develop the morale of employees working in the Prosecutor's Office, which is one of the main parts of state administration in the stages of development, the practical importance of organization of activities based on "service rendered by state agencies to our people is the main criterion for pleasing people" and "State service to the people[6]" in Uzbekistan as well as in the developed countries of the world is increasing day by day.

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In particular, the equal right of citizens to enter the public service increases the competitiveness, openness and professionalism of the public service. The equal right of competent young people and women to enter the public service will increase confidence in the public service and prevent the departure of talented, modern-minded personnel to foreign countries and the prevention of corrupt situations. This will serve to form the new "national personnel corps" that we have set before us.

Therefore, in the 21st century, the participation of mainly young people in the world-wide conflict events is increasing day by day, which serves a number of factors "...the fact that young people are at the center of global conflicts in the new century shows that the problem is becoming more acute. The easy exposure of young people to the influence of various radical ideas and fundamental ideologies creates a serious threat to the stability of the state and society[7]."

In particular, it is necessary to emphasize that the protests against the stable management system of Kazakhstan, Kyrgyzstan, Germany, France, the USA, Russia and other developed countries are caused by the ideological insatiability of civil servants. For example, the fact that the laws and decisions adopted in the way of public administration do not reflect the interests of the people lead to people's objections to the administration.

Although the above-mentioned events in foreign countries are sad, they also happened in the history of our country. In particular, it is necessary to conduct a deep systematic analysis of the occurrence of incidents like Andijan and Karakalpak events - the center of supernatural forces is mainly directed at state administration agencies and civil service employees. In this case, we can understand the existence of a certain gap in the field of management by the enemy, and the quality of the target of actions in the direction of their own interests, as a result of studying the determination of that gap.

Conclusions and suggestions. In conclusion, we believe that it is better to study the causes of the artificially created instability in various countries today and to take measures to eliminate it than to eliminate the disappointing situations that have arisen. The strength of the ideological immunity of employees in the field of public administration is considered an important factor in maintaining a stable state of society.

It is now more important than ever to establish moral ideals by preserving the timeless image of public servants, such as Andijan city prosecutor Ganijon Abdurahimov. He is celebrated as one of the dedicated public servants who sacrificed their lives in loyalty to their duty and homeland, and is remembered in history as an example of unwavering professional dedication. After all, today's societal demand is to cultivate a newly educated personnel corps, imbued with ideological and moral education in their respective fields, to achieve a prosperous homeland.

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EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# DYNAMICS OF CHANGES IN THE INDICES OF LIPID PEROXIDATION AND ANTIOXIDANT SYSTEM IN RATS WITH ALLOXAN DIABETES, MODELED ON THE BACKGROUND OF THE PRELIMINARY TOXICITY OF HEAVY METAL SALTS

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**Article DOI: https://doi.org/10.36713/epra18041**
**DOI No: 10.36713/epra18041**

## ABSTRACT

***Aim**: to study the processes of lipid peroxidation and the antioxidant defense system in rats with alloxan-induced diabetes against the background of isolated and combined exposure to lead and chromium salts.*

***Materials and methods**: an experimental study was conducted on 90 outbred male rats weighing from 230 to 270 g, divided depending on the intoxication caused into 8 subgroups: intact; subgroup "lead"; subgroup "chrome", subgroup "lead+chrome"; subgroup – alloxan diabetes in intact rats – "control"; subgroup – alloxan diabetes in rats exposed to lead – "lead + alloxan"; subgroup – alloxan diabetes in rats exposed to chromium - "chromium + alloxan"; subgroup - alloxan diabetes in rats that were simultaneously exposed to lead and chromium - "lead + chromium + alloxan". The rats were slaughtered under ether anesthesia after 30 days of metal priming, as well as on days 3 and 14 after the administration of alloxan. After decapitation, the liver was removed from the animals, washed with cold saline and frozen, then a 10% homogenate was prepared, where the content of diene conjugates, malonic dialdehyde, catalase and superoxide dismutase activity. The concentration of lead and chromium in the blood of rats was determined at the end of a 30-day priming using inductively coupled plasma atomic emission spectrometry.*

***Results:** Experimental alloxan diabetes, modeled in terms of the combined action of compounds of lead and chromium, in contrast to alloxan diabetes on isolated background of their action was characterized by a decrease in SOD enzyme activity compared to the level before the introduction of diabetogen. The combined effect of these metals reduces the resistance β-cells of the pancreas to the diabetogenic action of alloxan to a greater extent than their isolated effects. Isolated exposure to lead acetate resulted in increased diene levels conjugates by 13%, the isolated effect of potassium bichromate - by 18%, while the combined effect of lead and chromium - by 50% compared to intact rats. Malon content dialdehyde in the "lead" group and in the "chromium" group increased by 13%, in the "lead + chromium" group – by 68% in relation to intact animals. Increased lipid peroxidation processes in liver cells led to the activation of superoxide dismutase, the activity of which increased by 8% in the lead group, by 21% in the chromium group, and by 45% in the lead + chromium group compared to intact rats. While isolated exposure to lead and chromium had virtually no effect on the enzymatic activity of catalase, the combined influence of metals led to an increase in catalase activity by 13% compared to intact animals.*

***Conclusions**: isolated exposure to both lead and chromium activates the processes of lipid peroxidation in the liver of animals to approximately the same extent, does not affect the enzymatic activity of catalase, but the introduction of potassium dichromate activates superoxide dismutase by 12% more than exposure to lead acetate. The combination of these metals activates the processes of lipid peroxidation and the activity of superoxide dismutase to a greater extent than the isolated action of metals, and unlike the isolated action of lead and chromium, the combination of metals increases the activity of catalase.*

***Key words:** experiment, alloxan diabetes, oxidative stress, lipid peroxidation, antioxidant system, intoxication, lead, chromium*

Due to exposure to harmful agents of relatively low intensity, the occurrence or absence of diseases is largely determined by the state of the body's adaptive systems, however, their long-term, combined or combined influence leads to disadaptation and disregulation disorders, leading to the depletion of protective mechanisms, which in turn contributes to the development and/ or worsening of the disease [1,2]. Any adaptation or pathological process occurs against the background of the formation of reactive oxygen species and the intensification of free radical oxidation of biosubstrates [3]. At the same time, despite outstanding research in the field of studying diabetes mellitus and related metabolic disorders, the presence of numerous screening programs for the timely detection of the disease, many unresolved questions remain for the diabetes service and science in general [4]. Thus, not enough attention is paid to the study of the effects of heavy metal compounds on the development of diabetes mellitus, although

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

there is evidence in the literature that diabetes mellitus develops more often in people employed in industries associated with lead, chromium, nickel and other heavy metals [5]. In this case, it is important to establish the nature of the influence of heavy metals not only on the development, but also on the aggravation of diabetes.

## THE PURPOSE OF OUR STUDY

was to study the processes of lipid peroxidation (LPO) and the antioxidant defense system (AOD) in rats with alloxan diabetes against the background of isolated and combined exposure to lead and chromium salts.

## MATERIALS AND METHODS

The experimental study was carried out on 90 outbred male rats weighing from 230 to 270 g. The maintenance, care of the animals and their removal from the experiment were carried out in accordance with the order of the Ministry of Health of the Republic of Kazakhstan dated July 25, 2007 No. 442 "On approval of the rules for conducting preclinical research, medical and biological experiments and clinical trials in the Republic of Kazakhstan". Depending on the intoxication caused, the experimental animals were divided into 8 subgroups: 1 subgroup - intact animals, which were injected with an equal volume of 0.9% NaCl solution for 30 days; subgroup 2 – rats that received a 1% solution of lead acetate at a dose of 15 mg/kg body weight daily for 30 days ("lead" subgroup); subgroup 3 – rats that received a 0.5% solution of potassium dichromate at a dose of 5 mg/kg body weight, also daily orally for the same period – "chromium"; subgroup 4 – rats that received combined metal priming by daily oral administration of potassium bichromate + lead acetate for 30 days – "lead + chromium"; subgroup 5 – alloxan diabetes in intact rats – "control"; subgroup 6 – alloxan diabetes in rats exposed to lead – "lead + alloxan"; subgroup 7 – alloxan diabetes in rats exposed to chromium - "chromium + alloxan"; Subgroup 8 – alloxan diabetes in rats that were simultaneously exposed to lead and chromium – "lead + chromium + alloxan".

After 30 days, diabetes mellitus was modeled in animals of the first four subgroups with a 5% solution of alloxan (Reakhim) at a dose of 15 mg per 100 g of body weight by a single subcutaneous injection after a 48-hour fast [6,7]. The rats were slaughtered under ether anesthesia after 30 days of metal priming, as well as on days 3 and 14 after the administration of alloxan. After decapitation, the liver was removed from the animals, washed with cold saline and frozen, then a 10% homogenate was prepared, where the content of diene conjugates (DC), malonic dialdehyde (MDA) [8], catalase and superoxide dismutase (SOD) activity [9,15]. The concentration of lead and chromium in the blood of rats was determined at the end of a 30-day priming using inductively coupled plasma atomic emission spectrometry.

Static processing of the material was carried out using the statistical software package Statistica 6 ("StatSoft" USA). The reliability of intergroup differences was assessed using Student's t-test.

## RESULTS AND DISCUSSION

Studies have shown that in animals on the 30th day of isolated and combined exposure to metals in the liver, there was an increase in the content of lipid peroxidation products - DC and MDA, which indicated the activation of lipid peroxidation processes. The obtained data are presented in Table 1.

**Table 1**
**Indicators of LPO and AOD in the liver after 30 days of priming with metals (M±m)**

| Indicators | Subgroups of Animals | | | |
|---|---|---|---|---|
| | Intact | Lead | Chromium | Lead+Chrome |
| DC (μmol /ml) | 0.8±0.05 | 0.9±0.03* | 0.94±0.02* | 1.2±0.02* |
| MDA (μmol /ml) | 0.8±0.04 | 0.9±0.03* | 0.9±0.01* | 1.34±0.02* |
| SOD (U/ml/min) | 8.36±0.1 | 9.0±0.2* | 10.1±0.2* | 12.1±0.6* |
| Catalase (cat/l) | 678±1.2 | 682±1.9 | 680±6.4 | 766.9±9.1* |

Note: * - differences are significant compared to intact rats ($p \leq 0.05$)

Thus, from Table 1 it is clear that isolated exposure to lead acetate (the "lead" subgroup) led to an increase in the level of DC by 13%, isolated exposure to potassium bichromate (the "chromium" subgroup) - by 18%, while the combined influence of lead and chromium (subgroup "lead + chromium") led to an increase in DC content by 50% compared to intact rats. The MDA content in the "lead" subgroup and in the "chrome" subgroup increased by 13%, in the "lead + chromium" subgroup – by 68% in relation to intact animals. Activation of LPO processes in liver cells, in turn, led to activation of SOD, the activity of which increased by 8% in the "lead" subgroup, by 21% in the "chrome" subgroup, and by 45% in the "lead + chromium" subgroup. compared with intact rats. At the same time, isolated exposure to lead and chromium had virtually no effect on the enzymatic activity of catalase; the combined influence of metals led to an increase in catalase activity by 13% compared to intact animals (Fig. 1).

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

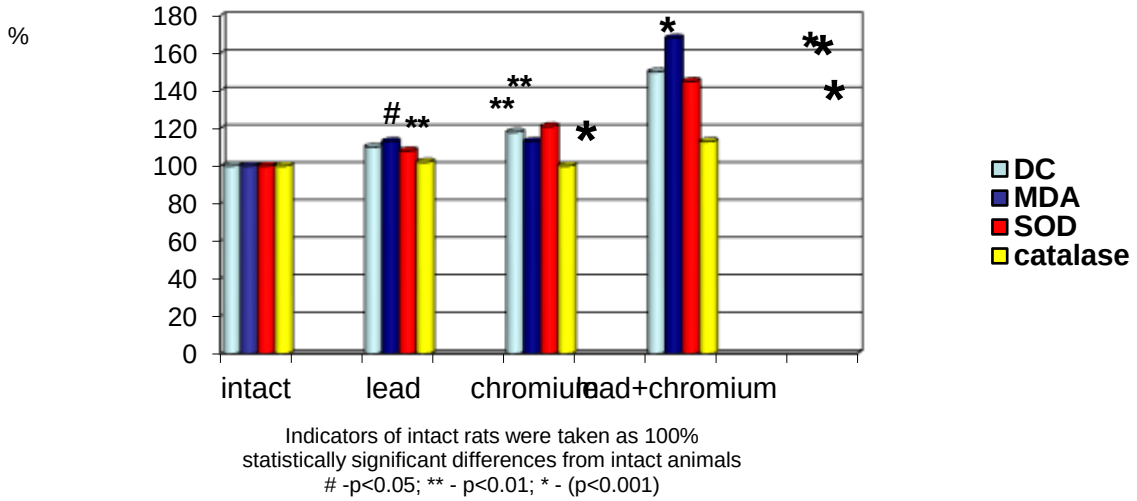


**Figure 1. Indicators of the LPO-AOP system in the liver of rats exposed to isolated and combined exposure to lead and chromium for 30 days**

Thus, studies have shown that isolated exposure to both lead and chromium activates lipid peroxidation processes in the liver of animals to approximately the same extent and does not affect the enzymatic activity of catalase, but the introduction of potassium dichromate activated SOD by 12% more than exposure to acetate lead Meanwhile, the combination of these metals activated lipid peroxidation processes and SOD activity to a greater extent than the isolated effect of metals, and in contrast to the isolated effect of lead and chromium, the combination of metals increases the activity of catalase.

A comparative analysis of the "lead + chromium" subgroup with animals under conditions of isolated exposure to metals revealed that the shift in the equilibrium in the LPO-AOP system in the case of simultaneous exposure to metals was more significant $K_{LPO} / _{AOD} = 2$ than in the "lead" subgroups $K_{POL} / _{AOZ} = 1.1$ and "chrome" $K_{POL} / AOZ = 1.3$.Summarizing the above, it can be noted that simultaneous exposure to metals leads to more pronounced activation of free radical oxidation (FRO) processes, as a result of which an excess of free radicals induces LPO, which in turn can lead to greater damage to pancreatic β- cells.

Alloxan diabetes in laboratory animals is a model of insulin-dependent diabetes, in the pathogenesis of which the progressive death of pancreatic β-cells plays a key role [10,11]. In our experiment, the development of diabetes with the administration of alloxan was accompanied by further activation of lipid peroxidation processes and a decrease in AOP, probably due to selective damage to pancreatic β-cells by alloxan, which, as a result of conversion to dialuric acid, generates free radicals and promotes the production of reactive oxygen species that cause rupture DNA and death of insulinocytes [12,13,16].

**Table 2**
**Dynamics of LPO and AOP parameters in the liver after alloxan administration (M± m)**

| Indicators | Subgroups Of Animals | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Intact+ Alloxan | | Lead+Alloxan | | Chromium+Alloxan | | Lead+ Chrome+ Alloxan | |
| | 3 days | 14 days | 3 days | 14 days | 3 days | 14 days | 3 days | 14 days |
| DC (μmol/l) | 1.11+0.04 ** | 1.04±0.02 | 1.1+0.05 ** | 1.01±0.01 | 1.12+0.04 ** | 1.06±0.03 | 1.22±0.02 | 1.16±0.03 |
| MDA (μmol/l) | 1.05±0.02 ** | 1.2±0.01▼ | 1.01±0.02 ** | 1.2±0.01▼ | 1.1±0.02 ** | 1.3±0.02▼ | 1.4±0.01 ** | 1.5±0.02 ▼ |
| SOD (U/ml/min) | 12.5±0.2 ** | 10.14±0.2 ▼ | 13.4±0.4 ** | 10.42±0.5 ▼ | 13.38±0.4 ** | 10.2±0.4▼ | 12.02±0.6 | 10.7±0.3 ▼ |
| Catalase (cat/l) | 756.2±3.5 ** | 692.7±5.7 ▼ | 720.2±5.4 ** | 698±3.7▼ | 722.2±5 ** | 697±4.6▼ | 778±5 | 771.2±11.1 |

Note: ** - differences are significant compared to the corresponding initial indicators;
▼ – compared with the corresponding indicators on the 3rd day (P ≤0.05)

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Table 2 shows that on the 3rd day after the administration of alloxan in the subgroup of rats "intact + alloxan" - control, there was an increase in the content of DC by 39% and MDA by 31%, SOD activity increased by 50%, catalase by 12%. compared to the corresponding source data. In the "lead + alloxan" subgroup, on the 3rd day after the administration of alloxan, the content of DC increased by 22%, MDA by 12%, SOD activity by 50%, catalase by 6% compared with the corresponding initial indicators. In the "chromium + alloxan" subgroup during these periods, the content of DC increased by 19%, MDA – by 22%, the enzymatic activity of SOD increased by 32%, catalase – by 6% compared to the initial data.

The introduction of alloxan in the "lead + chromium + alloxan" subgroup on the 3rd day had virtually no effect on the level of DC, as well as on the activity of SOD, the activity of catalase tended to decrease, while the level of MDA increased by 4% relative to the initial data.

When assessing the state of balance in the LPO-AOP system on the 3rd day after the administration of alloxan in the "lead + chromium + alloxan" subgroup, the balance coefficient was equal to 2.1, while in the control subgroup it was 1.1; in the "lead + alloxan" subgroup - 1 and in the "chromium + alloxan" subgroup - 1.2.

The correlation analysis carried out revealed a close positive relationship between the indicators of LPO and AOD processes $r = +1$, indicating the presence of a balance in the LPO-AOD system. In addition, the decrease in the value of the balance coefficient of the LPO-AOP system compared with that on the 30th day of priming indicates that we administered alloxan to rats of this group against the background of preliminary adaptation to the toxic effects of lead, since the enzymatic link of the cell AOD, represented SOD and catalase, to the introduction of the second pathogenic factor, were able to adequately respond and to some extent suppress the development of SRO. In the "chromium + alloxan" subgroup, a close negative correlation was observed $r = -0.88$ ($p < 0.01$). All of the above indicates the development of a more pronounced imbalance in the LPO-AOP system and, possibly, a breakdown in adaptive capabilities in animals of this subgroup, in contrast to the control and "lead + alloxan" subgroup.

Correlation analysis in the subgroup "lead + chromium + alloxan" revealed an inverse functional relationship between indicators of lipid peroxidation processes and antioxidant protection factors, the rank correlation coefficient was equal to $r = -1$. An increase in the balance coefficient and the presence of a negative correlation indicated the inability of the enzymatic component of antioxidants to influence FRO processes in this subgroup of animals.

Thus, on the 3rd day of experimental alloxan diabetes (EAD), against the background of the combined effect of lead and chromium, compared with EAD, in intact and under conditions of isolated influence of metals, a pronounced imbalance was found in the LPO-AOP system towards the accumulation of pro-oxidants.

On the 14th day of EAD in the control subgroup, compared to day 3, the level of DC did not change noticeably, the MDA content increased by 14%, the enzymatic activity of SOD decreased by 19%, and catalase by 8%. At the same time, in the "lead + alloxan" subgroup, the content of DC tended to decrease, MDA increased by 19%, the activity of SOD and catalase decreased by 22% and 3%, respectively, compared to the data on the 3rd day. In the "chromium + alloxan" subgroup, the content of DC remained at the same level, on the contrary, the level of MDA increased by 18%, the activity of SOD and catalase significantly decreased: SOD - by 24%, catalase - by 4% compared with the corresponding indicators on the 3rd day. The DC level in the "lead + chromium + alloxan" subgroup was the highest compared to all experimental subgroups. Thus, in the control subgroup the DC content was 90%, in the "lead + alloxan" subgroup - 87%, in the "chromium + alloxan" subgroup - 91% compared to the same indicator in the "lead + chromium + alloxan" subgroup. A similar pattern was observed on the part of MDA: the content of this indicator in the control and "lead + alloxan" subgroups was 80%, in the "chromium + alloxan" subgroup - 87% compared to the MDA level in the "lead + chromium + alloxan" subgroup.

Despite the fact that in the subgroup "lead + chromium + alloxan" the maximum intensification of lipid peroxidation processes was observed, the enzymatic activity of SOD and catalase, on the contrary, decreased. Thus, SOD activity was 89% ($p \leq 0.05$), catalase tended to decrease compared to the 3rd day. When comparing these indicators with other experimental subgroups, it was found that the activity of SOD in all the studied subgroups was not statistically significantly different, while the activity of catalase in the control subgroups ( intact + alloxan ) was 89.8%, "lead + alloxan" – 90.2%, "chrome + alloxan" - 90.3% compared to the same indicator in the "lead + chromium + alloxan" subgroup.

Thus, on the 14th day of EAD, against the background of the combined action of lead and chromium, maximum activation of lipid peroxidation processes and an increase in catalase activity were observed compared with EAD in intact animals, as well as against the background of isolated exposure to metals.

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Analysis of the state of balance of the LPO-AOP system in the "lead + chromium + alloxan" subgroup on the 14th day of EAD showed a further shift in the balance compared to the 3rd day: coefficient $K_{LPO}/_{AOD} = 3.2$, i.e. 52% more than on the third day, and 220% higher compared to intact animals. In the comparison subgroups, an imbalance of these processes was also observed and the coefficient of balance of the LPO-AOP system was 3.5 in the control subgroup, 2.7 in the "lead + alloxan" subgroup and 3.8 in the "chromium + alloxan" subgroup (Fig. 2).

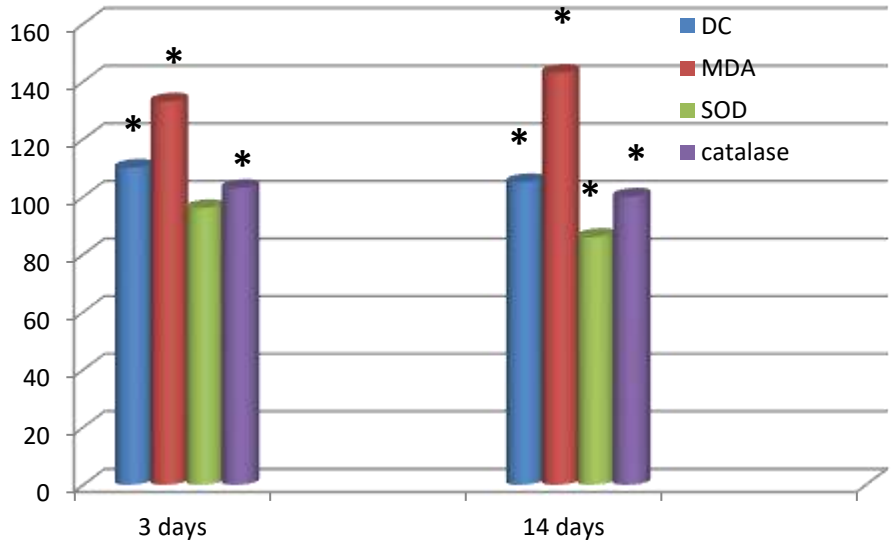


**Figure 2. Indicators of the LPO-AOP system in rats with EAD against the background of lead-chromium intoxication**

## CONCLUSION

The administration of alloxan against the background of the combined action of lead and chromium, in contrast to other subgroups of animals, led to a decrease in SOD activity below the initial level on the 14th day of diabetes. Meanwhile, in the control and "lead + alloxan" subgroups, although there was a decrease in SOD activity at the specified time, the indicators remained higher compared to the initial data. At the same time, in the "chromium + alloxan" subgroup, the SOD content on the 14th day of EAD did not differ significantly from the corresponding initial value.

Oxidative stress in diabetes mellitus is a vicious circle due to an increase in the sources of free radicals, potentiation of toxic effects and changes in the activity of AOD components, which leads to tissue damage [14,17].

Summarizing the above, we can conclude that experimental alloxan diabetes modeled under conditions of the combined action of lead and chromium compounds, in contrast to alloxan diabetes against the background of their isolated action, was characterized by a decrease in the enzymatic activity of SOD compared to the level before the introduction of the diabetogen. Considering the role of SOD as a key factor in antioxidant protection against the damaging effects of alloxan, it can be assumed that the combined effect of lead and chromium reduces resistance β- cells of the pancreas to the diabetogenic effect of alloxan to a greater extent than their isolated effect.

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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# INTEGRATING AI-POWERED TOOLS IN STEM EDUCATION: ASSESSING THE IMPACT OF CHATGPT ON PEDAGOGICAL PRACTICES IN HIGHER EDUCATION INSTITUTIONS ACROSS ASEAN

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**Article DOI:** https://doi.org/10.36713/epra18052
**DOI No: 10.36713/epra18052**

**ABSTRACT**

*This study explores the impact of ChatGPT on STEM pedagogy in Higher Education Institutions (HEIs) across the ASEAN region, focusing on its effectiveness, challenges, and the pedagogical shifts it may inspire. Using a mixed-methods approach, the research surveyed 300 educators and 1,000 students, supplemented by interviews and focus group discussions. The findings reveal that ChatGPT significantly enhances student engagement and understanding of complex STEM concepts, aligning with constructivist learning principles. However, challenges such as technological barriers, concerns about content accuracy, and the need for professional development were also identified. The study concludes that while ChatGPT has the potential to transform STEM education, its successful integration requires addressing these challenges and ensuring the tool is adapted to the diverse cultural and educational contexts within ASEAN. Recommendations for practice and policy include investing in infrastructure, providing tailored professional development, and developing culturally responsive AI tools. This research contributes to the growing literature on AI in education, offering insights for future research and practical implementation.*

**KEYWORDS:** *ChatGPT, STEM pedagogy, ASEAN, Higher Education Institutions, and AI in education*

## INTRODUCTION

The rapid advancement of artificial intelligence (AI) has permeated various sectors, including education, where AI-powered tools are increasingly utilized to enhance learning experiences and instructional methodologies. In recent years, the integration of AI in education has shifted from mere content delivery to more sophisticated applications such as personalized learning, adaptive assessments, and intelligent tutoring systems (Kim et al., 2023). Among these, conversational agents like ChatGPT, powered by generative pre-trained transformers, have gained significant attention for their potential to revolutionize pedagogy, particularly in Science, Technology, Engineering, and Mathematics (STEM) disciplines (Johnson & Cohen, 2023).

In the context of higher education institutions (HEIs) in the ASEAN region, innovative teaching strategies are paramount due to the diverse cultural and linguistic landscape and varying levels of technological infrastructure. STEM education, a critical driver of economic development, demands practical pedagogical approaches that can cater to these diverse needs (Lim & Pham, 2023). ChatGPT in this domain offers a promising avenue to address such challenges by providing interactive, real-time feedback and supporting educators in delivering accessible complex content (Nguyen et al., 2024).

Despite the growing interest, empirical studies on the effectiveness of AI tools like ChatGPT in STEM pedagogy within ASEAN HEIs are still in their infancy. Previous research has primarily focused on developed regions, leaving a gap in understanding how such technologies can be leveraged in the ASEAN context, where educational practices and technological adoption differ significantly (Tan & Aziz, 2023). This study aims to bridge this gap by exploring the application of ChatGPT in STEM education across ASEAN HEIs and assessing its impact on teaching practices, student engagement, and learning outcomes.

Given the increasing emphasis on digital transformation in education post-pandemic, this research is timely, where remote and hybrid learning models have become more prevalent (Wijaya & Sutanto, 2023). Understanding how ChatGPT can be effectively integrated into STEM pedagogy will provide valuable insights for educators and policymakers in the ASEAN region, ultimately contributing to the development of more effective and inclusive educational practices.

## LITERATURE REVIEW

This review identifies gaps in the existing literature by synthesizing findings from recent studies. It highlights the need for further research on the effectiveness of AI tools in diverse educational contexts, particularly within the ASEAN region. The review aims to provide a comprehensive understanding of how AI tools like ChatGPT are shaping STEM education and to inform future research and practice.

### 1. The Integration of AI in STEM Education

The integration of AI in STEM education has garnered significant scholarly attention in recent years, reflecting the broader digital transformation trends in educational practices. AI-powered tools, particularly those leveraging natural language processing (NLP), have

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Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

been identified as transformative in enhancing personalized learning, providing real-time feedback, and supporting complex problem-solving tasks (Garcia et al., 2023). Studies have shown that AI tools can bridge the gap between theoretical knowledge and practical application, a critical need in STEM education where abstract concepts often challenge student comprehension (Miller & Thomas, 2023). However, much of this research has focused on developed regions, leaving a gap in understanding how these technologies are adopted and adapted in the diverse educational landscapes of the ASEAN region.

**2. Research Gaps in the ASEAN Context**

While the global discourse on AI in education is rich, the specific implications for ASEAN Higher Education Institutions (HEIs) remain underexplored. ASEAN's educational systems are characterized by diverse linguistic, cultural, and socio-economic contexts, which present unique challenges for implementing AI-driven pedagogical tools (Lim & Tan, 2023). Existing studies primarily focus on technological infrastructure and readiness, often overlooking the pedagogical nuances required to integrate AI into STEM curricula effectively (Nguyen et al., 2023). Moreover, there is a paucity of empirical research examining the impact of AI tools like ChatGPT on teaching methodologies, student engagement, and learning outcomes in this region, creating a significant research gap that this study aims to address.

**3. Issues and Concerns in AI-Driven Pedagogy**

The deployment of AI tools in education raises several issues and concerns that need to be critically examined. One primary concern is the potential for AI to reinforce existing inequalities within and between ASEAN countries, where access to technology and digital literacy varies widely (Kaur & Tham, 2024). Additionally, there are concerns about the quality and relevance of AI-generated content, particularly in highly specialized STEM fields where the accuracy of information is paramount (Lee et al., 2023). Another critical issue is the pedagogical shift required from educators, who may need to develop new competencies to effectively integrate AI tools into their teaching practices (Zhang & Wang, 2023). These challenges underscore the need for comprehensive research that assesses the effectiveness of AI tools like ChatGPT and addresses the broader socio-cultural and pedagogical implications of their use in ASEAN HEIs.

**4. Theoretical Lens: Constructivism and AI in Education**

This study is grounded in the constructivist theory of learning, which posits that learners actively construct knowledge through their interactions with the environment rather than passively receiving it from a teacher (Piaget, 1972; Vygotsky, 1978). AI tools, particularly ChatGPT, align with constructivist principles by providing interactive, student-centered learning experiences that allow learners to explore, question, and apply knowledge in real-time (Kim & Reeves, 2023). Through this lens, the study examines how ChatGPT can facilitate active learning in STEM education, where learners engage in problem-solving, critical thinking, and applying theoretical concepts in practical contexts.

However, the integration of AI into a constructivist framework also presents challenges. For instance, the effectiveness of AI tools in fostering deep learning is contingent upon their ability to provide meaningful feedback and scaffold learning experiences appropriately (Sung & Lee, 2023). There is also a need to consider the cultural dimensions of learning, particularly in the ASEAN context, where constructivist approaches may need to be adapted to align with local educational philosophies and practices (Tran & Le, 2024). These considerations highlight the importance of a nuanced understanding of how AI tools can be effectively integrated into STEM pedagogy, to which this study seeks to contribute.

**5. Addressing the Research Gap**

Given the identified research gaps, issues, and theoretical considerations, this study aims to comprehensively analyze the use of ChatGPT in STEM pedagogy within ASEAN HEIs. By exploring both the opportunities and challenges associated with AI integration, the study offers insights into how such tools can be adapted to meet the specific needs of diverse student populations in the region. Moreover, it aims to contribute to the broader discourse on AI in education by providing empirical evidence from a region often underrepresented in global studies, thereby advancing our understanding of the potential and limitations of AI in transforming STEM education.

## METHODOLOGY

**1. Research Design**

This study adopts a mixed-methods research design, combining quantitative and qualitative approaches to comprehensively explore the impact of ChatGPT on STEM pedagogy in Higher Education Institutions (HEIs) across the ASEAN region. A mixed-methods approach is well-suited for this inquiry as it allows for data triangulation, providing both statistical insights and an in-depth understanding of educators' and students' experiences with AI tools (Creswell & Creswell, 2023). This design also enables the exploration of complex educational phenomena, such as the integration of AI in diverse cultural and pedagogical contexts, which is critical for addressing the research questions of this study (Johnson & Onwuegbuzie, 2022).

**2. Population and Sampling**

The population for this study included STEM educators and students from HEIs across selected ASEAN countries, specifically Indonesia, Malaysia, the Philippines, Thailand, and Vietnam. These countries were chosen to represent a range of educational contexts within ASEAN, considering factors such as technological infrastructure, digital literacy, and cultural diversity (Nguyen et al., 2023). A stratified random sampling technique was ensured representation across different HEIs, considering variables such as institution size, type (public or private), and urban or rural location (Etikan & Bala, 2017). This approach enabled the generalization of findings while also allowing for exploring contextual differences within the ASEAN region.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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The study included approximately 300 STEM educators and 1,000 students from various HEIs, ensuring a sufficient sample size for statistical analysis and thematic saturation in qualitative data (Morse, 2022). The final sample size was determined based on power analysis to ensure the validity of quantitative results (Cohen, 2022).

## 3. DATA COLLECTION METHODS

Data collection occured in two phases: quantitative data collection, followed by qualitative data collection.

### 3.1 Quantitative Data Collection

Quantitative data were collected through online surveys administered to both educators and students. The survey instruments were developed based on existing validated scales adapted to the context of AI usage in STEM education (DeLone & McLean, 2003). The educator survey focused on perceptions of ChatGPT's effectiveness, ease of use, and impact on teaching practices. The student survey assessed their engagement, satisfaction, and perceived learning outcomes when using ChatGPT in STEM courses. Both surveys included demographic questions for subgroup analyses (Bryman, 2022).

### 3.2 Qualitative Data Collection

Qualitative data were gathered through semi-structured interviews and focus group discussions. Approximately 30 educators and 50 students were selected from the survey respondents for in-depth interviews, using purposive sampling to ensure diversity in perspectives (Patton, 2023). The interviews explored participants' experiences, challenges, and suggestions regarding integrating ChatGPT in STEM education. Focus group discussions were conducted to facilitate a more interactive exploration of these themes, particularly among student groups, allowing for the emergence of collective insights (Krueger & Casey, 2023).

## 4. DATA ANALYSIS

### 4.1 Quantitative Data Analysis

Quantitative data were analyzed using descriptive and inferential statistics. Descriptive statistics will provide an overview of the sample characteristics and general trends in responses. Inferential statistics, including t-tests, ANOVA, and regression analysis examined the relationships between variables such as ChatGPT usage, student engagement, and learning outcomes (Field, 2022). Structural equation modeling (SEM) was employed to test complex models that hypothesize the direct and indirect effects of ChatGPT on pedagogical outcomes (Hair et al., 2022).

### 4.2 Qualitative Data Analysis

Qualitative data were analyzed using thematic analysis, following the framework proposed by Braun and Clarke (2006). This process involves familiarizing the data, coding, searching for, reviewing, and defining and naming themes. NVivo software assisted in managing and analyzing the qualitative data, ensuring systematic and rigorous analysis (Castleberry & Nolen, 2018). Triangulation of data from different sources (e.g., interviews and focus groups) will enhance the findings' credibility and validity (Flick, 2018).

## 5. ETHICAL CONSIDERATIONS

Ethical approval was sought from the relevant Institutional Review Boards (IRBs) of the participating HEIs. Informed consent was obtained from all participants, ensuring they are fully aware of the study's purpose, procedures, and their rights to withdraw at any time without consequence (Israel & Hay, 2020). Anonymity and confidentiality were maintained throughout the study, with data stored securely and only accessible to the research team. The ethical principles of beneficence, respect for persons, and justice guided all aspects of the research process (Resnik, 2023).

## 6. LIMITATIONS AND DELIMITATIONS

While this study aimed to provide comprehensive insights into the use of ChatGPT in STEM pedagogy across ASEAN HEIs, certain limitations should be acknowledged. The diversity within the ASEAN region may limit the generalizability of findings to all HEIs, and the reliance on self-reported data may introduce bias. Additionally, the rapidly evolving nature of AI technologies means that the findings may quickly become outdated as new tools and pedagogical approaches emerge (Yin, 2023). However, these limitations were mitigated by the study's robust mixed-methods design and the inclusion of diverse perspectives from across the region.

## FINDINGS

This section presents the findings from the quantitative and qualitative data collected in the study, exploring the impact of ChatGPT on STEM pedagogy across selected Higher Education Institutions (HEIs) in the ASEAN region. The results are organized according to the main research questions and themes identified during the analysis.

### 1. Quantitative Findings

#### 1.1. Demographic Characteristics of Participants

A total of 300 STEM educators and 1,000 students participated in the survey. The demographic breakdown of the participants is as follows:

- **Educators**: 55% male, 45% female; majority aged between 35-50 years; representing 50 HEIs across five ASEAN countries.
- **Students**: 60% male, 40% female; majority aged between 18-22 years; with a diverse mix of STEM disciplines including Engineering, Computer Science, and Biological Sciences.

### 1.2. Perceived Effectiveness of ChatGPT in STEM Education

Educators and students reported positive perceptions of ChatGPT's effectiveness in enhancing STEM education. Most educators (78%) agreed that ChatGPT facilitated more interactive and engaging learning experiences, while 70% of students indicated that the tool helped them better understand complex STEM concepts.

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- **Educator Survey Results**:
  - 80% found ChatGPT helpful in providing real-time feedback.
  - 72% noted an improvement in students' problem-solving skills.
  - 68% reported that the integration of ChatGPT reduced their workload regarding grading and providing feedback.
- **Student Survey Results**:
  - 75% found ChatGPT useful for immediate clarification of doubts.
  - 70% reported higher engagement in STEM courses where ChatGPT was used.
  - 65% indicated improved grades due to the use of ChatGPT.

**1.3. Challenges in Implementing ChatGPT**

While the overall perception of ChatGPT was positive, several challenges were identified:

- **Technological Barriers**: Approximately 30% of educators cited issues with internet connectivity and access to digital devices as barriers to effective implementation.
- **Content Accuracy**: 25% of educators expressed concerns about the accuracy of ChatGPT-generated content, particularly in specialized STEM fields.
- **Resistance to Change**: About 20% of educators reported resistance from colleagues who hesitated to adopt AI tools in their teaching practices.

**2. Qualitative Findings**

**2.1. Thematic Analysis of Educator Interviews**

Through thematic analysis, several key themes emerged from the interviews with educators:

- **Enhanced Engagement**: Educators highlighted that ChatGPT significantly enhanced student engagement, particularly in large classes where personalized attention is challenging. One educator noted, “ChatGPT has been a game-changer in getting students to participate more actively in discussions, especially those who are usually hesitant to speak up in class.”
- **Pedagogical Shifts**: The integration of ChatGPT led to shifts in teaching methodologies, with educators adopting more flipped classroom models. Many reported using ChatGPT to provide pre-class materials, allowing class time to be used for deeper exploration of topics.
- **Professional Development Needs**: A recurring theme was the need for professional development to integrate AI tools into teaching better. Educators desired more training and resources to use ChatGPT effectively in their courses.

**2.2. Student Focus Group Discussions**

The focus group discussions with students revealed several insights:

- **Positive Learning Experiences**: Students overwhelmingly reported that ChatGPT made learning more accessible and enjoyable. One student mentioned, "ChatGPT breaks down complex topics in a way that's easier to understand. It is like having a tutor available 24/7."
- **Concerns About Over-reliance**: Some students expressed concerns about becoming overly reliant on ChatGPT, fearing it might hinder the development of independent problem-solving skills. "Sometimes I feel like I am not thinking critically because I can just ask ChatGPT for answers," said one participant.
- **Cultural Considerations**: In some ASEAN contexts, students noted that ChatGPT sometimes lacked sensitivity to local examples or context, which affected their learning experience. They suggested that the tool could be improved by incorporating more region-specific content.

**3. Comparative Analysis Across ASEAN Countries**

The study also examined differences in the implementation and impact of ChatGPT across the selected ASEAN countries:

- **Indonesia**: Notable for the highest student engagement, attributed to strong institutional support and integration of AI tools in the curriculum.
- **Vietnam**: Faced significant technological barriers, with educators in rural areas reporting challenges in accessing reliable internet, which hindered the effective use of ChatGPT.
- **Malaysia and Thailand**: Demonstrated a balanced adoption of ChatGPT, with moderate levels of student engagement and educator satisfaction. Both countries emphasized the importance of localized content.
- **Philippines**: Reported the highest concerns about content accuracy, particularly in specialized subjects like engineering and medicine.

## DISCUSSION

This section interprets the findings in light of the research questions and the constructivist theoretical lens employed in this study. The discussion is organized around the key themes that emerged from the findings, reflecting on their implications for STEM pedagogy in Higher Education Institutions (HEIs) across the ASEAN region.

**1. Impact of ChatGPT on STEM Pedagogy**

**1.1. Enhancing Student Engagement and Understanding**

The study’s findings indicate that ChatGPT significantly enhances student engagement and understanding of complex STEM concepts, aligning with the constructivist principle that learning is most effective when students actively construct knowledge through interactive experiences (Kim & Reeves, 2023). Most students reported that ChatGPT made learning more accessible and enjoyable, with many citing the tool's ability to simplify complex topics and provide real-time feedback as particularly beneficial. These findings support previous research suggesting that AI-powered tools facilitate a more student-centered learning environment, promoting deeper engagement and comprehension (Garcia et al., 2023).

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However, the findings also revealed concerns about the potential for over-reliance on ChatGPT, which could hinder the development of critical thinking and independent problem-solving skills. This suggests a need for balanced integration of AI tools, ensuring they complement rather than replace traditional pedagogical methods that encourage independent learning (Zhao & Li, 2024). Educators may need to develop strategies that leverage ChatGPT's strengths while fostering students' critical thinking abilities, such as using AI tools to support, rather than dominate, the learning process.

## 2. Challenges and Barriers to Effective Integration

### 2.1. Technological and Infrastructure Barriers

One of the significant challenges identified in this study is the technological and infrastructure barriers that impede the effective use of ChatGPT in specific ASEAN contexts. This is particularly evident in countries like Vietnam, where educators in rural areas reported difficulty accessing reliable internet, which is crucial for utilizing AI tools effectively. These findings resonate with the broader literature on digital divides in education, highlighting the disparity in access to technological resources as a critical issue in the global South (Kaur & Tham, 2024). Addressing these barriers is essential for ensuring equitable access to AI-driven educational tools across the ASEAN region.

### 2.2. Concerns About Content Accuracy

Another challenge highlighted by educators, particularly in specialized STEM fields like engineering and medicine, is the concern about the accuracy of ChatGPT-generated content. This finding is consistent with previous studies that have raised questions about the reliability of AI-generated information, especially in contexts that require high precision (Lee et al., 2023). While ChatGPT has been shown to provide valuable support for general STEM learning, its limitations in handling highly specialized content underscore the need for continuous monitoring and validation of the information provided by AI tools. Educators should be trained to critically evaluate AI-generated content and supplement it with authoritative sources when necessary.

## 3. Pedagogical Shifts and Professional Development

### 3.1. Shifts Toward Student-Centered Learning

The integration of ChatGPT appears to have encouraged a shift toward more student-centered learning approaches, such as flipped classrooms, where students engage with content before class and use class time for deeper exploration. This shift aligns with constructivist theories that emphasize active learning and the importance of learners' engagement in constructing their understanding (Vygotsky, 1978). The positive reception of these methods by educators and students suggests that AI tools like ChatGPT can effectively support constructivist pedagogies in STEM education, providing opportunities for students to explore and apply knowledge in meaningful ways (Sung & Lee, 2023).

### 3.2. Need for Professional Development

Despite these positive shifts, the study also identified a strong need for professional development among educators. Many educators desired more training to integrate AI tools like ChatGPT into their teaching practices effectively. This finding is in line with the broader literature, which emphasizes the importance of equipping educators with the skills and knowledge necessary to navigate the complexities of AI-enhanced classrooms (Zhang & Wang, 2023). Professional development programs should focus on both the technical aspects of using AI tools and the pedagogical strategies that can maximize their impact on student learning.

## 4. Theoretical Implications and Contributions

### 4.1. Constructivist Learning Theory and AI Integration

The findings of this study provide empirical support for applying constructivist learning theory in the context of AI integration in STEM education. ChatGPT, as an AI tool, facilitates interactive, student-centered learning experiences that align with constructivist principles by enabling learners to actively engage with and construct knowledge through dialogue and problem-solving. This reinforces the notion that AI tools can be effectively integrated into constructivist pedagogies, particularly in STEM education, where complex concepts often require active exploration and application (Kim & Reeves, 2023).

However, the study also highlights the need to consider cultural and contextual factors when applying constructivist approaches in the ASEAN region. For instance, the concerns raised about the relevance of ChatGPT's content to local contexts suggest that constructivist pedagogies, when supported by AI tools, must be adaptable to the cultural and educational realities of diverse student populations (Tran & Le, 2024). This underscores the importance of culturally responsive teaching practices that align with the constructivist emphasis on contextualized learning.

## 5. Implications for Practice and Policy

### 5.1. Recommendations for Educators and Institutions

This study offers several recommendations for educators and institutions in the ASEAN region based on the findings. First, there is a need for tailored professional development programs that address the specific challenges and opportunities of integrating AI tools like ChatGPT into STEM education. These programs should focus on developing educators' competencies in using AI to enhance student engagement while fostering critical thinking and independent learning.

Second, institutions should invest in improving technological infrastructure to ensure that all students and educators have equitable access to AI tools, particularly in rural and underserved areas. Addressing these infrastructure gaps is crucial for successfully implementing AI-enhanced pedagogy across the region.

### 5.2. Policy Considerations

At the policy level, governments and educational bodies in ASEAN countries should consider developing guidelines and frameworks for using AI in education. These frameworks should address content accuracy, data privacy, and the ethical implications of AI in the

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classroom. Moreover, policies should promote the development of culturally relevant AI tools that cater to the ASEAN region's diverse educational needs.

## 6. LIMITATIONS AND FUTURE RESEARCH

While this study provides valuable insights into the use of ChatGPT in STEM pedagogy within ASEAN HEIs, several limitations should be acknowledged. The reliance on self-reported data may introduce biases, and the rapid evolution of AI technology means that the findings may become outdated as new tools and methods emerge. Future research should focus on longitudinal studies to assess the long-term impact of AI integration in education and explore the potential of other emerging AI tools in various educational contexts.

**Suggestions for Future Research**

Given the evolving landscape of AI in education, future research should focus on exploring the long-term impacts of integrating AI tools like ChatGPT in STEM pedagogy across diverse educational contexts. Longitudinal studies could provide deeper insights into how sustained use of AI influences student learning outcomes, engagement, and critical thinking skills over time. Additionally, research could investigate the differential effects of AI tools in various STEM disciplines, considering each field's unique challenges and requirements. Such studies could also assess the scalability of AI-enhanced pedagogy in HEIs across the ASEAN region, identifying best practices and potential pitfalls in the broader implementation of these technologies.

Moreover, future research should examine the cultural and contextual factors that influence the effectiveness of AI tools in education. Given the diversity within the ASEAN region, studies need to explore how AI tools can be adapted to align with local educational practices, cultural values, and linguistic diversity. Research could also investigate the ethical implications of AI in education, particularly concerning data privacy, content accuracy, and the potential for bias in AI-generated content. By addressing these areas, future studies can contribute to the development of more inclusive, effective, and culturally responsive AI tools for STEM education in the ASEAN context.

**Conclusion**

This study sought to investigate the impact of ChatGPT on STEM pedagogy within Higher Education Institutions (HEIs) in the ASEAN region, focusing on its effectiveness, challenges, and the pedagogical shifts it may inspire. The findings reveal that ChatGPT holds significant potential to enhance student engagement and understanding of complex STEM concepts, aligning well with the principles of constructivist learning theory. Both educators and students reported positive experiences with the tool, particularly its ability to simplify complicated topics and provide immediate feedback. These results underscore the value of AI in creating more interactive and student-centered learning environments, which are essential for fostering deep learning in STEM education.

However, the study also identified several challenges, including technological barriers, concerns about content accuracy, and the need for professional development among educators. These findings highlight critical areas that need to be addressed to fully realize AI's benefits in education. The discussion emphasizes the importance of balanced AI integration, ensuring that tools like ChatGPT complement traditional pedagogical methods rather than replace them. Additionally, the study underscores the need for culturally responsive AI tools that cater to the diverse educational contexts within the ASEAN region. While ChatGPT shows promise as a transformative tool in STEM education, its successful implementation requires careful consideration of the technological, pedagogical, and cultural factors that influence its effectiveness.

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EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# TRANSFORMING URBAN LAND USE: ECONOMIC AND ORGANIZATIONAL PATHWAYS TO SUSTAINABILITY

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**ABSTRACT**

*As Uzbekistan undergoes rapid urbanization, the sustainable management of urban land has become a pressing concern. This study explores the economic and organizational pathways necessary to transform urban land use in Uzbekistan, ensuring that urban development aligns with the principles of sustainability. It begins by examining the theoretical foundations of sustainable urban land use, followed by an analysis of current challenges within Uzbekistan's urban land management framework. The study identifies key economic mechanisms, such as land value capture, green taxation, and subsidies for sustainable practices, as vital tools for promoting efficient and equitable land use. Additionally, it highlights the need for organizational reforms, including decentralization, enhanced participatory planning, and improved land tenure security, to create responsive and adaptable governance structures. Environmental considerations are also emphasized, with recommendations for integrating green infrastructure and public transportation into urban planning. The study concludes with a set of actionable recommendations tailored to Uzbekistan's unique context, providing a roadmap for policymakers to achieve sustainable urban development. By implementing these strategies, Uzbekistan can ensure that its urban growth is not only economically viable but also environmentally sound and socially inclusive.*

**KEYWORDS:** *Urban Land Use, Sustainability, Economic Mechanisms, Organizational Reforms, Land Value Capture, Green Taxation, Land Tenure Security, Urban Planning, Decentralization, Uzbekistan, Environmental Integration, Public Transportation*

## INTRODUCTION

Urban land use is a critical factor in the sustainable development of any nation, and Uzbekistan is no exception. As the country continues to urbanize rapidly, the pressure on land resources in urban areas has intensified, necessitating a strategic and sustainable approach to land management. The challenge lies in balancing the need for economic growth with the imperative of environmental stewardship and social equity.

In Uzbekistan, the traditional mechanisms of urban land use have often been insufficient to address the complexities of modern urbanization, leading to inefficient land use, environmental degradation, and social disparities. Therefore, there is a growing need to transform these mechanisms by integrating innovative economic and organizational strategies that align with the principles of sustainability.

This transformation requires a comprehensive understanding of the existing challenges and opportunities within Uzbekistan's urban land management framework. By analyzing the current organizational and economic mechanisms, this study aims to propose pathways that not only enhance the efficiency of land use but also contribute to the broader goals of sustainable development. This involves rethinking how urban land is allocated, utilized, and managed, with a focus on creating systems that are adaptable, resilient, and equitable.

The following sections will explore the theoretical underpinnings of sustainable urban land use, examine the specific context of Uzbekistan, and propose actionable strategies for improving the organizational and economic mechanisms that govern urban land. The goal is to provide a roadmap for policymakers, urban planners, and stakeholders to ensure that Uzbekistan's urban growth is sustainable, inclusive, and economically viable.

## LITERATURE REVIEW

The sustainable management of urban land is a subject of growing importance, especially in rapidly urbanizing nations like Uzbekistan. The literature on urban land use and sustainability provides a broad spectrum of theoretical frameworks, empirical studies, and case analyzes that offer insights into the economic and organizational mechanisms necessary for sustainable development.

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**1. Theoretical Foundations of Sustainable Urban Land Use**

The concept of sustainable urban land use has been explored extensively in the literature, often framed within the broader context of sustainable development. Early works by scholars like McHarg (1969) and Lynch (1981) emphasized the importance of planning and ecological considerations in urban development. More recent studies, such as those by Beatley and Manning (1997) and Elmqvist et al. (2013), have expanded on these ideas, integrating economic, social, and environmental dimensions to propose holistic approaches to urban land management. These foundational theories underscore the need for a balanced approach that considers the interdependence of urban systems and the environment [1,2,3,4].

**2. Economic Mechanisms for Sustainable Urban Land Use**

Economic mechanisms play a crucial role in determining how urban land is used and managed. According to studies by Coase (1960) and Ostrom (1990), market-based approaches, property rights, and collective action are essential for efficient land use. In the context of Uzbekistan, research has highlighted the importance of economic incentives, land pricing, and taxation policies in promoting sustainable land use. Studies by scholars such as Naughton-Treves and Sanderson (1995) and more recent work by Gasparatos et al. (2017) suggest that the implementation of economic instruments like land value capture, green taxation, and subsidies for sustainable practices can significantly influence urban land management outcomes [5,6,7,8].

**3. Organizational Structures and Governance**

The role of organizational structures and governance in urban land use is another critical area explored in the literature. Governance frameworks that emphasize participatory planning, transparency, and accountability are seen as vital for achieving sustainable urban development. Works by Healey (1997) and Albrechts (2006) highlight the importance of collaborative planning processes that involve a wide range of stakeholders, including government agencies, private sector actors, and civil society. In Uzbekistan, the governance of urban land has been characterized by a strong centralized approach, but recent studies suggest a shift towards more decentralized and participatory models that could enhance sustainability. Scholars like Deininger and Feder (2009) and Rakodi (2006) argue that such organizational reforms are necessary to address the unique challenges faced by rapidly growing cities in developing countries [9,10,11,12].

**4. Case Studies and Empirical Evidence**

Empirical studies and case analyze provide concrete examples of how economic and organizational mechanisms have been applied to transform urban land use in various contexts. Research by Roberts (2000) and World Bank (2010) offers insights into successful urban land management practices in cities across Asia, Africa, and Latin America, where similar challenges to those in Uzbekistan have been addressed. These case studies demonstrate the effectiveness of integrated approaches that combine economic tools with robust organizational frameworks. For instance, the experience of Curitiba in Brazil, as documented by Rabinovitch (1996), showcases how strategic planning and economic incentives can lead to sustainable urban growth [13,14].

**5. Relevance to Uzbekistan**

The application of these global insights to the context of Uzbekistan requires a nuanced understanding of the country's unique socio-economic, political, and environmental conditions. The literature on Uzbekistan's urban land use is relatively limited, but key studies have identified the challenges and opportunities that exist within the country's specific context. Research by Abdullaev et al. (2009) and Djanibekov et al. (2013) provides a foundation for understanding the current state of urban land management in Uzbekistan, highlighting issues such as land tenure insecurity, inefficient land allocation, and the need for organizational reforms [15, 16].

The literature review reveals that while there is a robust body of knowledge on sustainable urban land use, there is a need for more context-specific research that addresses the unique challenges of Uzbekistan. By drawing on global theories and empirical evidence, this study aims to contribute to the ongoing discourse on sustainable urban development in Uzbekistan, proposing economic and organizational pathways that are both innovative and feasible within the country's current framework.

## MATERIALS AND METHODS

In recent decades, the concentration and activation of industrial and non-industrial activities has been so rapid that the environment of some cities in the world could not meet many biological and production needs. The increasing pace of the urbanization process, the emergence of a system of relations between man and nature has become one of the global problems of today.

Article 6 of the Law of the Republic of Uzbekistan "On Local State Power", Decree of the President of the Republic of Uzbekistan dated September 7, 2020 "On measures to radically improve the system of land accounting and state cadastres" No. PF-6061, 2020 of the President of the Republic of Uzbekistan Decision PQ-4819 dated September 7, 2021 "On measures to organize the activities of the Cadastre Agency under the State Tax Committee of the Republic of Uzbekistan", the Cabinet of Ministers of the Republic of Uzbekistan dated June 22, 2021 "Some regulations regulating the field of state cadastre management" Based on the decision No. 389 "On Approval of Legal Documents", the distribution of available land areas in the city of Bukhara according to the land report

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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as of January 1, 2023 on the types of land of land owners and land users in the city and their distribution, submitted by the Bukhara City Branch of the State Cadastre Chamber, is as follows:

| No | Er categories | Total area, to |
|---|---|---|
| **1** | General e r area | 7285 |
| **1.1** | That's it including e kin e r area | 1160 |
| **1.2** | That's it including a lot yearly tree groves | 707 |
| **1,2,1** | gardens | 476 |
| **1,2,2** | vineyards | 163 |
| **1,2,3** | traps | 0 |
| **1,2,4** | another a lot yearly tree groves | 68 |
| **1.3** | that's it including gray areas | 3 |
| **1.4** | that's it including grasslands | 35 |
| **1.5** | that's it including farm lands | 611 |
| **1.6** | that's it including ameliorative construction land in the state | 0 |
| **1.7** | that's it including garden vegetable growing Associations | 0 |
| **1.8** | that's it including forest lands | 23 |
| **1.9** | that's it including other lands | 4746 |

The formation of the urban environment and the main factors affecting the environment in large cities. Cities, as a rule, represent the closing links in the chain of resource cycles, where the stages of processing, consumption and return to nature of substances and energy are carried out.

There are certain contradictions between the socio-economic development of the city and the increase of the natural environment of its territory. The serious shortcomings of modern environmental management are the failure to analyze the ecological and economic situation, insufficient specificity of the planned measures and their weak socio-economic justification.

To date, the increase in the city's population has naturally led to the expansion of the city's boundaries, the reduction of land resources, and, accordingly, the destruction of the natural landscape and the sharp deterioration of sanitary and hygienic conditions in the city. In this regard, every year it becomes more and more important not only to preserve the land, but also to use it wisely and efficiently.

The grouping of land plots as part of agricultural land was carried out as follows:
I - suitable for cultivated fields, hayfields, pastures occupied by mines, perennial plantations, farm roads, communications, forest plantations designed to protect the land from the effects of negative (harmful) natural, anthropogenic and man-made phenomena, as well as water bodies designed to support agricultural activities. agricultural land;
II – Agricultural land, unsuitable for arable land, but used for growing some types of industrial crops, perennial plantations, shrubs, tea, grapes, rice;
III – agricultural land occupied by buildings. 1 buildings and structures used for production, storage and primary processing of agricultural products;
IV - agricultural lands occupied by water bodies and used for business activities;
V – Agricultural lands with forests.
VI – Other agricultural lands, including wetlands, degraded lands, landfills, landfills, ravines, sand lands.

Economic evaluation of land should not negate the principle of public property. In order to correctly determine the socio-economic effect of the construction, a realistic assessment of the land plot is necessary. This applies primarily to fertile land where industrial crops can be grown, as well as to land containing underground natural resources.

The development of vacant areas in cities is justified by the reduction of construction costs and, as a rule, it comes from the price per square meter of residential or common area. However, works on engineering preparation of the territory (vertical planning, laying drains, drainage, lowering the level of groundwater, fighting against ravines and landslides) and engineering improvement (water supply, sewage, heat supply, gas supply, electricity, telephony, transport equipment etc.) are not considered enough.

Large-scale trade is reflected in the profitability of the area in terms of the efficiency of the enterprises, the time spent by the population to move from the place of residence to the place of work, and other factors of functional amenities. Naturally, it is desirable to demolish old and cheap buildings and replace them with high-rise buildings.

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Bukhara region is one of the main suppliers of the most valuable agricultural crops in our republic. Conditional value of 1 hectare of arable land in Bukhara is 4 times more expensive than the average indicator in the republic. The area of this category of land decreased by 0.4 thousand compared to last year due to the transfer of 0.2 thousand hectares to the category of industrial and other special purpose lands, 0.1 thousand hectares to the category of settlements and 0.1 thousand hectares to the category of specially protected areas.

The study of the balance of territories in accordance with the master plan shows that there are spare lands within the city of Bukhara due to the unfavorable allocated land for construction, free and other lands. Among the tourism cities of Bukhara region, Bukhara city is the region with the largest population. Therefore, it is necessary to pay great attention to the rational use of the city territory and to develop improved projects based on science.

Morphological analysis of functional zoning of Bukhara defines it as an agro-recreational city. There is only 7,285 ha of land in the urban area, agricultural land occupies the first place in the structure of urban land and is 1,160 ha (15.9%).

The city of Bukhara is not only the largest industrial center in the region, a tourism city of federal importance with a share of recreational land occupying an important part of the city structure - 344 hectares (5.1%), but also the center of the region as a business and social center. By establishing effective use of all types of land in the city, the possibility of further improvement of the living conditions of the population will be increased. In particular, the effective use of the land allocated for rest and recreation, by adapting the activity to modern students, will provide the basis for ensuring the constant flow of funds and the creation of new jobs, which is an important branch of the modern economy.

The city's economy is experiencing all the negative trends typical of the modern economy, growth is observed only in the food industry. At the same time, the suburban economy has the necessary opportunities to fully supply the city with agricultural products. We consider sanatorium and agricultural sectors as the most promising for development. But currently, for various (including political) reasons, no further development is being resumed in Bukhara's resorts. The tourism survival model that was popular in the past worked in a few places. However, having such resources, it would be unwise not to preserve them until they are required. For example, in the United States, recreation is only 5% of the country's territory, but its income is more than the entire agriculture. A very important problem of urban landscape optimization is the problem of creating an ecological infrastructure of open spaces consisting of water-green geocomplexes. In residential areas of large cities, at least 40% of the area should be allocated to ecological infrastructure. This implies an integral, continuous geosystem that really forms the unique ecological basis of the urban landscape. The ecological approach implies the priority of the landscape foundation in the selection of the territorial development of the city, in the development of the functional zoning and planning structure. The ratio of landscape types to the size of the area and their nature varies depending on natural conditions, established settlement systems and environmental management.

The researches of scientists dedicated to calculating the environmental, economic and technological needs of people in the area showed the following:

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USA - 1 person needs 2 hectares of land (0.6 hectares of arable land, 0.4 hectares of industrial crops, 0.8 hectares of natural landscapes, 0.2 hectares of industry and social infrastructure), which is the following average balance ratio (in shares of one in 10 ) 5-natural landscapes, 4-partly modified-agriculture, recreation, 1-urbanized areas. In Germany, the normative quality of ecologically balanced areas in the ratio of 5.5:4.5:0.5 is proposed.
For Bukhara region, the ratio is 6.5:3:0.5. Of this, 6.5% are natural landscapes, 3% are partly modified-agriculture, recreation, and 0.5% are urbanized areas.
According to the report on the availability of land area, there are only 3972 ha of green areas in the administrative-territorial boundaries of the city of Bukhara, including:
- forests-1086 ha,
- tree and shrub plantations - 261 ha,
- parks, squares, boulevards, etc.-1030 ha,
- perennial seedlings-1213,
- 1231 ha of green areas in horticultural associations.

Currently, the plantings in existing public buildings cover 177.2 hectares, which are urban parks, squares, boulevards and embankments. In the settlement, the crop norm for collective use is 91.6 hectares. Itching depending on the type of total crop.
Bukhara is a region of wonderful nature, beautiful landscapes and various monuments of ancient material culture. It is intended for recreation and tourism. Therefore, this beauty should be preserved. In order to maintain harmony in nature, extremes in construction or agriculture should be avoided.

Today, the more vulnerable, irreplaceable, unique and ultimately more expensive use type must be prioritized in development and selection. The criteria for choosing priorities in development must be the interest of the local population, that is, their labor skills, demographic characteristics, level and structure of unemployment, rootedness and location, ethno-confessional characteristics, etc.

## ANALYSIS, FINDINGS, RESULTS

In our republic, effective use of land areas, including land allocated for cities, their protection, accurate quantitative accounting of land is one of the urgent issues today. Keeping an accurate account of urban land, drawing up specific plans for the future due to the expansion of cities, determining land tax in the context of land assessment of the urban area is based on the correct formation of the state land cadastre and other state cadastres.

Acquaintance of experts in the field with the existing methodology of quantitative accounting of land in urban areas will be important in the formation of their professional skills.

A transparent accounting of the land allocated for rational use of land areas, including urban land, is the basis for the solution of several problems presented in the previous sections of the research work. The analysis of the research carried out by scientists is especially useful in finding a solution to the objectives of the research work being carried out. We cite scientific and practical works on the issues of land accounting carried out by scientists and practitioners in production organizations. In particular, research on land use organization and land cadastre was carried out by S.A. Avezbaev, A.S. Altiev, S.A. Tkachuk, Q.R. Rakhmonov, S.N. Volkov, A.R. Babazhanov [17 ,18,19,20,21,22,23].

It is known that the results of land accounting are given in the land balance of districts and cities. The district and city divisions of the Cadastre Agency maintain the land account and provide information on the categories and types of land within the administrative boundaries of the district and city. This will reflect current or changed information about land areas and users. It should be noted that in the land balance, the amount of the land account is covered by the information on the section of land users (legal entities or individuals). Rights to land plots in cities are taken into account, and then the information is available in the state register.

Today, issues related to land accounting in our country, the district (city) land balance is being formed by district (city) branches of the State Cadastre Chamber of the Cadastre Agency under the Ministry of Economy and Finance as of January 1 of each year.

The completed land balance is reviewed in the district (city) hokim with the participation of relevant officials and approved by the relevant decision of the district (city) hokim and submitted to the regions and Tashkent city hokims (in the Republic of Karakalpakstan - to the Council of Ministers of the Republic of Karakalpakstan) for approval. The land balance approved by the district (city) administration is submitted for generalization to the regional offices of the State Cadastre Chamber within the specified period. The documents and data of the generalized land balance are approved by the appropriate decision in the prescribed manner after being reviewed with the participation of the relevant officials.

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However, the study of the land balances that are being prepared today shows that there are some shortcomings in their development, as well as in keeping the land account. In particular, in the land balances created to date (statistical collection of the "Land Fund of the Republic of Uzbekistan"), information on the comprehensive study of agricultural land (in terms of land users, land types) has been given a lot of space. In this collection, only one row is allocated to other land categories, mainly in form 22 (provincial section). In the section of districts, other land categories were not clearly mentioned. In general, this collection is being continued as it was formed in the 50s and 60s of the last century. Almost no changes have been made to the reporting forms. Land balances are not organized according to land fund categories in administrative-territorial units, i.e. district (city), sub-district city, town, village, and estate.

In the National Land Report on the State of the Republic's Land Resources, other land categories are presented in a summarized way, the areas of the main land types in the district section. However, this information is not sufficient for land accounting in other categories except for the category of agricultural land. Providing the results of land accounting for other land categories in such a single, generalized table cannot ensure its transparency and accuracy in land accounting. Even in the forms of the land balance of agricultural land, there are a number of shortcomings. Such shortcomings and defects have a negative impact on the results of the land balance. Taking this into account, it is appropriate to make necessary changes to the land balance of the district (city) that is being formed today.

The more accurate, complete, truthful and transparent the results of land accounting are, the easier it is to manage, organize, protect and control its effective use.

In the quantitative analysis of the land area actually used in the cities, it was found that the information about the irrigated land allocated for perennial trees, the land allocated for various constructions, the land allocated for homesteads is not fully substantiated, and the information about the changes in the area is not provided on time or the information is provided late for the intended purposes. how many deficiencies are encountered.

It is no exaggeration to say that the introduction of innovative technologies in the field, including drones, remote sensing data, data collected using space images, GAT programs make land accounting somewhat easier. We can see this in the fact that electronic maps are created by decoding based on orthophoto plans and are used as the main tool for mapping land areas in districts and cities. The role of maps is also incomparable in obtaining and analyzing data on land categories and land types in urban accounting with high accuracy.

The analysis of the current state of quantitative land accounting , we can say that it is recommended to partially or completely revise the current system of land accounting. In the correct and transparent management of land accounting, the main goal is to develop and put into practice optimal methods of separately collecting and presenting the data of towns, villages and villages within the administrative boundaries of districts and cities.

The following proposals and recommendations for the correct and transparent accounting of urban land were developed based on a thorough analysis of existing documents and the results of practical work conducted in the field today.

Proposals and recommendations for the quantitative accounting of urban land:

1. Collection of high-accuracy, continuously updated data in the development of projects for the targeted distribution of land areas allocated to cities;
2. Taking into account the global WGS-84 coordinate system when defining the administrative boundaries of the districts;
3. Take necessary measures to permanently enter the changes determined on the basis of the latest data on land areas into the data book.
4. Determining the division of the city territory into towns, villages and villages according to their boundaries and depicting them on maps.
5. Land types for cities and towns, villages and farms to include in the land balance of the City Land Cadastre;
6. Formation of databases of the results of the quantitative calculation of urban land using GAT.
7. Development of well-designed electronic maps that are open to experts and users to visually monitor changes in urban land.

The goals of developing these suggestions and recommendations can be explained by the improvement of quantitative accounting based on the characteristics of urban land use, the optimization of existing land fund categories in cities. Proposals and recommendations proposed in the quantitative accounting of urban land are the basis for efficient use of urban land, improvement of the quality of urban land use, and rational use of every square meter of land.

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The method of organizing work on the implementation of functions and tasks of land monitoring in urban areas provides for interrelated functional-technological work blocks that allow obtaining, systematizing and storing information, analyzing data and providing information to its consumers. The use of assessment data from land condition and monitoring is the subject content of the 4th (final) functional-technological block of the land monitoring system for the region, formed as data analysis, targeted interpretation and service to information consumers.

The problem of providing information on the state of land to the city's executive authorities and management services, as well as interested parties, is particularly important at the moment, especially in connection with the implementation of permanent administrative reforms.

The essence of the urban land resources management process is based on the periodic execution of "command-execution" operations, each of which must solve a specific goal. Real estate state cadastre management and land monitoring is a passive process to a certain extent, and feedback in the form of active management influence on the object of monitoring is in the process of land protection (including the impact of negative processes) and state control over their use and protection in the allocation of land plots, land protection and is carried out in the design and implementation of land plots. control measures. Environmental management processes are considered in detail in the works. The results of monitoring observations should be used in the practice of urban planning, legal and economic regulation of land use. Land monitoring data are public property. They provide the following: management of the land fund and regulation of land relations in the city; economic, production, research and other permitted activities of legal entities and individuals; the right of citizens to receive information about changes in the state of the environment.

urban land monitoring databases ensures the acquisition of textual, tabular, graphic and cartographic documents of different thematic content and different sizes as the main spatially organized information compiled in accordance with the administrative-territorial levels of the city's land resources management. Monitoring data, as a rule, is formed by individual plots of urban land, as well as parts of the territory (cadastral division units; functional zoning element; territories of separate administrative districts, etc.) and the city as a whole.

The urban land monitoring data bank is an integral part of the unified information space of urban management and environmental protection policy, and in cooperation with the competent executive authorities forms the urban body of the federal service of state registration, cadastre and cartography and acts as its owner. Technical solutions for its design are based on the multi-topical aspect-hierarchical (science-hierarchical) principle of designing and creating urban land monitoring databases organized in accordance with the administrative-territorial levels of land resource management of the city. Primary information producing organizations urban land monitoring data is responsible for the reliability and completeness of the data provided to the Bank.

The legal status and thematic structure of the main output materials produced as a result of the operation of the urban land monitoring subsystem ensure the solution of the usual, regularly occurring problems of land management and receiving answers to the arbitrary requests of users. Particular attention is paid to the requirements for cartographic data, their role in the output product prevails.
Information on the assessment of land conditions is produced within the framework of interdepartmental cooperation of urban organizations involved in the implementation of land use issues and land monitoring. During the operation of the urban land monitoring system, a number of technological processes must be carried out (Fig. 1).

It involves the technology of systematic operation of land monitoring in cities, primary data is collected, stored and processed using research methods (remote land sensing, ground surveys and observations, data exchanges). As a result, a number of technological processes should be implemented, such as comprehensive analysis of land monitoring data.

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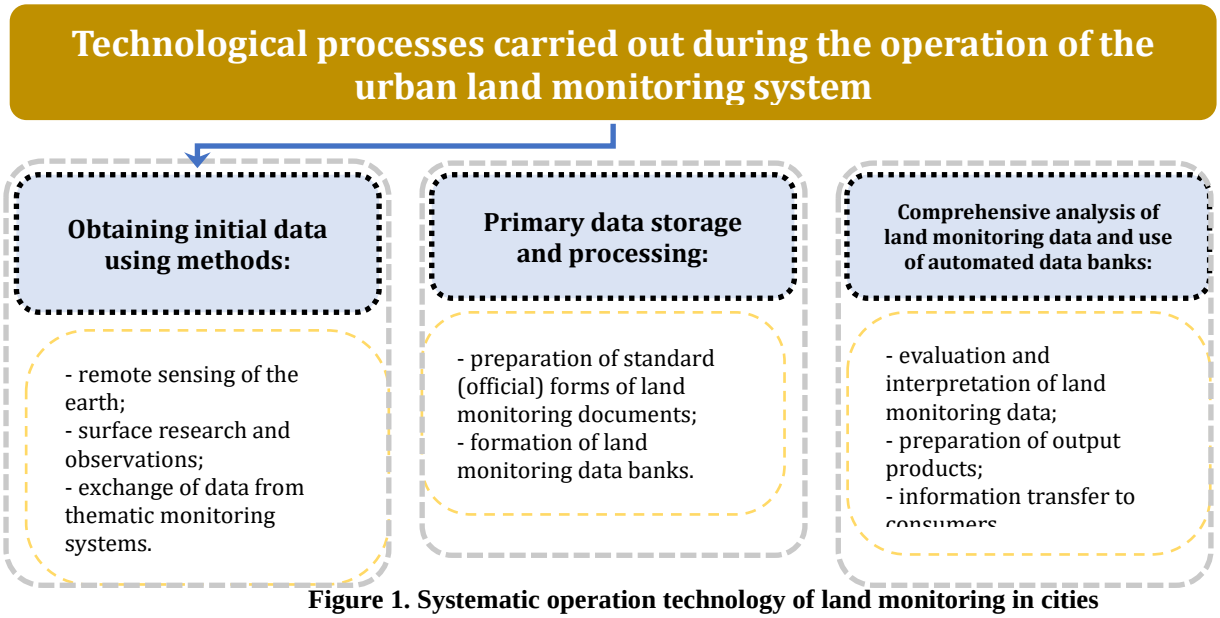


**Figure 1. Systematic operation technology of land monitoring in cities**

Information about organizations and their owners is located in a distributed database. There are units in the structure of city bodies, whose task is to monitor city land. UzDaverloyiha is the main owner of the land assessment and monitoring data bank in the city of Bukhara. Owners of relevant information providing monitoring data, as well as enterprises and institutions that collect, systematize, process and reproduce data are responsible for the reliability and completeness of data.

Data exchange can be done in manual and automated modes. Communication channels providing information to republican and city, including regional (district, district) governing bodies are provided.

When monitoring urban land, it is necessary to work with large arrays of the same type of structured data that are constantly updated. Some of these data must be archived for later retrospective data analysis, which complicates manual processing of monitoring materials. For this, it is necessary to create a geoinformation system for monitoring urban land.

**Figure 2. Scheme of GAT supply in urban land monitoring**

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A geo-information system for monitoring urban land should be provided with the ability to perform tasks such as maintaining graphic databases, making changes and additions to the database if necessary, processing data, and establishing a regular exchange of data with city and state administration bodies.

The possibility of integrating the geoinformation system into the state land monitoring system, state and city ecological monitoring systems, including telecommunications, should be provided for urban land monitoring. In addition, it is necessary to ensure protection against unauthorized access, including when transmitting information through communication channels and magnetic carriers.

The choice of technical means in the creation of a geoinformation system for monitoring urban land is determined by the size of the created data bank, the structure and nature of information flows, the reliability of the system and the requirements for data security. Different vocabularies, classifiers and thesauri are needed for the operation of a geoinformation system for urban land monitoring. The main ones are "classifier of urban land", " classifier of negative processes in urban land" and "classifier of indicators recorded during monitoring of urban land".

The output data of the geoinformation system of urban land monitoring is used in the development of recommendations for the rational use of land and the subsequent design of land protection, the removal of harmful industries and some sectors that make up the city. Users of monitoring data of the appropriate volume can be any legal entities and individuals, including foreign and international organizations interested in receiving them. The circle of main users includes organizations and individuals participating in the land market, in addition to the owners of the rights to land plots.

It is not enough to describe the condition of land only by monitoring it at the level of the whole city or in its separate administrative units. Plots located in natural complex lands, in zones of complex ecological and engineering conditions and intended for placement of objects that impose high requirements on environmental quality should have more detailed quality characteristics that can be obtained only as a result of detailed inspections. These include recreational use and community facilities, as well as plots earmarked for housing. Therefore, in the development of the ecological basis of land use, in order to improve the ecological situation in large cities, it seems necessary to include another document that is important in urban conditions, first of all, for natural complex lands.

This is the monitoring passport of the land plot, the monitoring passport of the land plot, which records the original quality of the land and its dynamics. Such a document is necessary for the formation of urban land monitoring data, which describes the ecological, urban planning and legal status of individual sections. The information of the data bank allows for more complete consideration of the quality of land in the cadastral assessment, ensuring rational use of land and increasing natural resources, as well as forecasting negative processes in urban land as a result of economic activity, etc. the content of the passport should be formed according to the results of a special inspection of the condition of land plots conducted during their monitoring. The form of the monitoring passport is developed poaspektnuyub, which includes a comprehensive and comprehensive description of the land in the plot, as well as a final expert opinion on the quality of the plot as a whole.

The proposed version of the compiled list of the most important indicators of land quality for large urban conditions obtained as a result of urban land monitoring and recorded in the monitoring passport includes six groups of indicators (Fig. 3).

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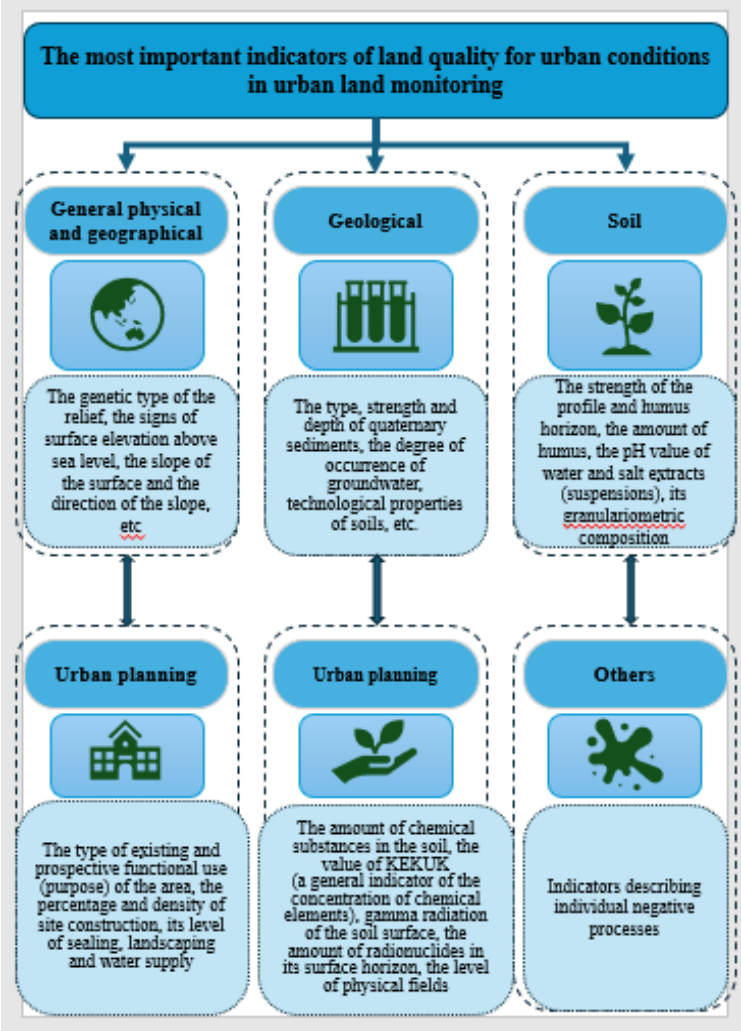


**Figure 3. The most important indicators of land quality for urban conditions in urban land monitoring**

Quality indicators describe the land plot as a whole or its homogeneous part (zone) according to this indicator. The values of certain quality indicators are measured in quantitative, metric units or selected on the basis of appropriate rating scales. According to the method of obtaining quantitative characteristics, indicators are divided into directly measured, analytically determined, calculated and determined by an expert. The main sources of specific information listed on some aspects of the land situation are documents of various statuses: survey reports, thematic maps, extracts from industrial cadastres, various classifiers and codifiers.

## DISCUSSION

Transforming urban land use in Uzbekistan presents both significant challenges and opportunities. As the country continues to urbanize, the need for sustainable land management has become increasingly urgent. This discussion explores the economic and organizational pathways necessary to achieve sustainable urban land use, focusing on how Uzbekistan can adapt and implement these strategies within its unique context.

1. Economic Incentives and Mechanisms

One of the critical pathways to sustainable urban land use in Uzbekistan involves the implementation of robust economic incentives. The current land use system in Uzbekistan often lacks the necessary economic mechanisms to encourage efficient and sustainable practices. For instance, land pricing and taxation policies have not been fully leveraged to promote sustainable development. By introducing land value capture mechanisms, Uzbekistan can ensure that the increase in land values, often resulting from public investments in infrastructure, benefits the broader community rather than just private landowners. Additionally, implementing green taxation policies, such as taxes on land that is left undeveloped or on practices that contribute to environmental degradation, could discourage unsustainable land use practices.

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Furthermore, subsidies and financial incentives for developers who incorporate sustainable practices into their projects could spur the adoption of green technologies and designs. These economic mechanisms must be carefully designed to align with Uzbekistan's broader economic goals and to ensure that they do not disproportionately impact low-income populations.

2. Organizational and Governance Reforms

The effectiveness of economic mechanisms in promoting sustainable urban land use is closely tied to the strength of organizational and governance structures. In Uzbekistan, the centralized nature of land governance has often led to inefficiencies, with decision-making processes being slow and sometimes disconnected from local realities. There is a need for reforms that enhance the responsiveness and adaptability of governance structures. Decentralization, for example, could empower local governments to make land use decisions that are more attuned to the specific needs and conditions of their communities. This would require building the capacity of local institutions and ensuring that they have the necessary resources and authority to manage urban land effectively.

Moreover, enhancing participatory planning processes is crucial. Involving a broader range of stakeholders, including residents, businesses, and civil society organizations, in land use planning can lead to more inclusive and sustainable outcomes. This participatory approach can also improve transparency and accountability in land governance, reducing the risk of corruption and ensuring that land use decisions reflect the public interest.

3. Addressing Land Tenure Security

Land tenure security remains a significant issue in Uzbekistan, where unclear and inconsistent land tenure arrangements can discourage investment in sustainable land use practices. Ensuring that land tenure is secure and clearly defined is essential for creating an environment where stakeholders are willing to invest in long-term sustainable projects. This involves both legal reforms to clarify land ownership and use rights and the strengthening of institutions responsible for land administration.

By improving land tenure security, Uzbekistan can also address social equity concerns, ensuring that all citizens, including vulnerable groups, have access to land resources. Secure land tenure can enable marginalized communities to participate more fully in urban development, fostering more equitable and sustainable urban growth.

4. Integrating Environmental Considerations

Sustainability in urban land use is inextricably linked to environmental stewardship. In Uzbekistan, environmental considerations must be integrated into every stage of urban planning and land management. This includes conducting thorough environmental impact assessments for new developments and implementing urban planning strategies that prioritize the conservation of natural resources and the mitigation of environmental risks, such as soil degradation and water scarcity.

Uzbekistan can also benefit from adopting international best practices in green urbanism, such as the development of green infrastructure and the promotion of public transportation over car-dependent urban sprawl. These practices not only contribute to environmental sustainability but also enhance the quality of life in urban areas.

5. Challenges and Limitations

While the pathways discussed offer promising directions for sustainable urban land use in Uzbekistan, several challenges and limitations must be acknowledged. First, the success of these strategies depends on the political will and commitment to implementing necessary reforms. Resistance to change, whether from vested interests or due to bureaucratic inertia, can impede progress. Additionally, the economic constraints faced by Uzbekistan, particularly in terms of funding large-scale infrastructure projects, may limit the extent to which these strategies can be implemented.

Moreover, the transition to more sustainable urban land use practices requires significant cultural and behavioral shifts among both policymakers and the public. Public awareness campaigns and education initiatives will be crucial in fostering a culture of sustainability that supports these changes.

Transforming urban land use in Uzbekistan through economic and organizational pathways is a complex but achievable goal. By implementing targeted economic incentives, reforming governance structures, securing land tenure, and integrating environmental considerations into urban planning, Uzbekistan can move towards a more sustainable future. While challenges remain, the potential benefits of sustainable urban land use, including improved environmental outcomes, greater social equity, and enhanced economic development, make this transformation a critical priority for the country's continued growth and prosperity.

## RECOMMENDATIONS

To achieve sustainable urban land use in Uzbekistan, a comprehensive and strategic approach is needed. Based on the discussion of economic and organizational pathways, the following recommendations are proposed:

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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1. Implement Land Value Capture Mechanisms

Uzbekistan should introduce land value capture mechanisms to ensure that the increase in land values resulting from public investments in infrastructure benefits the community as a whole. This can be achieved through:

- Tax Increment Financing (TIF): Use TIF districts to fund urban infrastructure improvements by capturing the future increases in property tax revenues that result from these investments.
- Development Impact Fees: Charge developers fees that reflect the true costs of the infrastructure needed to support new developments, ensuring that public investments are recovered.

2. Reform Land Taxation and Pricing Policies

Reforming land taxation and pricing policies is crucial for promoting efficient and sustainable land use. Recommendations include:

- Green Taxation: Introduce taxes on undeveloped or underutilized urban land to discourage land hoarding and speculative activities.
- Progressive Land Tax Rates: Implement a progressive tax system where higher land values are taxed at higher rates, incentivizing more productive and sustainable use of urban land.

3. Enhance Land Tenure Security

Strengthening land tenure security is essential for encouraging long-term investments in sustainable land use. Uzbekistan should:

- Clarify and Codify Land Rights: Legal reforms should be undertaken to clearly define land ownership and use rights, reducing uncertainties that can deter investment.
- Strengthen Land Administration Systems: Invest in modernizing land administration systems, including digital land registries, to ensure that land tenure information is accurate, accessible, and transparent.

4. Decentralized Urban Land Governance

To improve the responsiveness and effectiveness of urban land management, Uzbekistan should pursue decentralization by:

- Empowering Local Governments: Transfer more decision-making authority to local governments, allowing them to tailor land use policies to the specific needs of their communities.
- Capacity Building: Provide training and resources to local government officials to enhance their ability to manage urban land sustainably.

5. Promote Participatory Urban Planning

Fostering a participatory approach to urban planning can lead to more inclusive and sustainable outcomes. Recommendations include:

- Establish Community Planning Forums: Create forums where residents, businesses, and civil society organizations can actively participate in urban planning processes.
- Ensure Transparency and Accountability: Implement mechanisms to ensure transparency in land use decision-making, such as public disclosure of planning documents and decisions, and independent oversight bodies.

6. Integrate Environmental Considerations into Urban Planning

Environmental sustainability should be at the core of urban land use planning. Uzbekistan should:

- Adopt Green Infrastructure Practices: Encourage the development of green infrastructure, such as parks, green roofs, and urban forests, to enhance the ecological resilience of cities.
- Prioritize Public Transportation: Develop and expand public transportation networks to reduce reliance on private vehicles, decrease urban sprawl, and lower greenhouse gas emissions.
- Conduct Environmental Impact Assessments (EIAs): Require EIAs for all significant urban development projects to assess and mitigate potential environmental impacts.

7. Develop Financial Incentives for Sustainable Development

Financial incentives can play a crucial role in promoting sustainable urban land use practices. Uzbekistan should consider:

- Subsidies for Green Building Practices: Offer subsidies or tax credits to developers who incorporate energy-efficient technologies, sustainable materials, and other green building practices into their projects.
- Grants for Sustainable Urban Projects: Establish grant programs to fund innovative urban projects that promote sustainability, such as eco-friendly public spaces, renewable energy installations, and sustainable transportation initiatives.

8. Increase Public Awareness and Education

Cultural and behavioral shifts are necessary to support sustainable urban land use. Recommendations include:

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- Public Awareness Campaigns: Launch nationwide campaigns to raise awareness about the importance of sustainable land use and the role of individuals and communities in achieving it.
- Education Programs: Integrate urban sustainability topics into school curricula and offer training programs for professionals involved in urban planning and development.

9. Monitor and Evaluate Urban Land Use Policies

Continuous monitoring and evaluation of urban land use policies are essential to ensure their effectiveness and adapt to changing circumstances. Uzbekistan should:

- Establish Monitoring Frameworks: Develop frameworks for regularly assessing the impacts of urban land use policies on sustainability, including economic, social, and environmental outcomes.
- Use Data-Driven Decision-Making: Leverage data analytics and geographic information systems (GIS) to monitor land use patterns and make informed decisions about future urban development.

By implementing these recommendations, Uzbekistan can create a more sustainable, equitable, and efficient system of urban land use. The proposed economic and organizational reforms will not only improve the management of urban land but also contribute to the country's broader goals of sustainable development, social equity, and economic growth. The success of these efforts will require strong political will, stakeholder collaboration, and ongoing commitment to sustainability principles.

## CONCLUSION / SUMMARY

As Uzbekistan continues to experience rapid urbanization, the need for sustainable land use practices has become increasingly critical. This study has explored the economic and organizational pathways that can facilitate the transformation of urban land use in Uzbekistan, ensuring that the country's urban development aligns with the principles of sustainability.

1. Economic Mechanisms: The introduction of economic incentives such as land value capture, green taxation, and subsidies for sustainable practices can significantly influence the efficiency and sustainability of urban land use. These mechanisms are vital for promoting responsible development and ensuring that the benefits of urbanization are equitably distributed.
2. Organizational and Governance Reforms: The effectiveness of land use policies is heavily dependent on the strength of organizational structures and governance. Decentralization, participatory planning, and enhanced transparency are essential for creating responsive and adaptable urban land management systems that can address the specific needs of Uzbekistan's diverse urban environments.
3. Land Tenure Security: Secure land tenure is fundamental to encouraging long-term investments in sustainable land use. Legal and administrative reforms are necessary to clarify land rights and improve the efficiency of land administration systems, thereby reducing uncertainties and fostering a stable environment for development.
4. Environmental Integration: Sustainability requires that environmental considerations be fully integrated into urban planning. By prioritizing green infrastructure, public transportation, and thorough environmental impact assessments, Uzbekistan can mitigate the ecological impacts of urbanization and enhance the resilience of its cities.
5. Public Engagement and Education: A cultural shift towards sustainability is crucial for the success of these initiatives. Public awareness campaigns and education programs can foster a deeper understanding of sustainable practices among citizens, developers, and policymakers alike, driving broader support for sustainable urban land use.

The transformation of urban land use in Uzbekistan is not just a technical challenge but a multifaceted process that requires the integration of economic, social, and environmental considerations. The recommendations provided in this study offer a roadmap for achieving sustainable urban development, but their successful implementation will depend on strong political will, effective governance, and the active participation of all stakeholders.

Uzbekistan stands at a pivotal moment in its urban development journey. By embracing these pathways to sustainability, the country can ensure that its cities not only meet the needs of today's population but also provide a prosperous, equitable, and environmentally sound future for generations to come.

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EPRA International Journal of Research and Development (IJRD)
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# IN MADAGASCAR, INFLATION HURTS

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**ABSTRACT**

*The purpose of this study is to show that inflation adversely affects the economic performance of Madagascar. In this country, the inflationary environment is persistent. Through a first econometric estimation, it is proved that at some high level, inflation negatively impacts economic growth. Nonetheless, as suggested by many authors, the inflation-growth nexus is not linear. This case is verified for this country as we were able to determine an optimal level of inflation favorable to growth. In a second analysis, we show that an increase in inflation pushes individuals below the poverty line. The adoption of an inflation targeting regime seems to be unavoidable, to effectively and sustainably fight against inflation in Madagascar.*

***Résumé***

*Cette étude entend montrer que l'inflation affecte négativement la performance économique de Madagascar. Dans ce pays, l'environnement inflationniste est persistant. A travers une première estimation économétrique, nous sommes en mesure de prouver qu'à un certain niveau élevé, l'inflation impacte négativement la croissance économique. La relation entre ces deux grandeurs n'est toutefois pas linéaire, car nous avons pu déterminer un niveau optimal de l'inflation, propice à la croissance. Dans une seconde analyse, nous exposons qu'un accroissement de l'inflation fait basculer des individus en dessous du seuil de pauvreté monétaire. Le passage vers un régime de ciblage d'inflation semble être inéluctable, pour lutter de manière efficace et pérenne contre l'inflation à Madagascar.*

**KEYWORDS**: *inflation, growth, poverty, inflation targeting, monetary policy*
***JEL classification**: E31, I32*

## INTRODUCTION: *INFLATION DEVELOPMENT IN MADAGASCAR*

Madagascar has experienced a turbulent inflation history. Throughout the observation period (1980 to 2023), inflation recorded fluctuations of varying significance. Only during 2008-2020 did inflation experience relative stability. During this period, inflation averaged 7.6%, with a volatility of 1.6%. Outside this interval, inflation has been high and volatile like in the 80s. At that time, average inflation was 19.6% with volatility of 8.2%. There were also 3 years of high inflation during the 90s, from 1994 to 1996, when its average reached 35.9%, with a volatility of 14.9%. Between these two periods, inflation was relatively stable, but remained at a relatively high level.

The 80s' inflationary episode was linked to the severe shortage of basic goods. The lack in essential products has led to a general rise in prices. For the period 1994-1996, high inflation was associated in particular to the shock induced by the floating exchange rate regime adoption, one of the conditions imposed by international partners, within the economy's structural adjustment program. The depreciation of the national currency had an important impact on inflation. The other inflationary episodes were mainly caused by the repeated political crises in the country.

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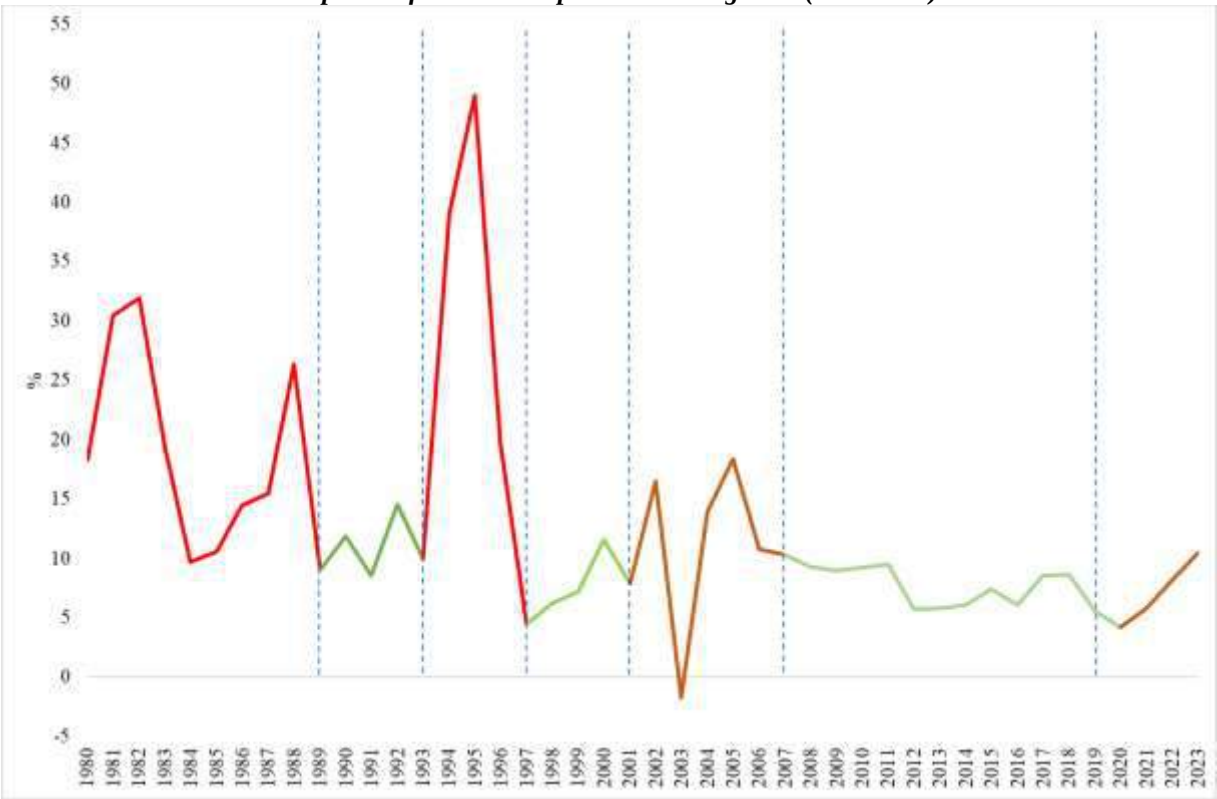
*Graph 1. Inflation development in Madagascar (1980-2023)*




*Source: data from World Economic Outlook, ed. April 2024*

In the 80s and 90s, inflation in Madagascar and at the global level were comparable. This era was marked by high and volatile inflation around the world. From late 90s, coinciding with the beginning of inflation targeting practice in some countries, global inflation fell to a relatively low level, except during the financial crisis and the post-pandemic and Russia-Ukraine crises. The trajectory of inflation in Madagascar has not followed this global trend. Certainly, inflation has fallen compared to the 80s'figures, but its level has remained high, as evidenced by the graph below. The volatility of inflation in Madagascar is also demonstrated by this figure, in contrast to global inflation which has now experienced relative stability.

Nonetheless, inflation in Madagascar, even if at a high level, was generally lower than the African average during the observation period. According to the African Development Bank latest economic report, the inflation situation in Africa was different from the rest of the world in 2023. While many regions in the world experienced a disinflation process in 2023, inflation in Africa has increased, with an average of 17.8%, after 14.1% in 2022. According to this report, supply shocks in the agricultural sector, weaknesses of African currencies, as well as rising imported goods' prices, were indicated to be at the origin of this situation. It should also be noticed that Africa includes the fewest countries practicing the inflation-targeting monetary policy regime.

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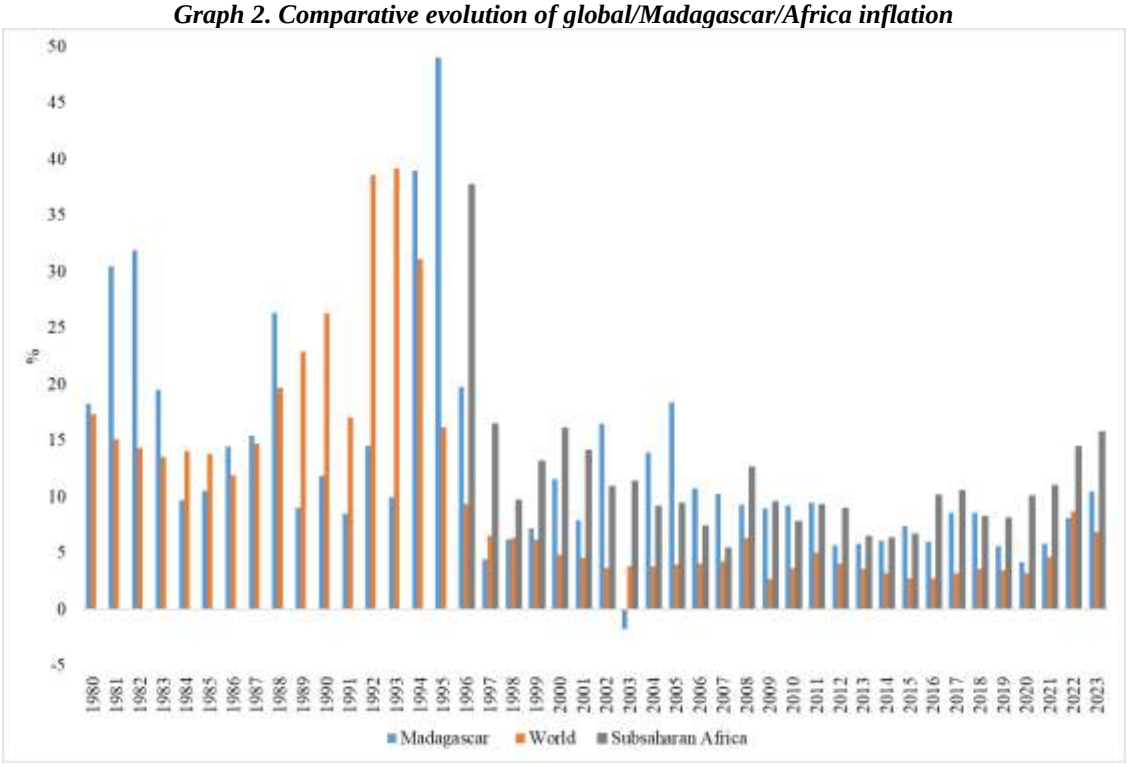
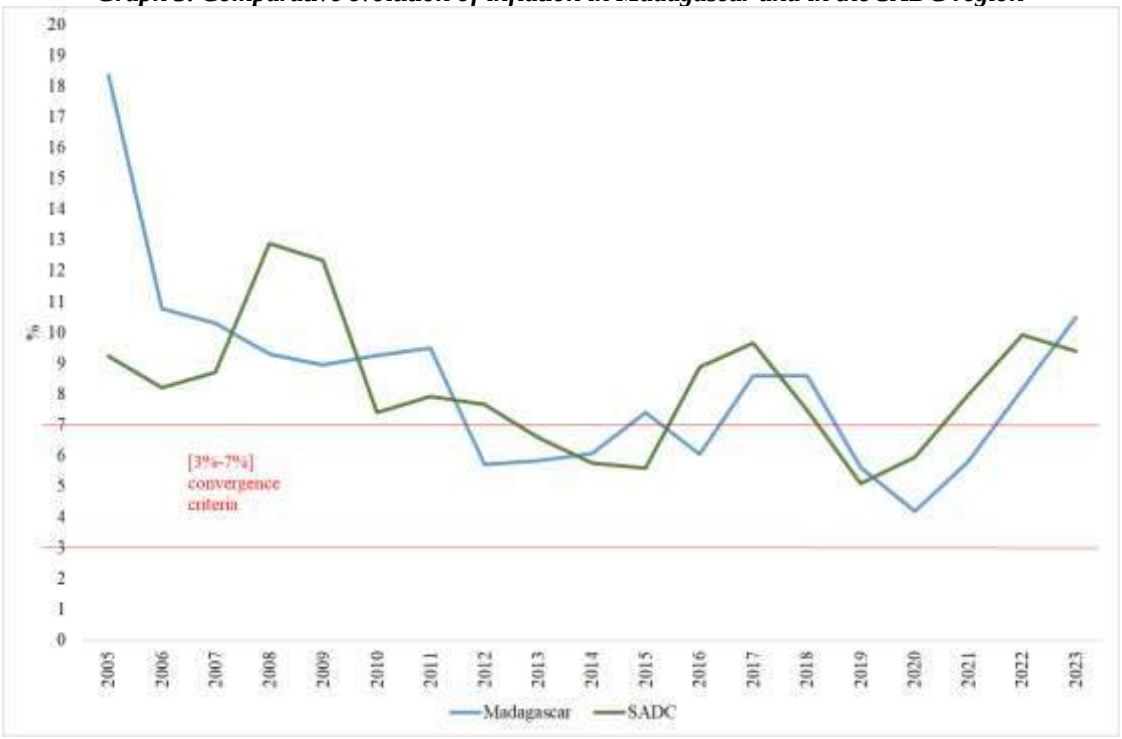
***Graph 2. Comparative evolution of global/Madagascar/Africa inflation***




*Source : data from World Economic Outlook, ed. April 2024*

Since Madagascar became part of the SADC[1], its inflation is almost in line with the region's average. However, the objective is not necessarily the alignment, but the compliance with the convergence criterion, represented by the red band in the following graph. According to this figure, the country's inflation has been outside the range most of the time.

***Graph 3. Comparative evolution of inflation in Madagascar and in the SADC region***




*Source: data from World Economic Outlook, ed. April 2024*

[1] *South African Development Community: Regional Economic Community composed of 16 countries from Southern Africa.*

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This succinct analysis of the recent history of inflation in Madagascar strengthens our conviction about the inflationary reality in this country. In the following section, we will try to prove that inflation affects the economic performance of this country.

Impacts of inflation on economic performance

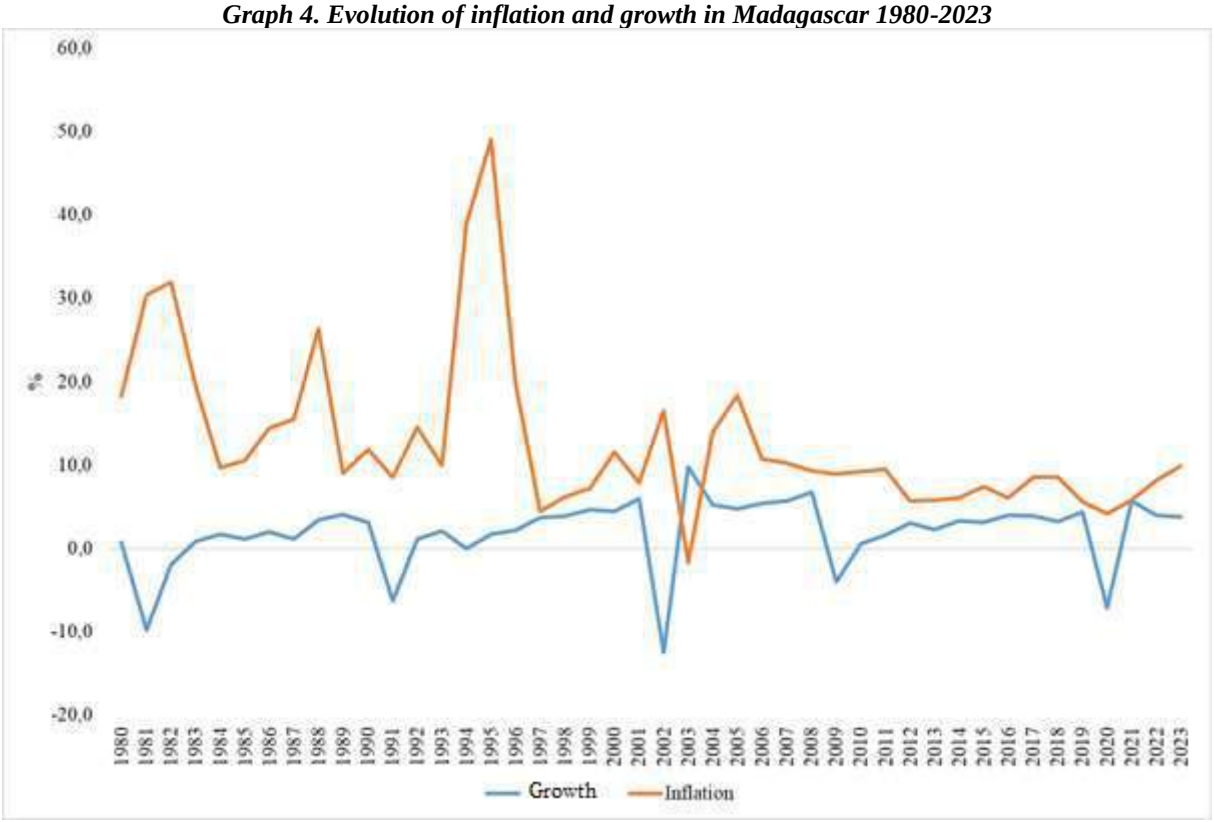
Following the descriptive analyzes on the inflation development in Madagascar, we will try to determine the harmful effects of this phenomenon on economic performance. First, we will attempt to show the negative impact of inflation on growth. Subsequently, we will demonstrate the consequence of inflation on poverty.

Inflation and growth nexus

In this section, we will try to determine the inflation-growth nexus for the case of Madagascar. Generally speaking, the literature suggests a negative relationship between these two variables (Fischer & Modigliani, 1978), (Fischer,1993), (Barro, 1995). In other words, inflation is detrimental to economic growth. However, these arguments contrast with the Keynesian thoughts, which argue a positive effect of inflation on growth. This theory is based on the Phillips curve (1958), which identified a decreasing relationship between inflation and unemployment, *i.e.*, high inflation leads to low unemployment. In turn, this latter positively affects growth (Grimes, 1991). For Mundell (1991), inflation is the consequence of the reduction in agents' net wealth. Thus, to restore this post-inflation wealth, agents are encouraged to save, lowering the interest rate, which in turn stimulates inflation.

In this paper, we assume the existence of a negative relationship between growth and inflation. First, we will check the existence of a long-term relationship between these two variables. Intuitively, the graph below displays us a certain symmetry between growth and inflation throughout the observation period.

***Graph 4. Evolution of inflation and growth in Madagascar 1980-2023***




*Source: data from World Economic Outlook, ed. April 2024*

Next, we will estimate a simple ordinary least squares model, liaising these two aggregates. The estimation results are given by the following table:

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*Table1. Impact of inflation on growth for the case of Madagascar*

| | Dependent variable : growth | | | |
|---|---|---|---|---|
| | *Coeff.* | *Std. Err.* | *t-stat* | *Prob.* |
| **Intercept** | 4.788051 | 0.484491 | 9.882647 | 0.0000 |
| **Inflation** | -0.120980 | 0.030522 | -3.963726 | 0.0003 |
| **Dum81** | -10.90337 | 1.923285 | -5.669138 | 0.0000 |
| **Dum91** | -10.06088 | 1.849410 | -5.440050 | 0.0000 |
| **Dum02** | -15.20001 | 1.848794 | -8.221580 | 0.0000 |
| **Dum09** | -7.683798 | 1.848591 | -4.156570 | 0.0002 |
| **Dum20** | -11.41939 | 1.863190 | -6.128945 | 0.0000 |
| | | $R^2$ = 0.840798 | | |
| | | DW = 0.981182 | | |
| | | Obs. : 44 | | |

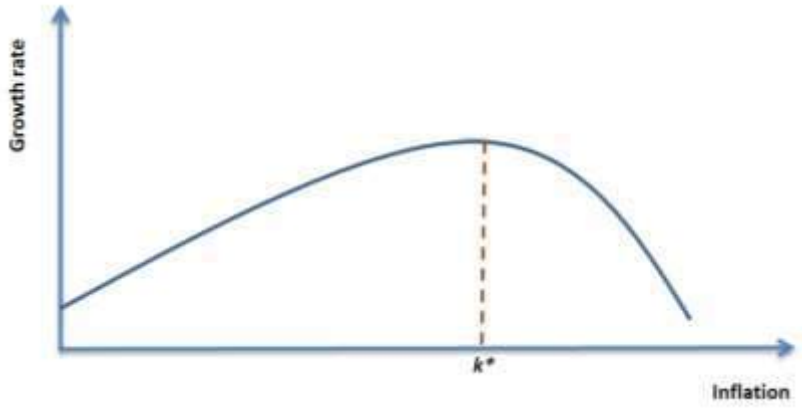
*Source: Author's Calculation*

This equation reveals the negative growth-inflation nexus for the case of Madagascar. This relation could be considered as a long-term one due to the fact that these two variables are stationary. It can be interpreted such as 1-point increase in inflation decreases growth by 0.13 point. The estimation includes 5 dummy variables correcting the effects of the crises that occurred in Madagascar, namely:

- *External payment default crisis in 1981;*
- *Political crises of 1991, 2002, 2009 ;*
- *Pandemic crisis of 2020.*

However, authors who defend the negativity of the inflation-growth nexus also argue that the relationship is not linear, *i.e.*, the relation is not negative in every way. For Gosh & Phillips (1998), "*moderate inflation can help to grease the economy*". Thus, there is some level of inflation which is favorable to growth. We attempt to determine this level for the case of Madagascar. For this purpose, we will use the pioneering study of Khan & Senhadji (2001). These authors carried out a panel-countries study, to test whether the relationship between inflation and growth is non-linear. They assumed that at a moderate level of inflation, the relationship between these two indicators can be positive, but at a high rate, inflation negatively affects growth. In this case, there should be an inflation threshold that splits these two situations. For Sattarov (2011), if this threshold exists, the relationship between inflation and growth is concave as illustrated by the graph below.

*Graph 5. Inflation threshold*




*k* : inflation threshold*
*Source: Sattarov (2011), p. 12*

This hypothesis will be tested for the case of Madagascar. However, for technical reasons linked to the availability of data, we will take only these two variables and leave the control variables used by Khan & Senhadji (2001). The model we are going to estimate is as follows:

$$dlog(y_t) = \mu + \gamma_1 \log(\pi_t) + \gamma_2 d_t^{\pi^*} [\log(\pi_t) - \log(\pi^*)] + \varepsilon_t$$

$$d_t^{\pi^*} = \begin{cases} 1 \; si \; \pi_t > \pi^* \\ 0 \; si \; \pi_t < \pi^* \end{cases} t = 1, \dots, T$$

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$y_t$ : real GDP
$\pi_t$ : average inflation rate at $t$
$\pi^*$ : inflation threshold
$d_t^{\pi^*}$ : dummy variable, taking the value of 1 when inflation is above the threshold, and 0 otherwise
$\varepsilon_t$ : error term
The observation period extends from 1980 to 2023. To obtain the optimal inflation level, we carried out numerous OLS regressions, increasing the threshold by 1 point each time. The table below summarizes the estimation results.

***Table 2. Determination of the optimal inflation level for the case of Madagascar***

| | | **Dependent variable: $dlog(y)$** | | | | | |
|---|---|---|---|---|---|---|---|
| **Explanatory variable** | $\pi^* \leq 4$ | $\pi^*$ =5 | $\pi^*$ =6 | $\pi^*$ = 7 | $\pi^*$ = 10 | $\pi^*$ = 14 | $\pi^*$ =15 |
| **μ** | No result | -0.33 *(-2.39)* | -0.13 *(-1.86)* | -0.05 *(-1.19)* | -0.002 *(-0.07)* | 0.01 *(0.68)* | 0.02 *(0.92)* |
| **$\log(\pi)$** | | 0.50 *(2.50)* | 0.18 *(2.06)* | 0.08 *(1.46)* | 0.01 *(0.49)* | -0.004 *(-0.20)* | -0.08 *(-0.43)* |
| **$\log(\pi) - \log(\pi^*)$** | | -0.53 *(-2.59)* | -0.21 *(-2.28)* | -0.12 *(-1.81)* | -0.05 *(-1.23)* | -0.03 *(-080)* | -0.02 *(-0.60)* |
| **$R^2$** | | 0.20 | 0.18 | 0.13 | 0.10 | 0.08 | 0.07 |
| **$DW$** | | 1.39 | 1.46 | 1.55 | 1.61 | 1.60 | 1.60 |

*Source : author's calculation*
We have tried estimation with inflation thresholds less than or equal to 4%, but encountered near-singular cases. This can be easily explained because the minimum inflation in our series is 4.2%. Thus, if we set the threshold below 4%, the series of the difference between achieved inflation and the threshold does not differ from the inflation series. Nevertheless, this situation can be interpreted economically, that during our observation period, an inflation rate below 4% would not be able to support economic growth.

Next, we will determine the optimal level of inflation, as indicated by Gosh & Phillips (1998). We immediately see in the gray area in the above-table that with an inflation threshold of 5%, inflation positively affects growth with a statistically significant coefficient. Likewise, for a threshold of 6%, the coefficient remains positive and significant, but is reduced to 0.18, after 0.5 for the 5% threshold. We can understand that from the 7% threshold, the coefficient, even if it remained positive, is no longer statistically significant. At a level of 10%, the positive effect of inflation dissipates. Continuing the estimates, it is observed that from the 14% threshold, inflation begins to negatively affect growth, even if the coefficients are not statistically significant. At a certain very high level of inflation, the negative impact of inflation on growth becomes important and statistically significant. According to these results, the optimal level of inflation to support growth is a range of 5%-6% for the case of Madagascar.

**Inflation and Monetary Poverty**
Beyond its impact on growth, inflation is a rather concerning phenomenon as it produces undesirable effects. One of the striking consequences of inflation is its effect on poverty. Numerous studies have argued for the exacerbation of poverty by inflation. We will delve into these works in the following literature review.

**LITERATURE REVIEW**
The relationship between inflation and poverty is explained through various approaches. The pioneering study was conducted by Cardoso (1992), who constructed an indicator measuring the inflation tax, affecting notably the middle class. Individuals already living below the poverty line are impacted to a limited extent because they hold very little cash. However, savings of the segment of the population belonging to the middle class are eroded by inflation. The decrease in disposable income is considered as the primary transmission channel of inflation to poverty. The second channel is the decline in real wages, as nominal wages grow less rapidly than prices during periods of high inflation. Therefore, according to this author, inflation increases the number of the poor. Easterly & Fischer (2000) conducted a survey of 31,869 households in 38 countries and concluded that high inflation tends to increase poverty. Additionally, inflation disproportionately affects lower-income households by directly reducing the *per capita* income of this population segment. In this empirical study, they argued that a 20% increase in the inflation tax reduces real wages by 8 percentage points.

According to Agénor (1999), there are 3 factors explaining the vulnerability of the poor to inflation:
- The wages of the poor are often defined in nominal terms, and they do not benefit from indexation mechanisms. Thus, in case of high inflation, their real wages tend to depreciate;
- The poor are less protected against price increases as they lack financial assets and real assets;
- Their cash holdings are subject to the inflation tax.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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A pertinent empirical study that served as a major inspiration for our research is the investigation conducted by Chani, Pervaiz, Jan, Ali & Chaudary (2011). They explored the relationship between poverty, inflation, and economic growth for the case of Pakistan. Using a 5-variable ARDL model encompassing factors such as the percentage of the population below the poverty line, the consumer price index, GDP per capita in the national currency, investment, and the level of foreign trade openness, these authors established a robust relationship between inflation and poverty, both in the short and long term, for the period 1972 to 2008 for Pakistan.

In a similar way, Arshad, Sheikh, Akhtar & Mushtaq (2019) also estimated an ARDL model, once again for the case of Pakistan, but their analyses delved deeper. These authors used two price indices, namely the Consumer Price Index (CPI) and the Wholesale Price Index (WPI). They decomposed these two indicators to better understand the influences of their components on poverty. Additionally, they employed two poverty measures, namely the head count ratio and the poverty gap. As such, 6 disaggregated models were estimated over the period 1982-2015. In general, these authors found a positive relationship between poverty and inflation. They proposed 3 factors explaining this link, including the contraction of individuals' real incomes, the weak bargaining power of the poor, and the low, or even absence of, indexation system.

Jayashankar & Murphy (2023) explored a study akin to that of Easterly & Fischer (2000) and found almost similar results. Through a survey conducted on thousands of American households, these authors noted that low-income households are more adversely affected by inflation because they lack the flexibility to purchase cheaper goods, as they already consume them. They do not have the capacity to stockpile goods like affluent households. Poor households have very little cash to shield themselves against high inflation. Therefore, these authors underscored the importance of price stability, a role to be fulfilled by the Central Bank.

## METHODOLOGY

In this study, we select ARDL modeling as econometric technique. This approach is commonly employed for time series unveiling at least one cointegration relationship. We opt for this method over a two-step Johansen-ECM (Error Correction Model) due to ARDL's advantage in combining variables with different orders of integration. Additionally, this model allows for distinguishing the effects of lags in the dependent variable and lags in the explanatory variables. It is also known to perform well with a limited number of observations. A 3-variable ARDL model is presented as follows :

$$y_t = c + \sum_{j=1}^{p} \gamma_j \, y_{t-j} + \sum_{k=0}^{p} \varphi_k x_{t-i} + \sum_{l=0}^{p} \vartheta_l z_{t-l} + \varepsilon_t$$

Regarding these variables, three aggregates are included in this model: monetary poverty, GDP per capita in USD, and the Consumer Price Index (CPI). Monetary poverty represents the percentage of the population living below the poverty line. Currently, the World Bank has updated the poverty line to $2.15 USD per day. The data is sourced from the WDI database[2]. For Madagascar, there are missing figures and we interpolated them using the Cubic Spline method. The other two variables were sourced from the IMF's WEO database. The observation period extends from 1980 to 2023.

By conducting Augmented Dickey-Fuller (ADF) tests for unit roots on the variables, we observe that GDP per capita and the Consumer Price Index (CPI) are not stationary in level. However, the interpolated monetary poverty variable is. This result may be surprising as in reality this variable should not be stationary, but similar cases exist in some studies. Thus, we have a combination of I(0) and I(1) variables, justifying the use of the ARDL model. The results of the unit root tests can be found in the appendix. We impose a maximum lag order of 6, and we let the Eviews© software automatically select the optimal ARDL model.

## RESULTS

The first result confirms the presence of a cointegration relationship among the variables included in this model. In this regard, the F-statistic calculated from the bound testing approach to cointegration shows a fairly comfortable value of 15.5. The maximum threshold for a number of observations of 30 at 1% significance level is 9.4. Thus, it can be confirmed that there is at least one cointegration relationship between monetary poverty, inflation, and per capita growth for the case of Madagascar. In other words, there exists a long-term equilibrium among these 3 variables.

However, the speed of convergence towards this equilibrium is slow, as the error correction term, although negative, is only around -0.095. This means that any short-term deviation from the long-term equilibrium is corrected by barely 10% each year. In the case of Pakistan, the authors found a convergence speed of around 60%.

In the short term, monetary poverty is strongly explained by its past values. As mentioned earlier, the ARDL model allows for distinguishing the effects of lags on the dependent variable. There is a strong persistence of this explanatory variable up to 4 years. We are most interested in the long-term relationship, which is presented as follows:

[2] *https://databank.worldbank.org/source/world-development-indicators*

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$$POV_t = 7{,}1 - 0{,}041GDPPC_t + 0{,}121CPI_t + \varepsilon_t$$
(6,1) (-2,583) (2,038)

The signs correspond to expectations, as GDP per capita is negatively related to monetary poverty, in contrast to the CPI, whose relationship with monetary poverty is positive. Concretely, this result suggests that an increase in GDP per capita of $100 would reduce the percentage of the population living below the $2.15/day by 4.1 points. However, the long-term relationship suggests that a 10% increase in the CPI pushes 1.2% of the population below the poverty line.

## CONCLUSION

This study attempted to show that inflation may hurt Madagascar's economic performance. At a certain level, inflation negatively affects economic growth. This hypothesis was proven through the long-term relationship, stipulating that an 1% increase in inflation leads to a 0.13% decrease in growth. However, as recommended in the literature, we also succeeded in proving that this relationship is not linear in this country. There is a certain level of inflation favorable to economic growth, that is a range [5-6%]. The 1% increase in inflation also pushes 0.12% of the population below the monetary poverty line. In this case, the fight against inflation should be a priority in this country. According to Federal Reserve Chair Jerome Powell (2022): *« Without price stability, the economy does not work for anyone. In particular, without price stability, we will not achieve a sustained period of strong labor market conditions that benefit all. The burdens of high inflation fall heaviest on those who are least able to bear them»*. Drastic measures should be implemented to reverse this trend and establish an environment of low and stable inflation. Migration to an inflation-targeting monetary policy regime is highly recommended.

Given the limitations this study, it should pave the way for future research. The use of an approximate measure of monetary poverty may be a major limitation in poverty studies for Madagascar. The results of estimation with a complete series of poverty, without resorting to interpolation, could have been different. Thus, the construction of comprehensive, robust, and reliable databases on poverty in Madagascar would provide significant added value to researchers and policymakers, especially for a country ranked among the least developed in the world. The same applies to data on the labor market, including employment and wages. It would also be interesting to conduct a study on the relationship between these two variables, decomposing the CPI as in Arshad and al. (2019), to observe the effects of price components on poverty in a country where food and energy prices are highly volatile compared to other products and services.

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# INNOVATIVENESS AND ENTREPRENEURIAL INTENTION AMONG STUDENTS-GLOBAL REVIEW

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**Article DOI: https://doi.org/10.36713/epra18085**
**DOI No: 10.36713/epra18085**

**ABSTRACT**

*This study examines the factors that impact innovation and entrepreneurial intention among the student population. The study explores the relationship between creativity, entrepreneurial education, and individual attitudes towards students' intentions for entrepreneurship. The findings indicate that creativity positively affects entrepreneurial intention, while entrepreneurial education and personal attitudes play a significant role in shaping students' proclivity towards entrepreneurship. The significance of nurturing entrepreneurial attitudes and behaviors among students to foster a more thriving and enduring future is underscored. The research concludes that cultivating a creative and entrepreneurial mindset among students is imperative for the advancement of entrepreneurship and innovation.*

**KEYWORDS**: *Entrepreneurial Intention, Innovation, Education, Personal Factors*

## INTRODUCTION

Academic institutions play a critical role in nurturing students' inclination towards entrepreneurship. Universities can create an atmosphere that motivates students to discover their entrepreneurial capabilities and gain the necessary skills to thrive as innovators and entrepreneurs through the provision of resources, mentorship, and hands-on learning experiences.

Creativity exerts a beneficial impact on entrepreneurial intention, demonstrating a noteworthy moderating influence. Entrepreneurial disposition emerges as the primary driver of entrepreneurial intention. The impact of perceived behavioral control and subjective norms on entrepreneurial intention is also substantial. Entrepreneurial self-efficacy demonstrates a positive relationship with entrepreneurial intention. The most potent factor shaping entrepreneurial intention is personal entrepreneurial attitude (Pérez-Macías et al., 2023; Shi et al., 2020)

Understanding the factors that impact a student's aspiration to become an entrepreneur, including personal characteristics, societal norms, resource availability, and the perceived feasibility and attractiveness of entrepreneurship, is essential for developing effective strategies to promote entrepreneurial mindsets and behaviors among students. Research focusing on these factors is vital due to the importance of entrepreneurship and innovation in addressing global challenges. The findings from such studies can inform the development of targeted policies, initiatives, and educational programs that empower students to actualize their visions and contribute to a more prosperous and sustainable future.

Self-efficacy, family support, and peer support have a positive impact on entrepreneurial intention. Knowledge of entrepreneurial skills, risk-taking capacity, and innovativeness plays a mediating function. (Martins et al., 2023)Entrepreneurial intention and entrepreneurship education are linked through creativity. Entrepreneurship education boosts self-efficacy, self-employment intentions, and employability value(Rungsrisawat & Sutduean, 2019).

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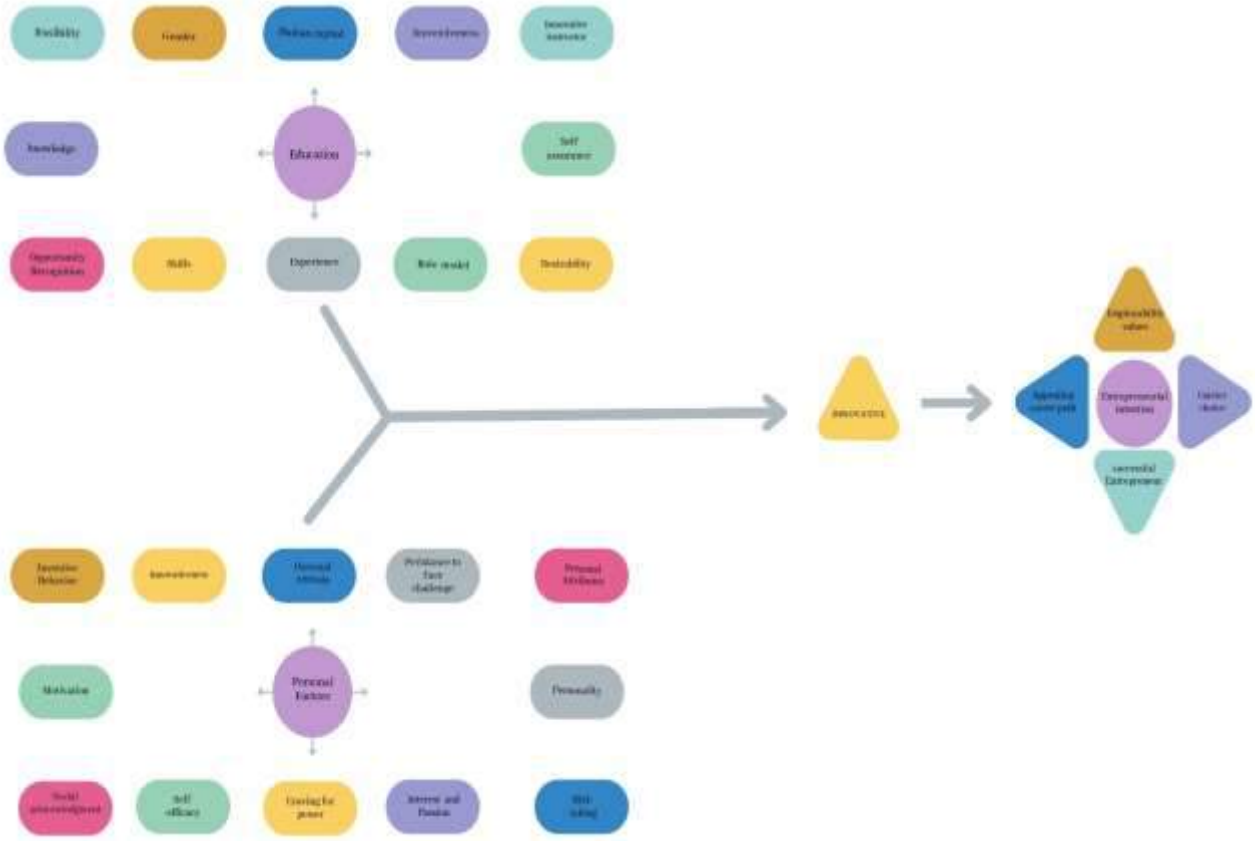


**Conceptual framework**

## METHODS

The comprehensive investigation aimed to integrate international data on student creativity and entrepreneurial intentions. A thorough Google Scholar search was done to ensure the identification of various kinds of literature in the field, with a focus on works most relevant to the goals of the study.

## INNOVATION AND ENTREPRENEURIAL INTENTION

Innovation has a big impact on entrepreneurial intention because it fosters the qualities that make an entrepreneur successful: creativity, opportunity recognition, and idea production. Research indicates that a fundamental quality of entrepreneurs is innovation, which is intimately related to entrepreneurship. Innovative businesspeople have a higher propensity to create original goods and services, successfully address obstacles, and propel expansion. Entrepreneurial purpose is greatly influenced by innovative conduct, such as coming up with and implementing novel ideas. Innovative conduct plays a major role in the interaction between entrepreneurial knowledge, attitude, and education and entrepreneurial intention. Therefore, innovation serves as a stimulant for entrepreneurial intention, encouraging people to launch and grow companies with a dedication to finding novel solutions and business prospects.

Active Learning Methods There is a moderate association between perceived opportunity and entrepreneurial aspirations, and visual thinking, flipped classroom, and other strategies all have an impact on entrepreneurial inclinations. First-year students' distinctive knowledge influences their inventiveness and entrepreneurial goals. The teacher's role model, the visitor's role model, and other ways all help to foster entrepreneurial intentions. Problem-based learning, visual thinking, and brainstorming all help to boost entrepreneurial intentions(Pérez-Macías et al., 2023).

There is a positive association between creative disposition and entrepreneurial intention(Anjum et al., 2020).Innovativeness promotes entrepreneurial intention through entrepreneurial alertness, and entrepreneurial alertness completely mediates the relationship between innovativeness and intention(Gozukara & Colakoglu, 2016).Creativity increased entrepreneurial intents, particularly in rural areas, and

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the utility of creativity had a greater impact on entrepreneurial conviction(Chia & Liang, 2016).Creativity has a strong influence on entrepreneurial attitudes (Kusmintarti et al., 2017).investigated the impact of technical innovation on the aspirations of entrepreneurs in sub-Saharan Africa(Ndofirepi et al., 2018).

Results validate the importance of innovative instructors in fostering entrepreneurial abilities(Alshebami et al., 2022) .The innovative cognitive style has a considerable impact on the intents of entrepreneurs and Entrepreneurial intentions are strongly impacted by cognitive style and theory of planned action(Pejic Bach et al., 2018).Entrepreneurial intention is significantly influenced by proactive personalities, whereas inventiveness has a minor effect(Kumar & Shukla, 2022).Student entrepreneurial inclinations are strongly impacted by the innovation of their lecturers(Saptono et al., 2019).

## ENTREPRENEURIAL EDUCATION

The aim of entrepreneurs is greatly influenced by entrepreneurial innovation and education. In order to develop an entrepreneurial attitude and set of skills, entrepreneurial education is essential. It enables people to recognize opportunities, take calculated risks, and launch new businesses. It gives people the skills and information necessary to thrive in the world of entrepreneurship.

Conversely, entrepreneurial innovation entails the development of novel concepts, goods, or procedures that boost competitiveness and economic growth. It inspires people to solve difficult challenges imaginatively, adjust to shifting surroundings, and think beyond the box. Through the incorporation of innovation into entrepreneurship, individuals can augment their capacity to generate value, set themselves apart in the marketplace, and grasp prospects for expansion.

Entrepreneurship education provides students with the necessary skills and knowledge to recognize opportunities, question established paradigms, and engage in creative thinking (Kuratko & Morris, 2024).

Examined the effects of entrepreneurial education, mentality, and creativity on intention to start a business and discovered that these factors had a beneficial impact(Jiatong et al., 2021).

The relationship between entrepreneurial intention and education is mediated by creativity, and education in entrepreneurship raises employability values, self-efficacy, and the ambition to pursue self-employment(Rungsrisawat & Sutduean, 2019).Focused on tertiary students' plans to start their own businesses after receiving instruction(Ndofirepi et al., 2018).Results validate the importance of innovative instructors in fostering entrepreneurial abilities(Alshebami et al., 2022).There is a considerable correlation between entrepreneurial education and entrepreneurial intention(Paliwal et al., 2022).Student entrepreneurial inclinations are strongly impacted by the innovation of their lecturers(Saptono et al., 2019).Intentions are positively impacted by entrepreneurship education, the drive for success, inventiveness, and self-efficacy(Lubada et al., 2021).

Research indicates that the attractiveness of entrepreneurship significantly influences the entrepreneurial inclination of students, referring to how students perceive entrepreneurship as an appealing career path(Hussain & Norashidah, 2015; Stephan & Roesler, 2010; Zhang et al., 2015). Previous studies have demonstrated that students who view entrepreneurship as desirable are more inclined towards entrepreneurial endeavors (Abdelkarim, 2021; Dehghanpour Farashah, 2013; Tsai et al., 2016)

Furthermore, the viability of entrepreneurship is a determining factor in entrepreneurial intention, indicating how students consider entrepreneurship as a feasible career choice(Bosma et al., 2012).Academic investigations have revealed that students who see entrepreneurship as viable are more inclined towards entrepreneurial pursuits(Bacigalupo et al., 2016; Liñán & Fayolle, 2015).

In addition, the presence of role models can have a substantial impact on students' entrepreneurial intentions (Hussain & Norashidah, 2015). Scholarly research has illustrated that students exposed to successful entrepreneurs and mentors are more likely to harbor entrepreneurial aspirations(Fayolle et al., 2014; St-Jean et al., 2014).This is attributed to the ability of role models to offer motivation, direction, and assistance, aiding students in enhancing their entrepreneurial capabilities and self-assurance(Kayed et al., 2022).

Studies have also highlighted the influence of gender on entrepreneurial intentions among students, with male students exhibiting a higher tendency towards entrepreneurship compared to their female counterparts(Kautonen et al., 2015).

Moreover, human capital, encompassing education, experience, and skills, can shape entrepreneurial intentions(Bignotti & Le Roux, 2020). Research has indicated that students with a greater level of human capital are more predisposed to entrepreneurial pursuits(Keller

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& Kozlinska, 2019). This is due to their possession of the necessary knowledge, skills, and experience to recognize and seize entrepreneurial prospects(Keller & Kozlinska, 2019; Ngek Brownhilder Neneh, 2012).

## PERSONAL FACTOR

Individual characteristics are important in determining both inventiveness and the desire to start a business. People's tendency for innovation and entrepreneurship is greatly influenced by their personal attributes, innovativeness, risk-taking propensity, self-efficacy, craving for power, and personality factors. These unique characteristics influence how people view possibilities, take calculated risks, and motivate their creative and entrepreneurial pursuits. For example, being innovative encourages the development of fresh concepts and solutions, which in turn influences entrepreneurial intention by motivating people to take on new business endeavors. Similar to this, traits like a tendency for taking risks and self-efficacy influence people's readiness to establish their own businesses and face the difficulties and uncertainties that come with it. Furthermore, personality qualities and the craving for power shape people's motivation and resolve for entrepreneurship and their intention to participate in it.

Attitudes act as a link between a person's disposition toward entrepreneurship and creativity(Anjum et al., 2020).Self-efficacy's mediating role in relation to entrepreneurial creativity and passion(Bignetti et al., 2021).Entrepreneurial intention was partly influenced by creativity and was predicted by attitude and perceived control(Alshebami et al., 2022).Entrepreneurial attitude plays a major role in determining entrepreneurial intention, and it also fully mediates the impact of creativity on entrepreneurial intention (Kusmintarti et al., 2017).Positive correlations between inventiveness, proactive personality, and entrepreneurial alertness were revealed using structural equation analysis(Hu et al., 2018).Intentions are influenced by one's own attitudes, subjective norms, and sense of behavioral control(Pejic Bach et al., 2018).Entrepreneurial intention is highly predicted by self-efficacy; self-efficacy fully mediates both creativity and intention, and it partially mediates the influence of proactivity(Kumar & Shukla, 2022).The impact of entrepreneurship education on intentions is moderated by entrepreneurial self-efficacy(Lubada et al., 2021)

Motivation is widely acknowledged as a consequential factor affecting entrepreneurial intention and innovation(Ratinho et al., 2020). Previous research has underscored the significance of intrinsic motivation, originating from internal sources like personal gratification and fervor, in propelling individuals towards entrepreneurial pursuits(TAMILSELVI, 2014). Intrinsic motivation is linked to a greater readiness to undertake risks, persist in the face of challenges, and display inventive behavior(Jing, 2022; Nabi et al., 2024). On the contrary, extrinsic motivation, steered by external stimuli such as monetary incentives and societal acknowledgment, can also influence entrepreneurial intention and innovation, albeit with potentially varying effects (Sánchez, 2013; Stephan & Roesler, 2010).Furthermore, qualitative research methodologies, encompassing interviews and case analyses, have been employed to scrutinize the intricate interaction between motivation and entrepreneurial results, furnishing valuable insights into this correlation(Moussa & Kerkeni, 2021).

As an astute graduate-level qualitative researcher, I comprehend that risk-taking can indeed impact innovation and entrepreneurial intention among students (Bae et al., 2014; Fayolle et al., 2014; Nabi et al., 2024).Risk-taking behavior is inherent in entrepreneurship and entails a readiness to confront uncertainty, challenge conventional norms, and pursue opportunities that entail a certain level of unpredictability(Guerrero & Urbano, 2019; Hu et al., 2018). Students who demonstrate a proclivity for risk-taking are more inclined to partake in innovative endeavors and embark on entrepreneurial(Obschonka et al., 2017; Urbano & Guerrero, 2013). The process of innovation often necessitates venturing beyond one's comfort zone and undertaking calculated risks to introduce fresh concepts, products, or services(Schlaegel & Koenig, 2014; Zampetakis et al., 2016).Students who are open to embracing risk exhibit a greater probability of recognizing and seizing entrepreneurial prospects, ultimately resulting in innovative outcomes(Liao et al., 2022; Obschonka et al., 2017) .

Nevertheless, it is crucial to acknowledge that the connection between risk-taking and innovation is non-linear. Engaging in excessive risk-taking without adequate assessment and control can yield adverse effects on entrepreneurial results(Gupta, 2017; Li et al., 2020). Students must adopt a well-balanced approach to risk-taking, taking into account potential benefits, resources, and likely repercussions, in order to optimize their innovative capacity(Shepherd & Patzelt, 2018; Wang et al., 2021). Qualitative research methodologies, such as interviews, case studies, and observations, can be utilized to delve deeper into the impact of risk-taking on innovation and entrepreneurial aspirations among students(Jiatong et al., 2021; Li et al., 2020). These methodologies facilitate the exploration of students' encounters, decision-making procedures, and views on risk within the entrepreneurial domain.

Interest and passion are significant factors that play a crucial role in shaping innovation and entrepreneurial intention among individuals(Fayolle et al., 2014; Gieure et al., 2020; Liñán & Fayolle, 2015). Genuine interest in a specific field or domain tends to motivate individuals to participate in activities that support innovation and entrepreneurial pursuits(Douglas & Shepherd, 2002; Edelman et al., 2016; Kong et al., 2020). A strong interest in a particular area or sector empowers individuals to remain driven, continually learn,

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and discover new avenues for innovation and entrepreneurship(Caliendo & Kritikos, 2012; Obschonka & Stuetzer, 2017; Sari et al., 2018). This inclination fuels their inquisitiveness and compels them to explore fresh solutions and strategies to tackle challenges and generate value(Ahmed et al., 2021)

.

## CONCLUSION

This study explores the complex network of variables that affect students' intentions to be innovative and entrepreneurial. After a thorough analysis of the research, it is clear that students' desires for entrepreneurship are shaped in large part by their personal attitudes, entrepreneurial education, and inventiveness. Creativity is a key component that promotes uniqueness, opportunity recognition, and idea production, so acting as a catalyst for entrepreneurial aim. By giving students the necessary abilities, information, and perspective to successfully traverse the entrepreneurial landscape, entrepreneurial education enhances creativity. Personal characteristics like proactive nature, risk-taking inclination, and self-efficacy also have a big impact on entrepreneurial goals. These innate tendencies highlight how crucial it is to deal with each person's attitudes and beliefs in order to help them develop an entrepreneurial mindset.

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EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# ENTREPRENEURIAL INTENTION AMONG UNIVERSITIES STUDENTS: A GLOBAL REVIEW

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**Article DOI:** https://doi.org/10.36713/epra18084
**DOI No: 10.36713/epra18084**

**ABSTRACT**
*The aim of this paper is to analyze the entrepreneurial aspirations of university students. Additionally, it investigates the moderating influence of entrepreneurial support systems on the relationship between entrepreneurial intentions. and factors that may affect students' inclination towards entrepreneurship. This research employed a literature-based methodology, gathering secondary data exclusively from the Emerald journal pertaining to university students. The results indicated that students' entrepreneurial intentions play a crucial role in fostering an entrepreneurial mindset among university students, leading them towards entrepreneurship. Furthermore, the inclination towards entrepreneurship is reinforced by the intention to pursue entrepreneurial endeavors, with a significant impact observed from educational support ,relational support, self-efficacy and desirability and feasibility. The study focused on exploring how university students transitioned into entrepreneurs and how fostering entrepreneurial intentions could benefit them on a global scale.*

**KEYWORD-** *Entrepreneurship, Entrepreneurial intention, University Students.*

## INTRODUCTION

Entrepreneurial intention among students has become a focal point in contemporary research, reflecting the growing interest in fostering entrepreneurial mindsets and behaviors within educational contexts. Entrepreneurial intention refers to the inclination or predisposition of individuals, particularly students, to engage in entrepreneurial activities and pursue entrepreneurial ventures. In recent years, there has been a surge of interest in understanding the factors that influence entrepreneurial intention among students. This interest stems from the recognition of entrepreneurship as a driver of innovation, economic growth, and job creation. Additionally, fostering entrepreneurial skills and attitudes among students is seen as essential for preparing them for the dynamic and uncertain future of work. While the concept of entrepreneurial intention has gained prominence, it is important to recognize that it is influenced by a multitude of factors, both internal and external

The findings show that female students' entrepreneurial inclinations are significantly predicted by their proactive personality, entrepreneurial self-efficacy, and university support variables.(Hussain & Imran Malik, 2018). The empirical findings demonstrate a connection between the various elements of entrepreneurial orientation and the favorable influence they have on entrepreneurial intentions (Kumar et al., 2021).According to the results, most respondents consistently expressed a desire to start their own business (Mohamad et al., 2015).Entrepreneurial motivation is a crucial link between intentions and actions (M. Z. Solesvik, 2013). Subjective norms and behavior attitudes have a positive and important link with entrepreneurial intention, according to the findings of multiple regression analysis and Pearson's correlation (Shah & Soomro, 2017)The desire to start one's own business is another factor that supports this entrepreneurial mindset (H. Hassan et al., 2020)

According to(Nabi et al., 2010) Firstly, it is established that over all the years of the research, a significant minority of students consistently maintain relatively strong intentions towards starting up a business. Secondly, the study emphasizes that despite significant attempts to boost the number of individuals pursuing start-ups, minimal impact can be observed.The primary conclusions indicate that the association between entrepreneurship education and innovative start-up intention is influenced by entrepreneurial mindsets (Hanandeh et al., 2021).

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## METHODS

The comprehensive analysis aimed to consolidate international data pertaining to entrepreneurial intention within university students. A thorough search was conducted on Google Scholar to ensure the identification of a vast array of literature in the field, with a specific emphasis on works most relevant to the research goals.

## EDUCATIONAL SUPPORT

The results of this study are expected to reveal a positive connection amid perceived education support and empire-building goal. It is hypothesized that students who perceive higher levels of education support will demonstrate greater entrepreneurial intentions. These findings will provide valuable insights for educational institutions, highlighting the importance of fostering an entrepreneurial-friendly environment to encourage entrepreneurial aspirations among students.

Entrepreneurship education positively moderates the self-efficacy-intention relationship, enhancing the influence of self-efficacy on entrepreneurial intention(A. Hassan et al., 2020).educational factors were positively linked to business intent among Malaysian university students (Bazkiaei et al., 2021).The study found that entrepreneurship education positively influence the empire-building attitude of youngsters towards venturing into entrepreneurship (H. Hassan et al., 2020)Positive relationship among entrepreneurial education and business intent (Passaro et al., 2018)Entrepreneurship education crucial for addressing high unemployment rates in Ghana.(Adu et al., 2020).Practical entrepreneurial education increases entrepreneurial intention compared to theoretical education(Yousaf et al., 2021).Studies show positive relationship between education and entrepreneurship.(Paliwal et al., 2022)

## SELF EFFICACY

Self-efficacy, originating from Bandura's social cognitive theory, pertains to individuals' confidence in their capability to carry out tasks and surmount challenges within specific domains. Numerous studies have consistently shown a positive correlation between entrepreneurial self-efficacy and students' inclination towards pursuing entrepreneurial ventures. Those students who possess higher levels of entrepreneurial self-efficacy demonstrate increased optimism, tenacity, and ability to bounce back in the face of entrepreneurial obstacles, thereby cultivating a more robust desire to partake in entrepreneurial pursuits. Additionally, entrepreneurial self-efficacy plays a role in shaping students' perception of control over their entrepreneurial outcomes, bolstering their confidence in effectively managing and navigating the intricacies associated with initiating and operating a business endeavor. By emphasizing the importance of self-efficacy beliefs in influencing entrepreneurial aspirations among students, existing research underscores the significance of promoting and nurturing entrepreneurial self-efficacy through focused educational interventions and practical learning experiences to inspire entrepreneurial ambitions and cultivate entrepreneurial triumph.

Entrepreneurial intention is positively impacted by self-efficacy and opportunity identification (H. Hassan et al., 2020). Results indicate that self-efficacy is positively impacted by entrepreneurship education(Soomro & Shah, 2022) .EE, attitude, and self-efficacy all have a role in determining entrepreneurial intention and Self-efficacy serves as a sequential mediator between EE and EI(Yousafetal.,2021).

Ultimately, it was discovered that learning motivation, attitude, self-efficacy, and inventiveness influence entrepreneurial intention through technology courses. (İlerisoyetal.,2021). The findings demonstrate the beneficial effects that acquaintance to and practical skill with digital engineering expertise in higher education can have on students' business goals and emotional intelligence (Monllor & Soto-Simeone, 2020). The findings show that the three main indicators of female students' entrepreneurial intents are their positive behavior, entrepreneurial self-efficacy, and university provision characteristics (Hussain & Imran Malik, 2018).

## RELATIONAL SUPPORT

Relational support, which includes encouragement, guidance, and assistance from various social networks, is now recognized as a critical element impacting students' entrepreneurial aspirations. Academics have underscored the importance of social capital present in these networks, enabling the acquisition of necessary resources for entrepreneurial pursuits. Additionally, emotional support stemming from supportive relationships has been shown to boost students' self-assurance, resilience, and confidence in their entrepreneurial abilities, hence influencing their inclination to partake in entrepreneurial activities. Furthermore, the significance of positive role models, mentors, and peers within students' social circles has been emphasized for motivating and steering entrepreneurial endeavors. These influential figures offer valuable perspectives, counsel, and networking possibilities, fostering students' belief in their entrepreneurial skills and drive. Moreover, the impact of social norms and perceptions concerning entrepreneurship within students' networks should not be underestimated, as they mold individuals' attitudes and actions towards entrepreneurial undertakings.

Perceived relational support can take various forms, such as support from family, friends, and mentors. parents can increase their children's chances of becoming entrepreneurs by approving entrepreneurship as a legitimate career option, encouraging and approving their children's business ideas(Baluku et al., 2020).Young graduates' parents are considered to have a big influence on

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their children's professional choices(Sawitri et al., 2014).The term "perceived relational support" describes how a prospective entrepreneur views and anticipates receiving support from the following groups: When starting a business or becoming self-employed, other people to consult include parents, siblings, and spouses(Salami et al., 2019).Therefore, it stands to reason that those who have family support will feel more at ease engaging in entrepreneurial endeavors since they will receive greater encouragement and support to take risks(Ahmed, 2022)

## FEASIBILITY AND DESIRABILITY

Desirability, distinguished by the attractiveness and charm of entrepreneurship, is accentuated by individual values, ambitions, and perceived advantages linked to engaging in business ownership. Empirical research consistently illustrates that students who view entrepreneurship as desirable demonstrate more positive attitudes towards entrepreneurial endeavors and articulate an increased intention to initiate entrepreneurial pursuits. Conversely, feasibility considerations, which encompass perceived obstacles, availability of resources, and entrepreneurial competencies, assume a crucial role in students' evaluation of the pragmatism and feasibility of their entrepreneurial ambitions. Despite acknowledging the appeal of entrepreneurship, students might be reluctant to pursue entrepreneurial ventures if they encounter significant feasibility hurdles, such as a lack of access to financial resources or relevant knowledge. Notably, the interplay between desirability and feasibility impacts students' entrepreneurial intentions, with the perceived feasibility of a venture determining the degree to which desirability translates into concrete entrepreneurial activities.
It was discovered that there was a favorable correlation between entrepreneurial education and master's students' perceived desirability (PD), perceived feasibility (PF), and intention to engage in entrepreneurial activities. Perceived desirability was found to function as a partial mediator in the link between entrepreneurial education and entrepreneurial intention (EI) and as a full mediator in the interaction between entrepreneurial education and PF. It was discovered that the shift from PD and entrepreneurial education to emotional intelligence (EI) was favorably moderated by past experiences working for oneself.(Le et al., 2023).

Undergraduates who mentioned a apparent feasibility and desirability for enterprise, inventiveness taking culture, and contribution in entrepreneurship-specific education (ESE) stated a significantly higher intensity of business mindset, according to an ordinary least squares (OLS) regression analysis (M. Solesvik et al., 2016). The findings show that perceived desirability (PD), perceived feasibility, and self-efficacy all have a optimistic and substantial impact on business intent (Soomro et al., 2020).Entrepreneurial intention is predicted by perceived feasibility and desire(Ahmad et al., 2019) .

## CONCLUSION

This study reveals that entrepreneurial intention among university students is influenced by factors such as entrepreneurial education, relational support, self efficacy and perceived desirability and feasibility of entrepreneurship. It emphasizes the need for tailored programs, fostering a positive personal attitude towards entrepreneurship, addressing perceived barriers like lack of resources and limited networking opportunities, and creating a conducive environment for entrepreneurship. The findings also suggest that promoting entrepreneurship among university students can create a pipeline of talented entrepreneurs, contributing to the economy's growth and development. Therefore, universities should focus on these factors to foster a culture of entrepreneurship.

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# CROTON BONPLANDIANUM IN TRADITIONAL INDIA

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**ABSTRACT**

*In an attempt to strengthen the scientific foundation for the extraction of bioactive components from the plant, the cytotoxic and antioxidant properties of Croton bonplandianum Baill's methanolic and dichloromethane extracts were assessed. Dichloromethane extract was not poisonous, and the methanolic extract had 59.62% DPPH and hydroxyl radical scavenging activity. The reference compound, gallic acid, displayed greater antioxidant activity than the plant extracts. The lethality of both methanolic and dichloromethane extracts on brine shrimp was assessed. An in vitro cytotoxic activity test for methanolic extract yielded an LD50 value of 115.76 (0.0048 - 13.76) µg/ml. The standard medication used was etoposide.The standard medication used was etoposide. Together, these findings support the notion that Croton bonplandianum extracts have significant inherent cytotoxic and antioxidant potentials, which is a strong argument in favor of isolating pure bioactive substances. The plant's parts are widely used in traditional medicine to treat a wide range of conditions, including wound healing, hepatoprotective, body swelling, hypertensive, abdominal dropsy, anti-fungal, anti-microbial, antidiabetic, anti-tumor, and anti-cancer. Because traditional multiplication proceeds slowly, the plant is abundant. Its traditional medical applications have been proven by several in vivo and in vitro tests.*

**KEYWORDS**:*Croton bonplandianus, Antioxidant Activity , anticancer activity medicinal plant, phytochemicals .Pharmacological uses; biological activity; bioactive compounds.*

## INTRODUCTION

As a complementary and alternative treatment, herbal medicine has developed to treat a wide range of illnesses brought on by anxiety, industrial dangers, pathogenic microorganisms, stress, and other factors. Even with the availability of contemporary synthetic pharmaceuticals and antibiotics, herbal remedies continue to be used in daily therapy and the medical sector. Many characteristics, including its relative lack of major side effects, affordability, accessibility, and effectiveness, have made herbal therapy a popular and respectable means of treating illnesses even in the present era. Ayurveda, which means "knowledge of long life," started in India during the Vedic era [6] . The two founders of the Ayurvedic medical system, Susrata and Charaka Sanhita, discussed the therapeutic use of several medicinal plants. Ayurvedic literature mentions Croton bonplandianus Baill as one such plant. Therefore, the review is predicated on C. bonplandianus's pharmacological and therapeutic qualities. [5] Diterpines and phorbolesters, such as 12-orthotrideconeoly-phorbol-13-acetate (TPA) and myristoyl-phorbol acetate (MPA), are present in Croton bonplandianum seeds. TPA alters prostaglandin metabolism and is a carcinogen [9,10]. Some ethnic groups utilize the plant's fresh juice as a remedy for headaches. Plant latex has the ability to mend cuts and wounds[11,12].This paper examines various phytochemicals, including tannin, phlobatannin, terpenoid, glycoside, phenolic, flavonoid, steroid, anthraquinone, saponin, alkaloid, cholesterol, carbohydrate, and protein, both qualitatively and quantitatively. The goal is to provide a clear understanding of the phytochemical status of the stem of C. bonplandianus, which will aid future researchers in their pharmacological analysis of this species. Various methods are employed with croton species. According to Salatino et al. (2007), common applications include the management of cancer, constipation, diabetes, dysentery, digestive issues, external wounds, fever, hypercholesterolemia, hypertension, inflammation, intestinal worms, malaria, pain, ulcers, and weight reduction.People in some regions of India used to treat rheumatism by applying a heated poultice made from powdered C. calefornicus leaves (Wilson et al., 1976). Croton nuts, like those from C. megalocarpus, have recently been demonstrated in Kenya to be a more cost-effective source of biofuel than jatropha. In Kenya, the production of one liter of biofuel from Jatropha requires up to 20,000 liters of water, whereas 0.35 liters are produced from wild cotyledon trees. Any region of the body can be affected by a wide range of disorders, collectively referred to as cancer. Neoplasms and malignant tumors are other words that are used.The primary cause of cancer-related mortality is a process known as metastasis. Globally, cancer is the leading cause of mortality (1 in 8). Between 1975 and 2000, the global cancer burden doubled; by 2020, it is expected to double once more, and by 2030, it is predicted to nearly quadruple. Globally, there were about 12 million new instances of cancer and 7 million cancer-related deaths in 2008; by 2030, that number is expected to rise to 20–26 million new cases and 13–17 million deaths [1]. Consequently, it is imperative that cancer be managed, treated, and cured effectively. The potential of alternative medicines may prove beneficial in the management of cancer, which is one of the primary causes

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of death globally. At best, conventional medicines just prolong the patient's life through significant side effects.only add a few years to the patient's life expectancy at most. There is an urgent need for more effective cancer therapies with fewer adverse effects. Therefore, it is necessary to employ alternate theories or methods for cancer prevention [2]. In order to reduce harm to normal tissues and target the various physiological and biochemical processes that promote tumor formation, an integrative approach to cancer patient care should be used. Interestingly, studies in the lab and in clinical trials have shown that herbal remedies may increase the level of efficacy and decrease harmful effects when used in conjunction with chemotherapy. These details made the use of herbal medicine in conjunction with chemotherapy more feasible [3].Significant advancements in the field of cancer treatment have been accomplished by higher plants. Vinblatine and vincristine, two antileukemic alkaloids derived from the Madagascan periwinkle (Catharanthus roseus syn. Vinca roseus), are two early examples. A few more anti-cancer medications are homoharringtonine, taxol, and several camplothein derivatives [4]. One of the common characteristics of cancer is an excess of apoptosis. For multicellular organisms, programmed cell death, or apoptosis, is an essential part of growth and development. Numerous triggers can cause cells to die, and during apoptosis, they do so in a regulated and controlled manner.Damaged cells normally go through apoptosis, but in the case of cancerous cells, changes may have taken place that stop cells from going through this process. Because there is no control over the growth of cells in these situations, the illness may worsen and lead to the development of tumors.Since many cancer treatments involve using radiation or chemicals to harm the cells, mutations in the apoptotic pathway frequently result in cells that are resistant to this kind of attack, making these tumors often tough to eradicate.[7]Many methods can be used to trigger apoptosis in cells grown in vitro.Glucocorticoid exposure to thymocytes is one of the conventional systems. Additional techniques include radiation exposure, topoisomerase inhibitor-treated environments, removing growth factors from growth media, cell cycle disruption, exposure to kinase or phosphatase inhibitors or activators, disruption of Ca2+homeostasis, overexpression of p [9], members of Ced-3/ICE, and many more [8].

**Taxonomical Position**

**Fig. 1. Croton bonplandianus[47]**

Kingdom: Plantae
Subkingdom: Tracheobionta
Infrakingdom: Streptophyta
Superdivision: Spermatophyta
Division: Magnoliophyta
Class: Magnoliopsida
Subclass: Rosidae
Order: Malpighiales
Family: Euphorbiaceae
Subfamily: Crotonoideae

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Tribe: Crotoneae
Genus: Croton L.
Species: Croton bonplandianus

**Genus Croton**

The deciduous shrubs and small trees that make up the Genus Croton can have lepidote scales or stellate hair. Minute requirements apply. Leaf blades have two glands at the base and alternate. Flowers can be either dioecious or monoecious. Racemose inflorescence that is often terminal. Flowers: five merous; males have little disk glands; stamens: five to thirty; females frequently have remnant petals; ovary: three lozenges. Fruit a pill. Small seeds ecaruncle or caruncle.[15]

**Phytochemical Aspect of Croton bonplandianum**

The genus Croton contains diverse types of biomolecules. Terpenoids are the predominant secondary metabolite constituents in the genus, chiefly diterpenoids, which may belong to the cembranoid, clerodane, neoclerodane, halimane, isopimarane, kaurane, secokaurane, labdane, phorbol, and trachylobane skeletal types. Triterpenoids, either pentacyclic or steroidal, have frequently been reported from Croton species. Volatile oils containing mono- and sesquiterpenoids, and sometimes also shikimate-derived compounds, are not rare in the genus. Several species have been reported as sources of different classes of alkaloids, a fact that considerably enhances the importance of the genus from a medicinal point of view. Phenolic substances have frequently been reported, among which flavonoids, lignoids, and proanthocyanidins predominate. (Salatino et al., 2007)A crimson sap is produced by a number of Croton species that include proanthocyanidins and/or alkaloids. The latter might be taspine or any of a number of benzyl compounds that resemble oquinolines. Diterpenes, which are related to clerodanes, cembranoids, halimanes, kauranes, labdanes, phorbol esters, trachylobanes, and sarcopetalanes, are highly prevalent in Croton. Certain species have volatile oils, which make them fragrant. From Croton species, representatives of novel chemical classes, such as phenylbutanoids, glycomate alkaloids, and sarcopetalane diterpenes, have been identified. Although laticifers have been reported in Croton species, little anatomical research has been done on the secretory structures of volatile oils yet. There isn't much research on flavonoids using Croton species. The genus has chemical affinities that group species that contain (i) alkaloids, (ii) trachylobanes, and (iii) kauranes and/or labdanes. pharmacological tests have repeatedly confirmed the customary applications of Croton species. The clerodane trans-dehydrocrotonin was the focus of a large portion of pharmacological tests involving Croton compounds (Salatino et al., 2007). 2010 saw the isolation of crotoncaudatin, a novel flavone, along with nine recognized analogues from the stems of Croton bonplandianum Geisel var. tomentosus Hook. Zou et al. (2010) identified the following compounds: 3,5,6,7,8,3′,4′-heptamethoxyflavone, tangeretin, nobiletin, 5,6,7,4′-tetramethoxyflavone, sinensetin, kaempferol, tiliroside, kaempferol-3-O-rutinoside, and rutin. Three flavonoids, two diterpenoids, and an indanone derivative are all present in the ethanol extract of Croton steenkampianus leaves (Adeboye et al., 2008). From the methanolic extract of Croton urucuruna, several antimicrobial compounds were isolated, including acetyl aleuritolic acid, stigmasterol, β-sitosterol, campesterol, β-sitosterol-O-glucoside, sonderianin, catechin, and gallocatechin (Marize et al., 1997).Phytochemically, the plant has been reported to contain rutin (C18 H36 O19) as its main constituent, together with crotsparinine, crotosparine, and its methyl derivative, aphorbol, which play a key role in wound healing (Divya et al., 2011). Apart from this, Croton bonplandianum is a good source of steroids, unsaturated steroids, phenolics, and alkaloids. It also contains flavonols, cardinolids, leucoanthocyanins, and flavonoids (Kothale et al., 2011). The plant also contains another two groups of compounds, viz., terpenoids and glycosides, along with flavonoids and alkaloids. The spent residue obtained after biocrude extraction of Croton bonplandianum is rich in biopolymers such as cellulose, hemicellulose, and lignin.This can produce ethanol and oil (Sharma et al., 1990). Jeeshna et al. (2011) investigated the potential of various solvents to extract various groups of compounds from Croton bonplandianum. They found that methanol was significantly more effective than acetone, chloroform, and petroleum ether in extracting alkaloids, flavonoids, glycosides, steroids, phenols, tannins, saponins, and resins (Table 1). Despite the absence of alkaloids and saponins in the chloroform fraction (Jeeshna et al., 2011), According to Ghosh et al. (2013), some identified triterpenoid compounds from the root of C. bonplandianum include sitosterol, ursolic acid, oleanolic acid, and 3-hydroxyurs-12,15-dien of the ursane skeleton. Tiwar et al. (1981) identified an alkaloid from extracts of Croton bonplandianum 3-methoxy-4,6-dihydroxymorphinandien-7-one and norsinoacutine.Alkaloids such as proporphine, isoquinoline dionone, sparsiflorine, crotoflorine, crotsparine, crotosparinine, Nmethylcrotsparine, and N-methylcrotsparinine are found in the plant and its leaves. β-sitosterol, tartaric acid, vomifoliol, uric acid, and tetrahydroglazievine are found in the leaves and stem. Rutin is also present in leaves. (C18 H 36O 19). The following compounds were detected in leaves: 16-Hexadecanoyl Hydrazide (88.69%), 1,2-Benzenedicarboxylic Acid, diisooctyl Ester (5.56%), 2-Piperidinone, N-[4-bromo-n-butyl] (2.56%), Phthalic Acid, bis (7-methyloctyl) Ester (1.80%), and Phytol (1.39%). Diterpines and phorbol esters, such as 12-orthotrideconeoly-phorbol-13-acetat (TPA) and myristoyl phorbol acetate (MPA), are present in Croton bonplandianum seeds. Apart from ß-sitosterol, the roots also include Diterpines and phorbol esters, such as 12-orthotrideconeoly-phorbol-13-acetat (TPA) and myristoyl phorbol acetate (MPA), are present in Croton bonplandianum seeds. The roots include 3-methoxy-4, 6-dihydroxy morphinan-dien-7-one, and the phenolic quinonoid alkaloid norsinoacutine in addition to ß-sitosterol. The hyperaccumulation of copper in this

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species is a remarkable discovery. The latex of C. bonplandianum contains the phytocompounds 3-methylquinoline (0.44%), 4-methylphenol (6.86%), and mequinol (0.74%). The fruits of C. bonplandianum were found to contain fifteen major phytocompounds: 1, propene, 2-nitro-3-(1-cyclooctenyl) (4.58%), 9,12,15-Octadecatrienoic acid, methyl ester (z,z) (41.81%), diazoprogesterone (19.03%), decanoic acid, ethyl ester (4.86%), and 6,9,12-Octadecatrienoic acid, 13-Tetradece-11-yn-1-ol (3.47%). [15]

**Analysis of Croton bonplandianum**

Qualitative Analysis

Chemical tests were carried out on the Chloroform, Methanol, and aqueous, extracts using procedures to identify the phytochemicals as described by Sofowara [14], Trease and Evans [15] and Harborne [16].

Test for Carbohydrates

To 2ml of extract, 1ml of Molisch's reagent and few drops of concentrated sulphuric acid were added. Formation of Purple colour at the inter phase of the two layers indicated the presence of carbohydrates

Test for Amino acids and Proteins

2ml of filtrate was treated with 2-5 drops of ninhydrin solution placed in a boiling water bath for 1-2 minutes and observed for the formation of purple colour.

Test for Tannins

To 1ml of extract, 2ml of 5% ferric chloride was added. Formation of greenish black color indicated the presence of tannins.

Test for Saponins

To 2ml of extract, 2ml of distilled water was added and shaken in a graduated cylinder for 15minutes lengthwise. Formation of 1cm layer of foam indicated the presence of saponins.

Test for Flavonoids

5ml of dilute ammonia solution was added to a portion of the aqueous filtrate of extract followed by addition of concentrated sulphuric acid. Appearance of yellow colouration indicated the presence of flavonoids.

Test for Alkaloids

To 2ml of extract, 2ml of concentrated hydrochloric acid was added. Then few drops of Mayer's reagent were added. Presence of green color indicated the presence of alkaloids.

Test for Quinones

To 1ml of extract, 1ml of concentrated sulphuric acid was added. Formation of red color indicated the presence of quinones

Test for Glycosides

To 1 ml of the extract add few drops of HCl, allowed for 5 minutes for hydrolysis and neutralized with NaOH solution. A few drops of Fehling's solution A and B for few minutes. An orange red precipitate indicates the presence of glycosides.

Test for Terpenoids

To 0.5ml of extract, 2ml of chloroform was added and concentrated sulphuric acid was added carefully. Red brown color formation at the interface indicated the presence of terpenoids.

Test for Phenols

To 1ml of the extract, 2ml of distilled water followed by few drops of 10% ferric chloride was added. Formation of green color indicated the presence of phenols.

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Test for Coumarins

**To 1 ml of extract, 1ml of 10% Sodium hydroxide was added. Formation of yellow color indicated the presence of coumarins.[43]**

| Compound | Water extrct | Methanol extract | Chloroform extract | Water extract | Methanol extract | Chloroform extract |
|---|---|---|---|---|---|---|
| Carbohydates | + | + | + | + | + | + |
| Amino acids and proteins | + | + | + | + | + | + |
| Tannins | + | + | + | + | + | + |
| Saponins | - | - | - | - | - | - |
| Flavanoids | + | + | + | + | + | + |
| Alkaloids | - | - | + | - | - | + |
| Anthrocyanins & β-Cyanins | + | + | + | + | + | + |
| Quinones | + | + | + | + | + | + |
| Glycosides | + | + | + | + | + | + |
| Terpenoids | + | + | - | + | + | - |
| Phenols | + | + | + | + | + | + |
| Coumarins | + | + | - | + | + | - |

**Table 1: Phytochemical screening**

## RECENT PHARMACOLOGICAL STUDIES

**Fig.2 Role of Croton bonplandianum Baill in different activities[46]**

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**Antioxidant Activity of Croton**

In traditional medicine, Croton lechleri sap, often known as "dragon's blood," is applied as a cicatrizant, an anti-inflammatory, and a cancer treatment. When Croton lechleri sap was tested against Saccharomyces cerevisiae, a yeast, and against maize plantlets treated with apomorphine and hydrogen peroxide, an oxidative agent, it was discovered that Croton lechleri sap exhibited a notable amount of antioxidant activity against the oxidative damages Caspomyces cerevisiae caused. With hydrogen peroxide, on the other hand, the sap's antioxidant activity was only seen in cells that were in the stationary phase of growth. Additionally, the sap was able to shield maize plantlet cells from apomorphine's harmful effects[30].A literature survey revealed that the essential oils from northeastern Brazilian Croton species, Croton zenthmeri, Croton nepetaefolius, and Croton argyrophylloides, exhibited good antioxidant activities .[31] The crude essential oil obtained from the stem bark of Croton urucurana exhibited antioxidant properties. The main components of the antioxidant fraction are α-bisabolol, α-eudesmol, and guaiol [32]. Two of the aromatic acids, vanillic and 4-hydroxybenzoic acid, along with N-methyltyrosine, have been isolated from Croton cajucara. These two aromatic acids have shown remarkable antioxidant activity in other species [33,34]. Based on such results, C. cajucara could be expected to possess antioxidant properties. Several kaempferol metabolites have proved to be antioxidant agents [35,36], and C. cajucara leaves also contain two of them, e.g., kaempferol 3,4',7-trimethyl ether and 3,7-dimethyl ether. [37,38]

**Antimicrobial**

The agar disc diffusion technique was used to examine the in vitro antibacterial activity of aqueous extracts (say) of Croton bonplandianus against three strains of Grampositive and four strains of Gram-negative bacteria, according to the National Committee for Clinical Laboratory Standards (1997). Sterile nutrient medium was removed and 100 µL of bacterial suspension containing 108 colony-forming units (CFU)/mL was mixed with sterile liquid nutritional agar and put to the sterile Petri dishes after the temperature was maintained at 45–50˚C. The nutrient-dense agar medium plates were initially dip-soaked in different extract concentrations (10, 25, 50, 75, and As an example, 100 mg/mL. The plates were allowed to harden before filter discs with a diameter of 5 mm were placed on top of them. The plates were incubated at 37 oC for an entire day. The nutritional agar was made by autoclaving it for 15–20 minutes (HI Media Laboratories Limited, Mumbai, India). The diameter of the zone of inhibition—which includes the 5 mm disc diameter—was calculated using a scale. Each experiment was conducted three times to reduce error, and the mean results were presented. [39,40]

**Anticancer Activity**

Native to Southeast Asia, Croton tiglium L is a leafy shrub of the Euphorbiaceae family. The plant's seed oil, known as croton oil, or its main active ingredient, 12-Otetradecanoylphorbol-13-acetate (TPA), is an irritant and an inflammatory agent that has been widely used on mice's skin that had previously been exposed to 7,12-dimethylbenz(a)anthracene or other polycyclic aromatic hydrocarbons as a tumor promoter (usual dose: 5–16 nmol, twice a week) [23,24] ,In vitro TPA is an incredibly powerful activator of differentiation in myeloid leukemia cells, even at concentrations 10,000 times lower. TPA has been demonstrated to suppress proliferation, induce apoptosis, or improve differentiation in human tumor cell lines generated from patients suffering from melanoma, prostate, breast, colon, or lung cancer in investigations involving solid tumors [25,26]. Treatment of LNCaP cells for prostate cancer with clinically feasible TPA doses (1-6 nM)induced apoptosis when these cells were treated with TPA at a concentration that was several times greater, and this treatment led to growth inhibition [27].TPA plus ATRA treatment had a synergistic inhibitory effect on the growth of cultured prostate cancer LNCaP cells and also inhibited the growth of existing LNCaP tumors in immunodeficient mice. A combination of TPA and ATRA administered to these tumor-bearing mice caused some tumor regression in all of the treated animals, and tumor regressions were seen in several of the treated mice [28] . It is unknown what molecular pathways TPA and ATRA use in concert to suppress proliferation and cause apoptosis in LNCaP cells. There has been evidence of a TPA-dependent rise in tumor necrosis factor-alpha (TNF-) in LNCaP cells [29] .

**Anthelmintic Activity**

The procedure was followed for performing the anthelmintic activity. Due to its morphological and physiological similarities to human intestinal roundworm parasites, the adult Indian earthworm, Pheretima pothuma. [41] Pheretima pothuma was put in a petridish with three different concentrations of Croton bonplandianum (pet ether, ethanol, and water extract) solutions (20, 40, and 60 mg/ml) in it. Six worms were added to each petri dish, and the worms' paralysis or death was monitored. The mean time for paralysis was recorded when the worm showed no movement at all, with the exception of when it was shaken violently; the time of worm death (min) was recorded once it was determined that the worms did not move when shaken or when the light of outside stimuli. Albendazole was also added as a reference substance in the same way. The test findings were contrasted with samples treated with albendazole (20, 40, and 60 mg/ml) as the reference compound [42].

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**Anti-Bacterial Activity**

10% w/v test solutions of C. bonplandianum's leaves, fruits, and latex extracts, as well as fresh latex, were made by mixing 500 mg of each extract separately with 5 milliliters of sterile 10% dimethyl sulfoxide (DMSO) in order to examine the antibacterial properties of the plant's materials. To assess fresh latex, extracts from the same source were used to calculate 25, 50, 75, and 100, which had 2.5, 7.5, and 10 mg of antibacterial activity, respectively. At different doses (2.5, 5, 7.5, and 10 mg), the C. bonplandianum whole plant and latex extracts were added to each well of Mueller Hinton Agar (MHA) plates that had already been previously infected with the corresponding bacterial cultures. The plates were then incubated at 37 oC for the entire day. In this investigation, 10% DMSO was utilized as the solvent, and the positive and negative control groups were streptomycin (10 µ g), respectively. Following incubation, the diameter of the inhibition zone (measured in millimeters) surrounding the well was determined using a zone reader.[44]

**Diphenly-2-picrylhydrazyl (DPPH) Scavenging Effect**

Diphenyl-2-picrylhydrazyl (DPPH) is used to measure the radical scavenging ability of natural products since it can create a stable molecule when it accepts an electron or a hydrogen atom .When an antioxidant and DPPH combine, a free radical known as 1,1-diphenyl-2-picrylhydrazine is produced. The antioxidant drug's scavenging potential is indicated by the degree of decolorization . To 3 ml of extract solution in ethanol at various concentrations (10, 20, 40, 80, and 100 µg/ml), a 0.1 mm solution of DPPH in ethanol was made. One milliliter of this solution was then added. At 517 nm, absorbance was measured after 30 minutes. The reaction mixture's reduced absorbance suggests increased free radical scavenging activity. Using the following formula, the ability to scavenge the DPPH radical was determined. The extract's antioxidant activity was reported as IC. The extract concentration (µg/ml) that suppresses the production of free radicals by 50% is known as the 50% inhibition coefficient (IC value)[15]

**Larvicidal Activity**

The study's results, which are shown in the larval susceptibility of Aegypti to C. bonplandianum methanolic leaf extracts, showed that the methanolic leaf extract was efficient against mosquito larvae. Moreover, it was shown that the effect of larval mortality was dose-dependent. The fourth instar of A. aegypti was found to have LC50 and LC90 values of 123.8 ppm and 364.0 ppm, respectively. Therefore, leaves at 124 ppm are recommended for improved vector control. The larvicidal characteristic of C. bonplandianum leaf extract could perhaps be attributed to the existence of phorbol derivatives, which are secondary metabolites belonging to the diterpenoids category (Chandel et al., 2005). According to Maria et al. (2006), the essential oils found in four species of a genus, Croton are responsible for their larvicidal activity against the mosquito, A. aegypti. Nazer et al.[45]

**Traditional Uses**

It was discovered that this plant originated in Asia and South America. C. bonplandianum is used to treat skin conditions such as ringworm infection, inflammation of the body, and respiratory issues because of its antiseptic qualities. Cholagogue and purgative are the properties of C. bonplandianum's bark and roots [17,18]. C. bonplandianum leaves are used to cure cholera, venereal sores, and cuts and lesions on the body to halt the bleeding. This plant's seeds are used to cure abdominal dropsy, liver problems, acute constipation, and internal abscesses. C. bonplandianumis fresh juice is used to treat headaches [19,21]. C. bonplandianum is widely grown in the rural parts of Malda, West Bengal, and is used as a detergent for fuel C. bonplandianum stems and branches are utilized. Once gathered, the ash is stored for five or six days in a bottle. To make a detergent for cotton clothing, mix ash with warm water. Ethnic people in rural West Bengal, India, use C. bonplandianum leaves and roots to treat high fever and snake venom [20].

## CONCLUSION

Traditional methods of treating cancer have involved the widespread usage of numerous medicinal herbs for many generations. One of the biggest genera of flowering plants is Croton, and several of its species are widely utilized in ethnomedicine to cure a variety of illnesses, including cancer. As a result, this genus has drawn increasing attention for phytochemical screening and the isolation of any and all anticancer chemicals. The quest for enhanced cytotoxic agents remains a crucial avenue in the advancement of contemporary anticancer pharmaceuticals.The oldest known kind of treatment is phytomedicine. One such plant that is widely utilized in ethnomedical traditions around the globe to cure a variety of ailments is Croton bonplandianus. The herb is quite safe and useful for usage as medicine against a variety of ailments, according to traditional and ethnomedical literature. In natural drug discovery, reverse pharmacological methods can be used to explore a plant for a safe and effective medicine.

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EPRA International Journal of Research and Development (IJRD)
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# TEACHERS PROFESSIONAL ATTITUDE, GAME-BASED LEARNING APPROACH AND ACADEMIC ACHIEVEMENT OF SENIOR HIGH SCHOOL STUDENTS IN SOCIAL STUDIES

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**ABSTRACT**

*This study aimed to determine whether teachers' professional attitude and game based learning approach significantly influence the student's academic achievement in social studies. A descriptive-correlational research design was used. The respondents of this study were 100 Grade 12 students in public secondary high schools in the Division of Davao del Norte and were chosen through controlled quota sampling. This study used two adapted questionnaires and one researchers made questionnaires. Mean, Standard Deviation, Pearson r, and Regression Analysis were used as statistical tools. The findings showed that teachers' professional attitude was fairly manifested while game based learning was fairly observed. The academic achievement of grade 12 students in social studies did not meet expectations. The findings also revealed that both teachers' professional attitude and game based learning have a significant relationship on students' academic achievement in social studies. The findings revealed that a game-based learning approach significantly enhances academic achievement in Social Studies but does not have a notable impact on teachers' professional attitudes. This suggests that educational institutions and policymakers should focus on both improving teachers' professional attitudes and incorporating game-based learning strategies to elevate students' academic outcomes in Social Studies. To support this, professional development programs should be tailored to enhance teachers' communication, classroom management, and pedagogical skills. While teachers generally exhibit positive attitudes in these areas, the variation in responses, particularly regarding pedagogy, suggests that some could benefit from more targeted support. Implementing workshops, mentorship programs, and ongoing professional development initiatives can help standardize and improve teaching practices. Additionally, introducing peer observation and feedback mechanisms could facilitate the sharing of best practices and ensure more consistent application of effective teaching methods across different educators.*

**KEYWORDS:** *teachers' professional attitude, game based learning approach, social studies achievement, descriptive and correlational design, regression analysis, Davao del Norte, Philippines*

## INTRODUCTION

Academic achievement in Social Studies is a critical component of a well-rounded education, as this subject plays a pivotal role in developing informed, engaged, and responsible citizens. Social Studies encompass the study of history, geography, economics, government, and culture, providing students with the knowledge and skills necessary to understand and navigate the complex world around them. However, many students face challenges in achieving academic success in this subject, often falling short of the expected standards. This underachievement can have far-reaching consequences, not only limiting students' academic progress but also impeding their ability to critically analyze societal issues, participate in civic life, and make informed decisions as future citizens. The factors contributing to this problem are multifaceted and include the quality of instruction, the relevance and engagement of the curriculum, student motivation, and external socio-economic influences. Addressing the root causes of low academic achievement in Social Studies is essential for educators and policymakers aiming to improve educational outcomes and prepare students for their roles in a democratic society.

Low academic achievement continues to be a widespread issue even today. In Nigeria, students continue to struggle with achieving high standards in social studies; their performance in this subject frequently falls short of expectations, highlighting a persistent issue in educational outcomes (Adewale, O. 2018). In United States, Interrupted learning time during the initial phase of school shutdowns has become a "compounding debt," creating gaps that have made it harder for students to move forward. (Schwartz, 2023).Similar problems in Canada, recent evidence shows that the performances of Canadian students have been generally declining. At the same time, the variability between the lowest and highest performing students has been increasing (Clifton 2021).

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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The Philippines is in the midst of an educational crisis (Masigan, 2022). Education remains a top priority in the country. Despite various government and sector development plans and projects, the quality of education in the Philippines still has much room for improvement (Nicolas, 2022).

Low academic achievement will lead to significant learning losses and widening educational inequalities (Schuurman, et al.,2022). These data are a warning sign to the education system which must address the student achievement problem. (Perry 2022). Thus, it is urgent to study this problem.

## STATEMENT OF THE PROBLEM

This study aims to look into the teacher's professional attitude and game-based learning approach towards academic achievement of Senior High School Students in Social Studies. It specifically answers the following questions:

1. What is the level of teachers' professional attitude as perceived by senior high school social studies students in terms of:
1.1 Teachers' Professional Communication Attitude
1.2 Teachers' Professional classroom management Attitude
1.3 Teachers' Professional pedagogical Attitude
1.4 Teachers' Professional Mastery of subject matter attitude?
2. What is the level of game-based learning approach as perceived by senior high school social studies students in terms of:
2.1 Knowledge
2.2 Perceptions and
2.3 Attitudes?
3. What is the level of academic achievement of senior high school students in social studies?
4. Is there a significant relationship between the teachers' professional attitude and academic achievement as perceived by senior high school social studies students?
5. Is there a significant relationship between the teachers' game-based learning approach and academic achievement as perceived by senior high school social studies students?
6. Which among the indicators of teachers' professional attitude and game based learning approach significantly influence academic achievement of senior high school students in social studies?

## HYPOTHESES

The study was tested at .05 level of significance.

HO1. There is no significant relationship between the teachers professional Attitude and academic achievement of senior high school students in Social studies

HO2. There is no significant relationship between the game-based learning approach and academic achievement of senior high school students in Social studies

HO3 There is no model that best describes the relationship between the teachers professional attitude, game-based learning approach and Academic achievement of senior high school students in Social studies.

## REVIEW OF RELATED LITERATURE

In this section, numerous literature pieces and studies have been published on the study of Teachers' Professional Attitude and the Game-Based Learning Approach concerning senior high school students' achievement in social studies. The provided information is relevant to this research endeavor.

### Teacher's Professional Attitude Towards Academic Achievement

In a study by Ajai (2015) that examined remedial students' views on their teachers' attitudes toward learning social science, it was found that students perceived their teachers' attitudes as negative. Similarly, research by Olubukola (2018) investigated the connection between teachers' professional attitudes and students' academic performance in secondary schools, revealing a significant correlation between the two. Ekperi (2019), in their exploration of how teachers' attitudes affect students' academic performance in Geography, also found a positive correlation between teachers' attitudes and students' academic success. Shittu (2015) additionally highlighted a prevalent negative attitude among teachers towards teaching social studies in secondary schools. When students perceive their teachers as lacking enthusiasm, energy, and interest in teaching, it can lead to feelings of disappointment and a lack of motivation, ultimately resulting in a negative learning experience (Tang & Hu, 2022). The attitude that a teacher brings to the classroom can greatly influence students' emotions (Frenzel et al., 2021).

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In summary, a teacher's attitude, whether positive or negative, directly impacts students' emotions and their motivation levels. Teachers' attitudes can elicit positive emotions, thereby fostering a desire for further learning.

**Professional Communication**

In (Obilor's 2020) study on teachers' communication skills and students' academic performance, it was emphasized that students' academic success is strongly influenced by teachers' communication abilities, including aspects such as speaking, listening, attitude, gestures, and facial expressions. As a result, it is crucial for the school curriculum to provide ample opportunities for student teachers to develop effective communication skills. Furthermore, practicing teachers should receive sufficient training and retraining to enhance their communication proficiency. According to Amadi (2017), personal communication by teachers involves sharing ideas, opinions, and information with a clear purpose, and its effectiveness is enhanced when the recipient understands and applies fundamental skills. Effective teaching often stems from effective communication. A teacher who demonstrates positive professional attitudes places significant emphasis on their students, illustrating an unwavering focus on students as the central concern of their profession. This approach reflects unconditional positive regard and addresses students' needs with patience.

**Classroom Management**

Efficient classroom management is essential for effective teaching and learning. It has the power to either motivate students to succeed or hinder their academic progress by creating additional challenges. Teachers with positive professional attitudes not only organize the physical layout of the classroom but also foster a psychological environment that supports learning. In contrast, teachers who adopt strict authoritarian methods or show indifference to their students' academic well-being may impede their progress (Gidado, 2023). In senior secondary schools with overcrowded classrooms, as Sadiq (2019) highlighted, the teacher-student relationship is significantly affected. In these situations, teachers often spend more time managing classroom dynamics and student behaviour rather than focusing on teaching. Overcrowded classrooms frequently lead to disruptive behaviours, making it difficult for optimal learning to occur. Effective learning happens when teachers create an environment where students feel comfortable exploring new ideas without hesitation.

**Pedagogical**

The effectiveness of teaching and learning largely depends on teachers' pedagogical skills, which involve carefully selecting appropriate methods tailored to the individual needs of students to create meaningful learning experiences. Skilled educators can recognize the diverse learning contexts of their students and apply suitable methods accordingly, with the success of these approaches largely depending on their effective implementation. (Van Geel et al., 2023). A solid understanding of pedagogical competence is essential for fostering students' critical thinking and creativity, which in turn enhances their academic achievements. Proficient teachers adapt their instructional methods and incorporate modern teaching tools to address the varied needs of learners, aiming to deepen student understanding. They are expected to be resourceful, utilizing a range of teaching materials and maintaining positive pedagogical attitudes to encourage good study habits and attentive listening skills among students, as highlighted by Ogunjobi (2018).

**Mastery of the subject matter**

Subject mastery plays a crucial role in the teaching and learning process. Competent educators are essential for enhancing student performance and closing achievement gaps. Without opportunities for teachers to refine their practices, student outcomes may decline (Naz, 2016). In secondary education, where teachers specialize in specific subjects, a deep understanding of the material is vital (Heggart, 2016). Insufficient knowledge can hinder a teacher's ability to explain concepts clearly, leading to disengagement. Conversely, knowledgeable teachers with positive attitudes and strong interpersonal skills consistently command respect and capture students' attention (Zhang, 2022).

**Game-Based Learning Approach and Academic Achievement**

Game-Based Learning involves integrating games into educational processes to enhance learning activities (Trajkovik et al., 2018). In the digital age, students' interest in computers presents an opportunity to leverage these tools for educational purposes (The Scottish Government, 2019). Research indicates that educational games are effective, promoting learning through play (Chen et al., 2015) and proving to be both engaging and motivating (Hwang et al., 2015). Although still an emerging field, incorporating games into teaching fosters greater student participation and engagement. While educational games have gained popularity as learning tools (Gaydos, 2015), there is still a need for a thorough evaluation of their educational efficiency and full impact on student involvement, despite their positive effects on engagement.

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**Knowledge**

Game-based instruction incorporates various multimedia elements, such as audio-visuals, animations, videos, and interactive games, to create engaging learning experiences (Chen et al., 2019). These instructional games, available in multiple formats, complement traditional teaching methods and enhance the overall learning process (Zirawaga et al., 2017). The concept of self-reliance involves individuals taking an active role in recognizing, utilizing, and managing opportunities and resources in their surroundings to improve their quality of life, living standards, and overall well-being This suggests that fostering self-reliance could lessen reliance on government aid and employment as primary drivers of development. Consequently, education that encourages self-reliance could be instrumental in promoting national progress. (Mba, 2024).

**Perception**

As technology advances rapidly, educators are increasingly incorporating it into formative assessment practices. Research shows that while 92.6% of Indonesian students have internet access, only a small fraction, 9.6%, use it for educational purposes, with social media and chat applications being more common. According to a study by Chan et al. (2021) on gamification perceptions among teachers and students, most university and college students (87%) view gamification as effective for learning, with only a small minority (1.4%) disagreeing. Chan and Lo (2021) found that many students strongly support learning through games, with 11.6% fully agreeing and 55.1% strongly agreeing with this method. Additionally, 31.9% consider it somewhat effective. In total, 73.9% of students find gamification beneficial, with 15.9% viewing it as highly effective. Furthermore, 58% of students regard gamification as highly effective in higher education, while a small percentage (5.8%) disagree, but most acknowledge its benefits in enhancing student engagement.

**Attitude**

Research indicates that gamification has a positive impact on students' attitudes towards lessons and their engagement levels (Yildirim, 2017). Students generally respond well to gamification, which triggers positive feelings towards game elements (Yildirim, 2017). They express a preference for more gamified lessons, enjoying them and noting increases in engagement, cognitive load, and achievement (Smiderle et al., 2020). Game-based instruction, a crucial skill for the twenty-first century, promotes student collaboration, enhances engagement, and fosters teamwork (Zainuddin et al., 2019). Furthermore, gamification tends to encourage more collaboration among students compared to traditional teaching methods (Chen et al., 2019).

**Academic Achievement**

Academic achievement refers to a student's ability to fulfill academic requirements, often assessed through final grades and grade point averages (Steinmayr et al., 2014). Education is widely recognized as crucial for individuals, as it provides access to job opportunities, personal growth, and better living standards (Alsheikh, 2019; Mishra, 2019). As educational institutions proliferate, there is a growing emphasis on delivering specialized knowledge and technical skills to boost student productivity and contribute to national economic development (Stanca et al., 2021). The main goal of educational institutions is to help students grasp course content and achieve grades that support their academic and professional advancement (Apriana et al., 2019). Moreover, research by Fereidooni-Moghadam et al. (2017) found a significant link between students' motivation for achievement and their academic performance. Similarly, Bolkan et al. (2015) explored how instructor clarity affects learning, motivation, and academic performance, finding a positive relationship between teachers' attitudes and students' academic outcomes.

**Synthesis**

After examining a range of literature, the researcher has found numerous studies and scholarly articles that explore teachers' professional attitudes in the classroom and the game-based learning approach. These sources suggest that incorporating game elements into education can positively impact students' performance. Authors generally agree on the definitions of teachers' professional attitudes, game-based learning methods, and academic achievement, highlighting the positive effects of using game-based strategies to enhance student engagement and motivation.

**Theoretical and Conceptual Framework**

This research is based on Jean Piaget's constructivism theory (1964), which highlights the importance of active student participation in the learning process. According to this theory, teachers serve as facilitators who guide, prompt, and support students in developing and evaluating their understanding. Learning, from this perspective, is a collaborative effort within a social context where students and teachers work together to build knowledge (Constructivism, 2024). In constructivist philosophy, teachers adapt their methods to meet each learner's individual needs, allowing students the freedom to build their own understanding. Teachers must consider each learner's unique characteristics, such as cultural background, personal disposition, and prior knowledge, when helping students acquire and integrate new knowledge into their own experiences (Ginny 2015).

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In this study, Piaget's theory highlights the value of hands-on, experiential learning. Teachers designing social studies curricula incorporate activities and games to foster active student engagement and challenge existing understandings. Game-based learning, supported by Piaget's theory, is seen as an effective method that offers students opportunities for collaborative problem-solving and exploring concepts. Teachers' attitudes are crucial; those who adopt a constructivist approach emphasize student-centered learning, encouraging inquiry, exploration, and critical thinking. Positive attitudes towards innovative teaching methods, such as game-based learning, can inspire students to engage more deeply with the material and achieve better academic results. Piaget's theory also underscores the need for assessments that align with constructivist principles, recommending authentic assessments that evaluate students' real-world application of knowledge and provide feedback to support their reflective processes.

## Conceptual Framework

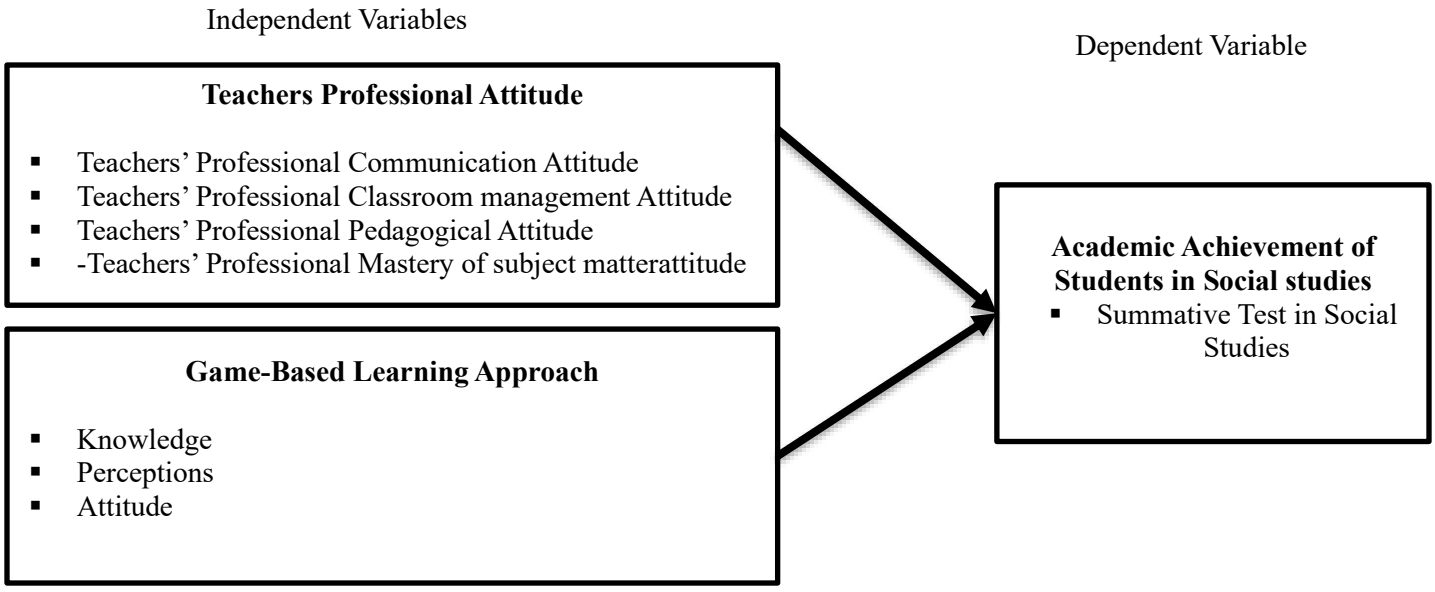


**Figure 1. Conceptual Framework of the Study**

The conceptual model depicts the relationships among variables. There are two independent variables: the teacher's professional attitude and the game-based learning approach. The dependent variable is students' academic achievement

## METHOD

This chapter will describe the methods to be used in this study. It will cover the research design, participants and sampling, the researcher's role, data collection, data analysis, and ethical considerations.

### Research Design

Quantitative research involves gathering and evaluating numerical data to characterize, anticipate, or regulate variables of interest. It aids in examining causal connections between variables, making forecasts, and extrapolating findings to broader populations (Sreekumar, 2024). The researcher will employ the descriptive-correlational method in this study. This method is chosen because the researcher is primarily interested in describing the relationship between variables rather than establishing a causal connection. A descriptive correlational study focuses on describing relationships among variables without seeking to establish causality (Mustieles, 2020). By utilizing this research design in the study, it will demonstrate how teachers' professional attitudes and the game-based learning approach relate to the academic achievements of senior high school students in social studies.

### Research Respondents

The respondents for this study are one hundred (100) actively enrolled Senior High School students from one of the public school in Davao del Norte division,15-17 years old both male and female having an average grade of 80% or above. The researcher will use controlled quota sampling, which specifically involves imposing specific limits on the researcher sample selection.

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**Research Instruments**

The researcher adapted the questionnaire from the study of (Gidado, 2023), known as the Teachers' Professional Attitudes Questionnaire (TPAQ). The Likert model will be utilize as the instrument for data collection. The structured questionnaire contains 40 items focusing on teachers' professional attitudes regarding communication, classroom management, pedagogical skills, and mastery of subject matter to gather data on teachers' attitudes. In assessing the game-based learning approach on knowledge, perceptions, and attitudes, the researcher adapted a survey questionnaire called the Survey Instrument on Game-Based Learning Approach (SIGBLA). The alpha values for the subscales of the survey instrument are greater than 0.70, indicating an acceptable range of internal consistency for all three subscales. To measure the level of academic achievement of Senior High School (SHS) students in social studies, the researcher created a 40-item summative test based on the MELCs to assess students' academic achievement in Social Studies. The items were developed according to the Social Studies module for grade 12 and included 30% easy questions, 40% average questions, and 30% difficult questions. The survey questionnaires will be administered face-to-face in the respondents' classrooms during vacant hours.

**Data Analysis**

The data gathered will be tabulated into different separate master data sheets accordingly. The results will be analyzed and interpreted using the following statistical treatments.

Mean. This will be used to answer the first three questions of the study. More specifically it will be used to describe the level of teacher's professional attitude, game-based learning approach and academic achievement of senior high school students in social studies.
Pearson Product moment of Correlation. This will be used to determine the relationship among variables. This statistical tool will be used to determine the significance of the relationship between the teachers' professional attitude, game-based learning approach and academic achievement of senior high school students in social studies.
Regression Analysis. This will be used to determine which indicators of teachers' professional attitude, game-based learning approach significantly influence academic achievement of senior high school students in social studies.

**RESULTS AND DISCUSSION**

This chapter discusses the findings and results from the data gathered. The researcher also tested the null hypotheses formulated in the study.

**Table 1. Level of Teachers' Professional Attitude**

| Indicators | Mean | SD | Description Equivalent |
|---|---|---|---|
| Teachers' Professional Communication Attitude | 3.30 | 0.56 | High |
| Teachers' Professional classroom management Attitude | 3.36 | 0.50 | High |
| Teachers' Professional pedagogical Attitude | 3.38 | 0.62 | High |
| Teachers' Professional Mastery of subject matter attitude | 3.28 | 0.56 | High |
| **Overall Category Mean** | **3.33** | **0.56** | High |

The table 1 shows the level of Teachers' Professional Attitude, it provides a summary of the mean scores and standard deviations (SD) across four indicators related to teachers' professional attitudes.

The first indicator is teachers' Professional Communication Attitude measures how teachers communicate professionally. With a mean of 3.30, it suggests that teachers generally possess a positive attitude towards professional communication. The SD of 0.56 indicates moderate variability in the responses.

The second indicator is Teachers' Professional Classroom Management Attitude focuses on teachers' attitudes towards managing the classroom effectively. The highest mean score of 3.36 among the indicators suggests that teachers feel relatively more confident in their classroom management skills. The lower SD of 0.50 indicates less variability in this area, suggesting more consistency in attitudes across the group.

The third indicator is teachers' Professional Pedagogical Attitude measures the attitude of teachers towards their teaching methods and pedagogy. The mean of 3.38 is the highest overall, indicating that teachers are most positive about their pedagogical approach. However, the SD of 0.62 is the highest, showing more variability in this attitude among teachers.

The overall mean of 3.33 suggests that, on average, teachers possess a generally positive professional attitude across all the indicators. The overall SD of 0.56 reflects moderate variability in these attitudes across the teachers surveyed.

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In summary, the table indicates that teachers generally hold positive professional attitudes across various domains, with the highest confidence in their pedagogical approaches and classroom management. However, there is slightly less confidence in their subject matter expertise. The variability in responses suggests some differences in attitudes among the teachers, particularly in their pedagogical attitudes. Overall, the professional attitudes are fairly consistent across the group.

**Table 2. Level of Game-Based Learning Approach**

| Indicators | Mean | SD | Description Equivalent |
|---|---|---|---|
| Knowledge | 3.40 | 0.50 | High |
| Perception | 3.20 | 0.60 | High |
| Attitude | 3.60 | 0.55 | High |
| **Overall category Mean** | **3.40** | **0.55** | High |

The table 2 shows the level of game-based learning approach, it presents the mean scores and standard deviations across three indicators related to the game-based learning approach.

The first indicator is Knowledge which assesses the level of knowledge regarding the game-based learning approach. The mean score of 3.40 indicates that participants generally have a good level of knowledge about this approach. The standard deviation of 0.50 suggests moderate consistency in the knowledge levels among the students.

The second indicator is perception which measures students. ' perceptions of the game-based learning approach. With a mean score of 3.20, perception is slightly lower compared to the other indicators, indicating a relatively less favorable view. The standard deviation of 0.60, which is the highest among the indicators, shows greater variability in perception, suggesting differing opinions or experiences among the students.

The third indicator is attitude which reflects students. ' attitudes towards the game-based learning approach. The highest mean score of 3.60 suggests that students generally have a positive attitude toward this method. The standard deviation of 0.55 shows moderate variability in attitudes, indicating that while the overall attitude is positive, there is some variation in how strongly students feel about it.

The overall mean score of 3.40 indicates that students have a generally positive view of the game-based learning approach across knowledge, perception, and attitude. The overall standard deviation of 0.55 reflects a moderate level of variability, meaning that while there is general agreement, there are some differences in how students perceived, know, and feel about the approach.

In summary, the table shows that the students have a solid understanding and generally positive attitude towards the game-based learning approach, with the strongest area being their attitude and the weakest area being their perception. The variability in responses, particularly in perception, suggests that while the overall view is positive, individual experiences and views differ more significantly in how game-based learning is perceived.

**Table 3. Level of Academic Achievement of Students in Social Studies**

| Indicators | Mean | SD | Description Equivalent |
|---|---|---|---|
| Academic Achievement in Social Studies | 33.37 | 10.29 | Did not meet expectation |

The table shows the level of academic achievement of students in social studies presents the mean score and standard deviation for students' academic achievement in social studies.

The mean score of 33.37 indicates the average level of academic achievement in social studies among the students. This score is relatively low, as indicated by the description "did not meet expectation." This suggests that on average, students are not achieving the expected level of performance in social studies.

The standard deviation of 10.29 shows the degree of variability in the students' academic achievement scores. A standard deviation of this magnitude suggests that there is considerable variation in the performance levels of students. Some students may have scored significantly higher or lower than the mean, indicating a wide range of achievement levels within the group.

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The table highlights a concerning status of academic achievement in social studies among students. With a mean score of 33.37, it is clear that, on average, students are not meeting the expected academic standards. The high standard deviation of 10.29 indicates considerable variability in achievement, pointing to disparities in student performance. These results suggest a need for interventions to help improve academic outcomes in Social Studies and bring more students up to the expected performance level.

**Table 4. Significance of the Relationship between teachers' Professional Attitude and Game-Based Learning Approach to Academic Achievement of Students in Social Studies**

| Variables Correlated | r | p-value | decision on Ho | decision on Relationship |
|---|---|---|---|---|
| Between Teachers Professional Attitude and Academic Achievement of Students in Social Studies | 0.235 | 0.000 | Reject Ho | Significant |
| Between Game-Based Learning Approach and Academic Achievement of Students in Social Studies | 0.272 | 0.000 | Reject Ho | Significant |

The table presents the results of a correlation analysis, examining the significance of relationships between teachers' professional attitudes and students' academic achievement in Social Studies.

The first predictive variable, Teachers' Professional Attitude has an r-value of 0.235, the value is positive, showing a weak to moderate positive correlation, indicating that while there is a positive relationship between teachers' professional attitudes and students' academic achievement in Social Studies, the strength of this relationship is not very strong, it means that improvements in teachers' professional attitudes are associated with better academic performance by students. A p-value of 0.000, means rejecting the null hypothesis. Therefore there is a there is a statistically significant relationship between Teachers' Professional Attitude and academic achievement of students in Social Studies.

The second predictive variable, game-based learning approach has an r-value of 0.272, this value is positive, showing a weak to moderate positive correlation, this suggests that as the game-based learning approach increases, there is a slight to moderate tendency for the academic achievement of students in Social Studies to increase as well, though the relationship is not very strong. A p-value of 0.000, means rejecting the null hypothesis. Therefore there is a there is a statistically significant relationship between game-based learning approach and academic achievement of students in Social Studies.
In summary, the rejection of the null hypotheses and the significance of the relationships emphasize the importance of fostering positive professional attitudes among teachers and integrating innovative teaching strategies like game-based learning to enhance student learning outcomes in Social Studies.

**Table 5. Regression Analysis on the significant influence of Teachers Professional Attitude and Game Based Learning Approach on Academic Achievement of Students in Social Studies**

| Independent Variable | Unstandardized Coefficient | | Standardized Coefficient | t-stat | p-value | Decision@ a=0.05 |
|---|---|---|---|---|---|---|
| | B | Standard Error | B | | | |
| (Constant) | 12.523 | 4.019 | | | | |
| Teachers Professional Attitude | 2.344 | 1.227 | 0.125 | 1.910 | 0.057 | Accept Ho |
| Game Based Learning Approach | 3.839 | 1.223 | 0.206 | 3.139 | 0.002 | Reject Ho |
| *Dependent Variable: Social Studies Achievement* | | | | *Adjusted R Square: 0.079* | | |
| *F- ratio 13.911* | | | | *p-value. 0.000* | | |

The table shows the regression analysis of the significant influence of teachers professional attitude and game-based Learning Approach on Academic Achievement of Students in Social Studies

Teachers' Professional Attitude has a positive influence on students' Social Studies achievement; however, the p-value (0.057) is slightly above the significance level of 0.05. This suggests that while there may be a positive relationship, the evidence is not strong enough to confidently assert that Teachers' Professional Attitude influence on students' Social Studies achievement. On the other hand, game-based

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learning approach is significantly influence on students' Social Studies achievement supported by the p value of 0.002, which is below the significance level. The results indicate that although Teachers' Professional Attitude may positively influence students' academic performance, it is not statistically significant in this context, possibly due to factors like sample size limitations, differences in teaching styles, or unexamined external variables. Conversely, the Game-Based Learning Approach demonstrates a significant positive impact on students' Social Studies achievement, underscoring the effectiveness of integrating game-based strategies into teaching to better engage students and improve their understanding and retention of the subject matter.

The overall model is statistically significant, as shown by an F ratio of 13.911 and a p-value of 0.000, which is well below the 0.05 threshold. This indicates that Teachers' Professional Attitude (b1) and the Game-Based Learning Approach (b2) together account for a statistically significant portion of the variance in Social Studies achievement scores, with an adjusted R squared of 0.079.

## RECOMMENDATION

Based on the findings, it is suggested that educational institutions and policymakers focus on enhancing both teachers' professional attitudes and the implementation of game-based learning approaches to improve students' academic achievement in Social Studies. Specifically, professional development programs should be tailored to improve teachers' professional communication, classroom management, and pedagogical approaches. Although teachers generally exhibit positive attitudes in these areas, the variability in responses, especially in pedagogical attitudes, suggests that some teachers might benefit from more targeted support. Workshops, mentorship programs, and continuous professional development initiatives could be implemented to standardize and elevate teaching practices across the board. Given the variability in teachers' professional attitudes, particularly in pedagogy, it may be beneficial to implement peer observation and feedback systems. This could help identify best practices and encourage more consistent application of effective teaching methods across different teachers. Additionally, given the significant positive impact of the Game-Based Learning Approach on students' achievement, schools should consider integrating game-based learning more extensively into the Social Studies curriculum. This could involve incorporating educational games, simulations, and interactive activities that align with the learning objectives of Social Studies. To ensure effective implementation, teachers should be provided with training on how to effectively use game-based learning tools in their classrooms. Moreover, resources such as educational software, technology support, and access to quality game-based learning materials should be made readily available to teachers.

## CONCLUSION

The study highlights the importance of teachers' professional attitudes and game-based learning approaches in influencing students' academic achievement in Social Studies. While Teachers' Professional Attitude showed a positive impact, it was not statistically significant in this context, suggesting the need for further exploration into this variable. In contrast, the Game-Based Learning Approach demonstrated a significant positive effect, emphasizing its potential as a powerful tool for enhancing student learning outcomes. Overall, the model was statistically significant, indicating that these factors collectively explain a meaningful portion of the variance in Social Studies achievement scores. This underscores the need for targeted interventions to improve both teaching practices and the adoption of innovative instructional strategies in Social Studies education

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EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# EARLY BLIGHT DISEASE OF TOMATOES IN THE CONDITIONS OF THE REPUBLIC OF KARAKALPAKSTAN AND MEASURES TO COMBAT THEM

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**Article DOI: https://doi.org/10.36713/epra18045**
**DOI No: 10.36713/epra18045**

**ABSTRACT**
*The article provides information on tomato alternaria disease, its spread and development, as well as the importance of disease prevention in the conditions of the Republic of Karakalpakstan. The information obtained during the research can be used to develop a system for protecting tomatoes from early blight disease.*
**KEY WORDS**: *tomato, disease, causative agent, alternaria, fungicides, biological efficiency.*

## INTRODUCTION

In order to obtain a high and high-quality harvest from tomatoes, it is important to protect them from harmful organisms, including diseases, along with paying attention to high agrotechnical rules and farming culture. A number of fungal diseases have been registered in tomatoes, among them is early blight.

Early blight disease of tomatoes has become widespread in recent years, causing serious damage to tomato plants. It is recorded mainly in the republics of Belarus, Ukraine, Moldavia and the Far East, East Siberia and Central regions of the Russian Federation and many other regions [1,4,7,8,9,12].

Early blight (EB) is one of the dreadful diseases of tomato caused by several species of *Alternaria*, which includes *A. solani* and *A. tomatophila*, as well as *A. alternata*.

Pathogen Alternaria solani. under its influence, the yield of the plant decreases to 20-78% [5,10,15].
The fungus grows and develops on the diseased tissues of the plant with multicellular gray-brown mycelia and forms conidia with conidial bands on top of them.

Conidial bundles emerge from short, sparsely branched plant tops or in the form of bunches. The conidia of A.solani are 15-19 x150-300μm in size, 9 to 11 times transverse and sometimes also longtidual septate.

Plants infected with early blight develop small black or brown spots, usually about 0,25 to 0,5 inch (6-12 mm) in diameter, on leaves, stems, and fruit. Leaf spots are leathery and often have a concentric ring pattern. They usually appear on older leaves first. Spots on fruit are sunken, dry and may also have a concentric pattern; frequently they occur near the calyx end of the fruit. The entire leaf may be killed and will drop off the plant. Early blight can result in extensive defoliation, exposing fruit to sunscald and reducing yields. This disease typically progresses from base of the plant, upward.

The early blight fungus survives in the soil on residue of infected tomatoes, potatoes, and nightshade weeds. The fungus is spread by spores (oval shaped with long beak) carried by wind or splashed in water. Spores thrive in moist , warm temperatures (80-90 $^0$ F) and can persist in partially decomposed garden waste for at least a year.

## RESULTS OF RESEARCH AND THEIR DISCUSSION

Herbarium samples collected from diseased parts of tomatoes served as a source during the research conducted in the conditions of the Republic of Karakalpakstan in 2023-2024.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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Diagnosis, spread and development of diseases were carried out using methods accepted in phytopathology and mycology [2,3,6,11,13,14].
Ridomil super 69% n.kuk against tomato alternaria disease during the conducted research. (1.8-2.5 kg/ha), Petrak Mz Wp 69% n.kuk. (1.8-2.2 kg/ha), Bio strobi 50% s.d.g. (0.15-0.25 kg/ha), Fastrobi 60% s.d.g. (0.15-0.25 kg/ha) fungicides were used in the specified rate.

As a model- Access 50% sus.k. (3.0 l/ha) fungicide was used. In the control option, water was used.
Experiments against early blight disease were carried out in the tomato fields of the Jaqsibai-Genjebay farm of Nukus district (table).

**Table**

**Biological effectiveness of fungicides used against tomato early blight disease (Volgogradsky 5\95 variety, 2023-2024, Jaqsibai-Genjebai farm, Nukus district, Republic of Karakalpakstan, 2023-2024).**

| Experience Options | Expenditure amount kg/l to ga\l | Spread of the disease % | Development of the disease % | Biological efficiency of fungicides, % |
|---|---|---|---|---|
| Control (not processed) | | 22,4 | 7,2 | - |
| Access 50% sus.k. (benchmark) | 3,0 | 5,9 | 1,4 | 80,5 |
| Ridomil Super % n.kuk. | 1,8 | 7,5 | 2,0 | 72,2 |
| | 2,2 | 2,0 | 1,0 | 86,1 |
| | 2,5 | 1,7 | 0,7 | 92,8 |
| Petrak Mz Wp 69% n.kuk. | 1,8 | 6,5 | 2,2 | 69,4 |
| | 2,0 | 2,4 | 0,9 | 87,5 |
| | 2,2 | 1,5 | 0,6 | 91,7 |
| Bio Strobi 50% s.d.g. | 0,15 | 7,0 | 2,3 | 68,0 |
| | 0,2 | 3,0 | 1,8 | 75,0 |
| | 0,25 | 1,8 | 1,4 | 80,5 |
| Fastrobi 60% s.d.g. | 0,15 | 4,5 | 1,0 | 86,1 |
| | 0,2 | 2,6 | 0,8 | 88,9 |
| | 0,25 | 1,4 | 0,4 | 94,4 |

According to the obtained results, the spread of the disease in the control variant was 22.4%, the development of the disease was 7.2%.

As a model against this disease Access 50% sus.k. in the variant where fungicide was used, the spread of the disease was 5.9%, the development of the disease was 1.4%, and the biological efficiency was 80.5%.

Ridomil Super 69% n.cuk is one of the tested fungicides against tomato alternaria disease. (2.2-2.5 kg/ha), Petrak Mz Wp 69% n.kuk. (2.0-2.2 kg/ha), Fastrobi 60% s.d.g. (0.15-0.25 kg/ha) the highest results were obtained. Biological efficiency increased from 86.1% to 93.0%. Disease prevalence ranged from 1.4% to 6.7%, and disease progression ranged from 0.4% to 2.2%.

In conclusion, Ridomil Super 69% n.cuk., Petrak Mz Wp 69% n.cuk., Fastrobi 60% s.d.g. it is considered appropriate to use fungicides in the specified consumption norms.

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EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# DEVELOPING GENETICALLY ENGINEERED ORGANISMS FOR BIOREMEDIATION OF POLLUTANT

**Ms. Sakshi A. Ekhande , Ms.Anjali Shinde, Ms.Dr.Rani Mhetre , Mr.Dr Vijay Sable**

**ABSTACT**

*Worldwide, environmental pollution is a serious issue that has an impact on ecosystems, public health, and biodiversity. At the moment, traditional technology cannot resolve this problem because the necessary treatments are costly, time-consuming, and unsuccessful [4] . The method of removing toxic waste from the environment by means of biological agents is now referred to as bioremediation[1].The dangers involved in releasing genetically modified microorganisms (GEMs) into the environment have limited the use of GEMs for pollution abatement [2].The usual engineering approaches based on physicochemical methods for the remediation of these polluted sites present both technical and financial challenges. [The most promising, reasonably efficient, and economical approach is bioremediation, which uses microorganisms to remove contaminants[8]. Transgenic plants and genetically modified microorganisms can work together symbiotically to improve the efficiency of bioremediation at contaminated locations[4]. Due to their improved ability to degrade a broad variety of chemical pollutants, genetically modified microbes, or GEMs, have demonstrated promise for bioremediation applications in soil, groundwater, and activated sludge environments[7].*

**KEYWORDS** : - *Bioremediation , pollutants, Recombinant DNA technology, GEMs,*

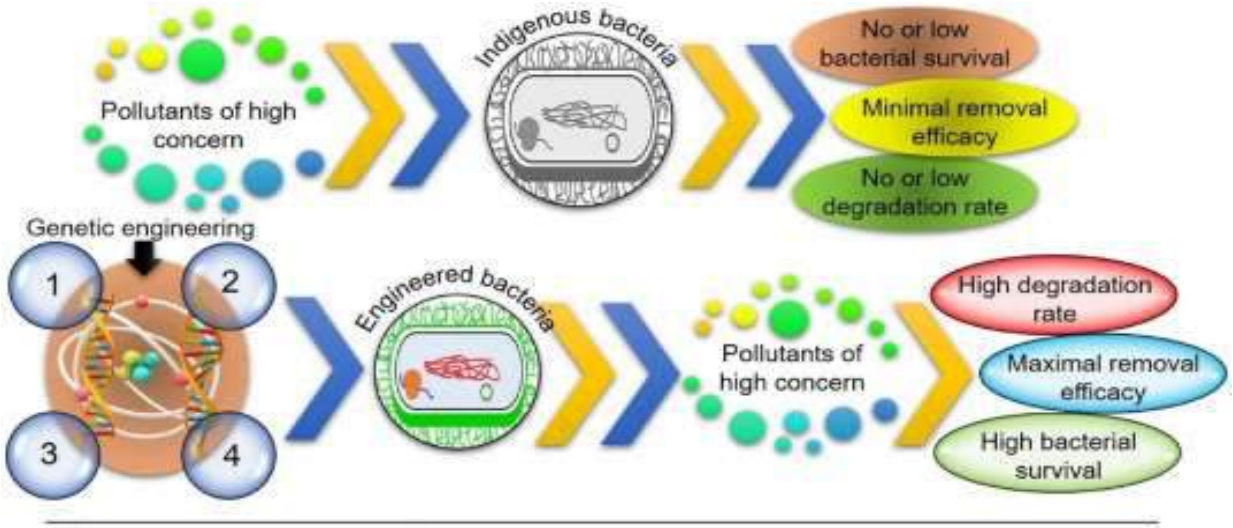
## INTRODUCTION

Environmental biotechnology's basic research and field application emphasis are found in the bioremediation and natural attenuation areas.The amount of contaminated land and water has increased as a result of the global population boom[1]. number of genetically modified microbes (GEMs) have been successfully created recently. However, in order to use bioremediation, environmental Their in situ applicability is limited by regulatory restrictions and considerations[2]. The traditional methods of remediation have involved either excavating contaminated soil and disposing of it in a landfill or capping and enclosing the polluted parts of a site[3].The rise in mining and heavy industry has led to xenobiotic chemical contamination of the environment. Xenobiotic substances' intrinsic toxicity can cause direct harm to environmental ecosystems[4].These days, anthropogenic organic pollutants are widely distributed in the environment and can be quite resistant to the biodegradation mechanisms exhibited by naturally existing microorganisms[5].Due to the carcinogenic properties of certain of the more persistent hydrocarbons, such as PCBs and PAHs, hydrocarbons can become harmful if they get into the food chain . Organic contaminants in the sediments have the potential to momentarily bind with particle matter, creating equilibrium relationships at the water-sediment interface[6].The use of genetically modified microorganisms (GEMs) in bioremediation has not advanced much in the last ten years[7].The demand for energy, the need to detoxify the contaminants, or chance could all be factors in the microbial transformation (cometabolism) .Pollution is the process by which a resource (natural or man-made) is, more often than not, rendered unfit for use by people due to harmful effects or damages caused by the contaminants. Since the beginning of time, pollutants have existed, and life as we know it now has always developed alongside them. The earth will always be a filthy planet because to pollution mimics from comets, space dust (about 100 t of organic dust per day), and geothermal and volcanic activity[8].

### Mechanism of Bioremediation by Genetically Engineered Microbes

High concentrations of metal ions can either completely prevent the microbial population from carrying out any of its various metabolic functions or they can make the organisms resistant to the high metal concentrations. Heavy metals are more difficult to remove from contaminated ecosystems than many other pollutants, despite the fact that they can biodegrade and create less hazardous, less mobile, and/or less bioavailable compounds. Though their speciation and bioavailability may vary depending on environmental conditions, these metals are ultimately eternal and cannot be broken down physiologically. Certain metals, such zinc, copper, nickel, and chromium, are essential or useful micronutrients for microbes, plants, and animals.[15].

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal




1.Screening & clobing of highly effective degraning genes. 2.increasing the expression of enzyme with degradation function of microorganisms 3.Protoplast fusion by blending the advantages of bothparent for pollution degradation 4. Expression degradation gene for different pollutants to construct super engineered bacteria[28].

**Development of recombinant DNA technology for bioremediation**

In prokaryotes, post-transcriptional processing of a multi-cistronic mRNA containing the coding regions for all of an enzyme's subunits is frequently used to regulate the expression of genes encoding for enzyme subunits . With this kind of regulation, the requirement for several promoters of varying intensities for each subunit's gene is removed.Through degradative genes, DNA enables an organism to acquire the capacity to digest a foreign substance. Genetically modified microbes and recombinant microorganisms have been employed as an efficient method for the breakdown of pollutants[12].The generated mRNA hairpin was intended to be positioned one nucleotide from the 5/-end using a synthetic DNA cassette. The DNA cassette's sequence was selected to give the resultant hairpin a specific secondary structure and dG of formation[11].Using 2 ll of each DNA fraction and their decimal dilution as templates, a PCR amplification of 16S rDNA was performed to assess the purity of the DNA recovered following treatment with Sepharose 4B.Following the PCR amplificability tests, fractions 2, 3, 4, and 5 from the purification of Sepharose 4B were combined for every soil sample. For PCR tests, DNA was resuspended in TE pH 8 after being precipitated with ethanol[14].By definition, plasmids with a broad host range are able to replicate in multiple host organisms. The benefit of employing these vectors is that they can be replicated only once, with the resultant clone being utilised by numerous bacteria.If a gene is being cloned for use in numerous hosts, narrow-host range plasmids have the drawback of being able to replicate in a smaller number of hosts than broad-host range plasmids.A transposon is a particular DNA sequence that moves randomly within a chromosome on its own[11].This study set out to both establish the applicability of DNA-based technologies in a full-scale bioremediation strategy and to choose a candidate location for bioremediation. In order to accomplish these goals, we created, produced, and applied DNA chips for the diagnosis of contaminated soil; furthered our investigation of a site with a favourable prognosis for biological degradation by using genomic data; and bioslurped the contaminated locations that were chosen[13].Using a DNA thermal cycler, nested PCR was performed in a total volume of 50 ~1 plus an overlay of mineral oil. After the tubes were heated to 80°C, the inner and outer reactions were set up using "hot-start," which involved introducing the dNTPs. DNA electrophoresis was carried out utilising accepted methods. Terminal deoxynucleotidyl transferase (TdT) was used to tail capture probe B in order to facilitate reverse dot blot (RDB) detection. After the electrophoretic separation, DNA was denatured within the gel and the entire gel content was transferred (blotted) onto a flexible membrane, typically a nitrocellulose filter, so that the DNA fragments would bind to this support without changing their relative positions within the gel. The final reaction concentrations were 50 units of TdT, 250 nmol of TTP, and 100 pmol of probe in a 100 ~1 volume of the buffer suggested by the manufacturer. Washing in TE stopped the reaction after IO–30 minutes. Probe D was end-labeled in a reaction using I nmol of probe, 2 nmol of digoxigenin-I I-ddUTP, and 50 units TdT in a 100 ~1 volume of the manufacturer's suggested buffer as a direct RDB control. The reaction was incubated for two hours at 37°C and then for ten minutes at 70°C[16]. It only takes one nucleotide alteration at a restriction cutting site to change the pattern of digestion and influence cleavage. The Southern blot method, which was first introduced in 1976, marked a breakthrough in the physical mapping of DNA by restriction enzyme digestion.The various heuristic and practical methods that use restriction enzymes have shown to be essential for physical DNA mapping . The ability to insert targeted deletions of genes or promoter sub-regions has been made

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possible by restriction enzyme-mediated DNA editing. This allows researchers to compare the behaviour of deleted templates with wild-type counterparts in terms of substrates for RNA transcription/processing and translation .The field of restriction enzyme characterisation has advanced quickly, leading to the identification of four distinct groups of enzymes [17].

**Genetically Engineered Microbes for Remediation**

According to environmental biotechnology, heavy metals can be extracted from aqueous solutions by microorganisms like filamentous fungi, yeast, and bacteria[4].Bacteria and pollutants need to come into touch for degradation to occur. This is difficult to accomplish since the pollutants and bacteria are not distributed evenly throughout the soil. Certain bacteria are chemotactic, meaning they go towards contaminants they sense. These bacteria are mobile. Fungi and other such bacteria grow filamentously in the direction of the contamination. Although a wide variety of organisms, including plants, can be employed in bioremediation, microbes have the most promise. The first recyclers in nature were microorganisms, namely bacteria and fungi[1].It is possible to separate microorganisms from practically any kind of environment. Microbes are adaptable and can develop in a variety of environments, including subzero temperatures, intense heat, desert heat, water, an abundance of oxygen, anaerobic circumstances, the presence of dangerous substances, and waste streams. An energy source and a carbon source are the two primary needs.

Aerobic : When oxygen is present.It has frequently been reported that these bacteria break down hydrocarbons, including polyaromatic chemicals and alkanes, as well as pesticides. For many of these bacteria, the pollutant serves as their only source of energy and carbon . Anaerobic : - the absence of oxygen is called anaerobic. Compared to aerobic bacteria, anaerobic bacteria are not used as much[3].

In aquatic ecosystems, algae are essential for the biomonitoring of organic contaminants. In certain instances, adding the bacterial culture in the form of activated sludge to the Chlorella vulgaris microalgal consortia greatly accelerates the hydrocarbon biodegradation process at the oil-polluted location. It has been demonstrated that choosing suitable yeast and bacterial strains to employ in combinations during biodegradation investigations is a highly successful process. These ideas have recently been applied by some researchers to assess the possibility of a microbial consortium consisting of varying proportions of bacteria and yeast for the biodegradation of diesel oil[19].

**Bioremediation by Genetically Engineered Plant**

Various plant species are environmentally benign and economically viable ways to clean up water and soil. Certain possible cellular and molecular processes found in plants may be used to aid in the detoxification of heavy metals. On contaminated areas, plants can break down pollutants in a way that is less harmful to the environment and profitable. Metals can be dissolved in soil by plants, which then absorbs them into their roots and transports them to the shoots[4]. For all living things, mercury and its derivatives pose a risk. Bacteria have developed strategies for settling in environments contaminated with mercury, and it has been discovered that an operon of mercury resistance (mer) genes codes for transporters and enzymes necessary for biochemical detoxification [20]. Mercury finds its way into water streams through industrial processes such the manufacturing of chemicals, paper, and textiles, as well as as a byproduct of gold mining . The distinctive characteristic of elemental mercury is its liquid state at normal temperature, which makes it susceptible to volatilisation[29]. The following qualities are desirable in a plant for phytoremediation:1) the capacity to accumulate metals, preferably in the aboveground portions; (2) tolerance to the concentration of metals accumulated;(3) rapid growth and high biomass;(4) a widely distributed, highly branched root system; and (5) ease of harvesting. Trees are good candidates for genetic engineering because they are high biomass plants that can survive for a long time and have the innate potential to do phytoremediation.

**Factors Influenzing Bioremediation of Contaminated Site**

Numerous biotic and abiotic elements influence the development and behaviour of microbial cells, which in turn influences a range of biological processes taking place inside a microbial community. The multiphasic heterogeneous environment that the bioremediation process is subjected to (Boopathy 2000) affects the rate of reactions. Implementing a process with inadequate knowledge of the elements driving it frequently results in reduced process efficacy[21].The availability and capacity of reduced organic materials as energy sources is one of the main factors influencing the activity of bacteria . The average oxidation state of the carbon in the material determines whether a pollutant will be an efficient source of energy for an aerobic heterotrophic cell[22]. Redox potential (Eh), pH, ionic strength, solubility, presence or absence of electron acceptors and donors, temperature, and the age of organometalic ions are examples of physicochemical factors. Many intrinsic features of microbes influence how quickly substrates degrade. For example, plasmid-encoded genes give specificity for substrates and encode particular enzymes (proteins). However, microbes, particularly bacterial cells, have been shown to have diverse specificity for various substrates in the natural world[21]. Several plant species have been employed in the phytoremediation of soil contaminated by petroleum. Since petroleum is poisonous to plants, TPH concentrations above a certain point prevent plants from growing. Fertiliser addition has a significant impact on both plant growth and microbial activity, making it a crucial factor in determining the bioremediation process's efficiency[23].

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**Containment Strategies After Bioremediation**

Regarding GEO's continued presence in the environment during bioremediation, people are worried. Pieper and Reineke found that plasmids can spread to other bacteria through both recombinant genes and selection markers, as well as the chemical and physical stability of the plasmids. It may be possible to address this issue by substituting selected markers that focus on antibiotic resistance with selective markers that do not [4].The three treatment approaches were (a) biostimulation with inorganic nutrient addition (O-N), (b) organic remediation (oiled control; O-C), and (c) biostimulation with inorganic nutrient addition plus nitrate (O-NN), an alternative electron acceptor. To assess the effectiveness of the treatment, a randomised complete-block design with repeated measures was employed .The inorganic nutrient supply was commercial-grade fertiliser (diammonium phosphate), with a target dose of 40 mg N/ kg dry sediment weight (ppm N) at each application event.The baseline samples were taken two days before the petroleum was applied. Four days following the petroleum application, on Day 0, the experiment started with the first treatment application[24] .The most popular use of the bioremediation approach is the treatment of soil contaminated by coal, petrol, crude oil, petrol, etc.When used to vast areas with low pollutant concentrations, this approach works well. Because it is widely accessible and has minimal negative effects on the environment and ecosystem, it is well accepted by the general people. In addition, it is less expensive and disrupts the soil structure less[25.]

**Current Challenges and Perspective**

The long-term impacts of environmental pollution on human health are a major global concern. The body's ability to use mitochondria to produce energy may be altered by Pb accumulation, leading to neurological disorders, paralysis, and finally death. Plants, animals, and humans are all at risk from some heavy metals. Certain plants that are edible have the potential to absorb dangerous metals from the soil and become ingested by people and other animals, leading to negative consequences. Bureaucratic obstacles and the political climate provide challenges to the application of genetically modified bacteria in bioremediation[4].Microorganisms face significant challenges when dealing with polyethylene because of its hydrophobicity, massive molecular impurities, and absence of reactive functional groups in the polymer backbone. Long chain aliphatic compound consumption by microorganisms is well-documented, and n-alkane consumption by bacteria and fungus has been demonstrated .Plastics have the advantage over many of the materials they have replaced in various applications, such as extending the shelf life of food, lowering the risk of infection in medical equipment, and creating robust yet lightweight building materials.The biodegradation investigations show that a variety of fungal species can cause modifications to the physical and chemical characteristics of LDPE and HDPE, as well as the polymer chains' fragmentation and, to a lesser degree, the polymer's absorption and mineralisation[26].

## CONCLUSION

Many organic pollutants pose a persistent toxicological risk to humans and wildlife alike, including pesticides, polycyclic aromatic hydrocarbons, and polychlorinated biphenyls. These pollutants are not easily broken down[5] ·Using microbial activity, bioremediation is a very effective and appealing option for cleaning, managing, and returning contaminated river water to its original state[27]. Although there are a few present obstacles to overcome, including the spread of transgenic pollen, the horizontal transfer of plasmids among bacteria, and the low survival rate of GEO and transgenic plants, GEO may be a viable and sustainable strategy for the bioremediation of contaminated sites[4].Bioremediation can be carried out in relation to process validation, optimisation, and its impact on the ecosystem. Bioremediation can now be turned from a mere practice into a science through the prudent use of models that can predict the activity of microorganisms involved in bioremediation[15] .

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# AWARENESS AND USAGE OF EDUCATIONAL APPS IN RELATION TO HEUTAGOGY OF UNDERGRADUATE STUDENTS

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**ABSTRACT**

*Educational apps are mobile applications considered to educate in some way or the other. These are specifically crafted to provide valuable learning experiences and knowledge improvement to their users. There is a vast variety of such apps available in the society. Education apps are a way to inspire student's minds while keeping them interested with fun gamification and creative learning methods. The usage of educational apps such as pictures and videos can complement the study attention outside of the classroom, which in time can imitate on better grades and a development in academic performance. Heutagogy is the organization of learning for self-managed learners. Pedagogy, andragogy, and heutagogy, recreated in an accessible format from teach believed. The study aims were to investigate awareness and usage of educational apps in relation to heutagogy of undergraduate students. In this study 773 undergraduate students from government, government aided, and private colleges in Salem district. Stratified random sampling technique used in the study and survey method was adopted for the study. The awareness and usage of educational apps scale was developed by the investigator. It contains twenty-seven items. The reliability value was 0.859. The heutagogy scale was prepared by the investigator and thirty items. The reliability value was 0.847. The data collected were subjected to statistical technique like percentage analysis, t-test, ANOVA and correlation. The findings of the study there was significant relationship between awareness and usage of educational apps have positive correlation with heutagogy of undergraduate students.*

**KEYWORDS:** *awareness, educational apps, heutagogy, undergraduate students*

## INTRODUCTION

Technology has rapidly exploded in education during the global epidemic. With technology on every profession is learning about more development of new knowledge. Technology has been used in education; however, the use of educational applications was restricted. It started out as an option but is now required. This increased adoption of mobile apps for educational software development enabled firms, particularly in the education sector, to new heights. (Dayna Serxner, 2022). Clearly, there was a great demand for technology tools and stages that enabled teachers to part of their courses, maintain records of their students' progress, or communicate with them during required distance learning. Technology-assisted education and learning just accelerated up, simplified, and made the process easier. Using the most of apps has become essential for both teachers and students at many schools. (Itesh Sharma, 2010). The study of self-determined learning is known as heutagogy. Furthermore, it's an effort to challenge some of the teacher-centered learning paradigm's fundamental ideas about education. Considering the rapid pace of innovation and the ways that societies and workplaces are changing, heutagogy expects a time when learning will be an essential capacity. For highly motivated, self-directed learners who do best in an exploratory, open-ended learning environment, this is the appropriate learning method.

## REVIEW OF LITERATURE

According to Lara Hoareau and Youssef Tazouti (2024) stated that effect of teachers' acceptance of an educational apps on students' primary knowledge and early proficiency skills. Results revealed a significant difference between the students' post-test e primary knowledge and early proficiency skills scores and their teachers' awareness of the app's usability. The results also showed that taking teachers' acceptance into account is an interesting opportunity to better understand the potential effectiveness of educational apps in school settings. Aadi Swadipto Monda (2023) analyzed user reviews of collaborative educational apps of a sentiment investigation method. The results indicated that education apps that do not integrate augmented truth are receiving higher user approval than apps that integrate these developing knowledges. According to Silvia Handayani; Lewes Peddell; Tony Yeigh (2023) revealed that the participants' skills in heutagogy teacher professional instruction. Conclusion of the study there were significant difference between for enhancing

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teachers' professional education in Indonesia, mostly in terms of the efficiency of heutagogy-informed methods compared to traditional approaches of teacher training programme. Handayani, et al (2022) conductive study on heutagogy approach to promoting teacher capabilities. The findings obtained that the heutagogy technique in this study was probable to be significant for improving teacher capabilities.

**Operational definitions of the key terms**

***Awareness and Usage of educational apps***

The educational apps are is software that facilitates it possible to teach virtually. It is not only for students; it is also for applicants, teachers, experts, virtual classrooms, and anyone else looking to enhance their knowledge or abilities. Education apps offer the following benefits of online learning: a controlled environment, no physical communication, flexibility in learning, and simple use.

***Heutagogy***

Heutagogy is an innovative method to education that inspires students to take care of their own education by encouraging the self-directed learning. The needs of students in the twenty-first century can be met by heutagogy, especially when it comes to enhancing their own abilities.

***Undergraduate Students***

Undergraduate students are individuals enrolled in a college or university who are pursuing their first degree, typically a bachelor's degree. The term undergraduate distinguishes them from graduate students, who are pursuing advanced degrees like a master's or doctorate. Undergraduate programs usually last three to four years and cover a broad range of subjects, including general education and courses specific to a student's chosen major or field of study.

**OBJECTIVES OF THE STUDY**

- To study the level of awareness and usage of educational apps and heutagogy of undergraduate students
- To assess the significant difference in the awareness and usage of educational apps and heutagogy of undergraduate students with respect to sub samples gender, locality, types of device
- To find out the significant relationship between awareness and usage of educational apps and heutagogy of undergraduate students.

**HYPOTHESES OF THE STUDY**

- The level of awareness and usage of educational apps and heutagogy of undergraduate students was moderate
- There is no significant difference in the awareness and usage of educational apps and heutagogy of undergraduate students with respect to sub samples gender, locality, types of device
- There is no significant relationship between awareness and usage of educational apps and heutagogy of undergraduate students.

## RESEARCH METHODOLOGY

**Method**

The survey method adopted for the study

**Sampling Technique**

The stratified random sampling technique method was used. The data was collected from boys and girls of arts and science colleges.

**Population and Sample**

Population of the study consisted undergraduate students in Salem district. They were selected randomly from each college.

**Sample Size**

773 undergraduate students were taken for this investigation. They were from government, government-aided and private colleges.

**Tools Used for the Present Study**

Investigator used the following tools for the collection of data.

- Awareness and usage of educational apps scale
- Heutagogy Scale

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**Pilot Study**

Awareness and usage of educational apps scale consists of 27 items. The Heutagogy Scale consists of 30 items intended for the pilot study was administrated to the sample of 100 undergraduate students studying arts and science colleges in Salem District, Tamil Nadu. Then, the responses have been scored carefully, and the marks secured by all the undergraduate students have been noted.

**Awareness and usage of educational apps scale**

Awareness and usage of educational apps scale was developed by the investigator of undergraduate students containing twenty seven items and six dimensions viz, performance expectancy, effort expectancy, social influence, voluntariness of use, facilitating conditions, perceived playfulness. The maximum scale value: 135, Minimum value: 27. The reliability value is 0.859.

**Heutagogy scale**

Heutagogy scale was developed by the investigator of undergraduate students containing thirty items and six dimensions viz, explore, create, collaboration, connect, share, reflect. The maximum scale value: 150, Minimum value: 30 The reliability value is 0.847.

## DATA ANALYSIS AND RESULTS

**Ho:1** To study the level of awareness and usage of educational apps and heutagogy of undergraduate students

**Table -4.1 showing level of awareness and usage of educational apps and heutagogy of undergraduate students**

| Dimensions | Total Sample | Low | | Moderate | | High | |
|---|---|---|---|---|---|---|---|
| | | N | % | N | % | N | % |
| **Awareness and usage of educational apps** | 773 | 143 | 18.49 | 463 | 59.89 | 167 | 21.60 |
| **Heutagogy** | | 152 | 19.66 | 415 | 53.68 | 206 | 26.64 |

- Low level of undergraduate students 143 (18.49%), moderate level of undergraduate students 463 (59.89%) while high level of undergraduate students 167 (21.60%) in the awareness and usage of educational apps of undergraduate students.
- Low level of undergraduate students 152 (19.66%) moderate level of undergraduate students 415 (53.68%) while high level of undergraduate students 206 (26.64%) in the heutagogy of undergraduate students.

**Ho:2** There is no significant difference between awareness and usage of educational apps and heutagogy of undergraduate students with respect to sub samples gender, locality, types of device

**AWARENESS AND USAGE OF EDUCATIONAL APPS**

**[A] Gender**

**Table – 4.2 showing awareness and usage of educational apps of undergraduate students with respect to gender (Male – 353, Female – 420)**

| AUEA | Mean | S D | t value | p value |
|---|---|---|---|---|
| Performance expectancy | 27.30 | 4.617 | 2.242 | 0.015** |
| | 28.63 | 4.920 | | |
| Effort expectancy | 20.70 | 3.272 | 2.502 | 0.023** |
| | 22.25 | 4.523 | | |
| Social influence | 16.77 | 3.558 | 2.546 | 0.017** |
| | 17.57 | 4.778 | | |
| Voluntariness of use | 24.26 | 4.663 | 0.259 | 0.865* |
| | 24.29 | 4.927 | | |
| Facilitating conditions | 16.43 | 3.385 | 2.156 | 0.027** |
| | 16.86 | 4.043 | | |
| Perceived playfulness | 22.17 | 4.517 | 3.162 | 0.005** |
| | 23.45 | 5.288 | | |

**Interpretation**

The results showed that above table a significant difference between male and female undergraduate students with respect to performance expectancy, effort expectancy, social influence, facilitating conditions, perceived playfulness at <0.05 level. Hence, the formulated null

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hypothesis is not accepted. But not a significant difference is observed between male and female undergraduate students with respect to voluntariness of use at >0.05 level. Hence, the formulated null hypothesis is accepted.

**Conclusion**

- Male and female undergraduate students do differ in the dimensions performance expectancy, effort expectancy, social influence, facilitating conditions, perceived playfulness of awareness and usage of educational apps
- Male and female undergraduate students do not differ in the dimension voluntariness of use of awareness and usage of educational apps

**[B] Locality**

**Table – 4.3 showing awareness and usage of educational apps of undergraduate students with respect to locality (Rural – 508, Urban – 265)**

| AUEA | Mean | S D | t value | p value |
|---|---|---|---|---|
| Performance expectancy | 30.81 | 5.264 | 17.850 | 0.000** |
| | 25.87 | 2.525 | | |
| Effort expectancy | 22.28 | 4.155 | 6.827 | 0.000** |
| | 23.39 | 3.766 | | |
| Social influence | 18.36 | 4.274 | 8.421 | 0.000** |
| | 15.72 | 4.034 | | |
| Voluntariness of use | 26.24 | 3.923 | 14.267 | 0.000** |
| | 22.15 | 4.639 | | |
| Facilitating conditions | 18.61 | 3.727 | 16.935 | 0.000** |
| | 14.90 | 2.856 | | |
| Perceived playfulness | 24.26 | 4.527 | 15.424 | 0.000** |
| | 20.59 | 4.487 | | |

**Interpretation**

The results showed that above table a significant difference between rural and urban undergraduate students with respect to performance expectancy, effort expectancy, social influence, voluntariness of use, facilitating conditions, perceived playfulness at <0.05 level. Hence, the formulated null hypothesis is not accepted.

**Conclusion**

- Rural and urban undergraduate students do differ in the dimensions performance expectancy, effort expectancy, social influence, voluntariness of use, facilitating conditions, perceived playfulness skill of awareness and usage of educational apps

**[C] Types of Device**

**Table – 4.4 showing the awareness and usage of educational apps of undergraduate students with respect to types of device**

| Dimensions | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Performance expectancy | 1760.677 | 2 | 930.339 | 43.973 | 0.000** |
| | 19234.378 | 770 | 21.167 | | |
| | 21355.055 | 772 | | | |
| Effort expectancy | 371.703 | 2 | 186.341 | 11.530 | 0.000** |
| | 14779.354 | 770 | 15.162 | | |
| | 15202.056 | 772 | | | |
| Social influence | 557.604 | 2 | 277.756 | 15.349 | 0.000** |
| | 16587.142 | 770 | 17.149 | | |
| | 17234.826 | 772 | | | |
| Voluntariness of use | 167.423 | 2 | 839.693 | 39.218 | 0.000** |
| | 18702.983 | 770 | 21.416 | | |
| | 21272.379 | 772 | | | |

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| | | | | | |
|---|---|---|---|---|---|
| Facilitating conditions | 617.863 | 2 | 309.432 | 22.603 | 0.000** |
| | 13594.442 | 770 | 12.690 | | |
| | 12213.304 | 772 | | | |
| Perceived playfulness | 810.085 | 2 | 404.041 | 16.549 | 0.000** |
| | 21530.784 | 770 | 23.490 | | |
| | 22350.869 | 772 | | | |

**Interpretation**

The results showed that above table a significant difference between different types of device undergraduate students with respect to performance expectancy, effort expectancy, social influence, voluntariness of use, facilitating conditions, perceived playfulness skill at <0.05 level. Hence, the formulated null hypothesis is not accepted.

**Conclusion**

- Undergraduate students from different types of device do differ in the in the dimensions performance expectancy, effort expectancy, social influence, voluntariness of use, facilitating conditions, perceived playfulness of awareness and usage of educational apps.

**HEUTAGOGY**

**[D] Gender**

**Table – 4.5 showing heutagogy of undergraduate students with respect to gender (Male – 353, Female – 420)**

| Heutagogy | Mean | S D | t value | p value |
|---|---|---|---|---|
| Explore | 27.63 | 4.452 | 1.344 | 0.067** |
| | 28.22 | 5.035 | | |
| Create | 21.06 | 4.143 | 1.012 | 0.548** |
| | 22.30 | 3.993 | | |
| Collaboration | 17.86 | 4.085 | 0.468 | 0.321** |
| | 16.23 | 4.523 | | |
| Connect | 24.75 | 4.347 | 0.045 | 0.113** |
| | 23.28 | 5.186 | | |
| Share | 15.89 | 3.672 | 0.303 | 0.421** |
| | 16.73 | 3.870 | | |
| Reflect | 21.71 | 4.956 | 1.688 | 0.284** |
| | 23.37 | 5.086 | | |

**Interpretation**

The results showed that above table not a significant difference between male and female undergraduate students with respect to explore, create, collaboration, connect, share, reflect at >0.05 level. Hence, the formulated null hypothesis is accepted.

**Conclusion**

- Male and female undergraduate students do not differ in the dimensions explore, create, collaboration, connect, share, reflect of heutagogy.

**[E] Locality**

**Table – 4.6 showing heutagogy of undergraduate students with respect to locality (Rural – 508, Urban – 265)**

| Heutagogy | Mean | S D | t value | p value |
|---|---|---|---|---|
| Explore | 28.27 | 4.524 | 4.630 | 0.001** |
| | 28.47 | 5.356 | | |
| Create | 22.52 | 3.987 | 0.854 | 0.317* |
| | 22.38 | 4.490 | | |
| Collaboration | 16.54 | 3.847 | 4.952 | 0.002* |
| | 18.63 | 5.431 | | |
| Connect | 24.38 | 4.383 | 1.688 | 0.530* |

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| | | | | |
|---|---|---|---|---|
| | 24.76 | 6.126 | | |
| Share | 16.50 | 3.391 | 2.365 | 0.002** |
| | 17.54 | 4.954 | | |
| Reflect | 22.87 | 4.667 | 3.613 | 0.001** |
| | 24.32 | 5.984 | | |

**Interpretation**

The results showed that above table a significant difference between rural and urban undergraduate students with respect to explore, share, reflect at <0.05 level. Hence, the formulated null hypothesis is not accepted. But not a significant difference between rural and urban undergraduate students with respect to create, create, collaboration, connect at >0.05 level. Hence, the formulated null hypothesis is accepted.

**Conclusion**

- Rural and urban undergraduate students do differ in the dimensions explore, create, collaboration, connect, share, reflect of heutagogy.
- Rural and urban undergraduate students do not differ in the dimensions create and connect of heutagogy.

**[F] Types of Device**

**Table – 4.7 showing heutagogy of undergraduate students with respect to types of device**

| Dimensions | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Explore | 224.650 | 2 | 110.725 | 3.876 | 0.007** |
| | 20101.456 | 770 | 22.925 | | |
| | 21325.034 | 772 | | | |
| Create | 426.441 | 2 | 218.213 | 11.931 | 0.001** |
| | 14825.656 | 770 | 15.105 | | |
| | 15142.076 | 772 | | | |
| Collaboration | 334.139 | 2 | 166.067 | 8.184 | 0.003** |
| | 16820.625 | 770 | 17.391 | | |
| | 17254.796 | 772 | | | |
| Connect | 28.344 | 2 | 15.654 | 1.652 | 0.542* |
| | 21353.138 | 770 | 22.220 | | |
| | 21372.279 | 772 | | | |
| Share | 240.996 | 2 | 121.995 | 7.582 | 0.000** |
| | 12961.320 | 770 | 14.098 | | |
| | 13233.383 | 772 | | | |
| Reflect Between Groups | 324.523 | 2 | 162.261 | 5.476 | 0.002** |
| | 23076.327 | 770 | 25.018 | | |
| | 22370.867 | 772 | | | |

**Interpretation**

The results showed that above table a significant difference between different types of device undergraduate students with respect to explore, create, collaboration, share, reflect of heutagogy at <0.05 level of significance. Hence, the formulated null hypothesis is not accepted. But not a significant difference between different types of device undergraduate students with respect to connect at >0.05 level of significance. Hence, the formulated null hypothesis is accepted.

**Conclusion**

- Undergraduate students from different types of device do not differ in the dimension connect of heutagogy.
- Undergraduate students from different types of device do differ in the dimensions explore, create, collaboration, share, reflect of heutagogy.

**Ho: 3** There is no significant relationship between the awareness and usage of educational apps and heutagogy of Undergraduate Students.

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**Table -4.8 showing the correlation coefficient of awareness and usage of educational apps and heutagogy of Undergraduate Students**

| Variables | Pearson Correlation "r" Value | P value | Level of Significance |
|---|---|---|---|
| Awareness and Usage of Educational Apps and Heutagogy of Undergraduate Students | 0.742 | 0.001** | Significant at 0.01 level |

**Interpretation**

- The awareness and usage of educational apps have positive correlation with heutagogy of undergraduate students.

**Conclusion**

- There is a significant relationship between educational awareness and usage of educational apps have positive correlation with heutagogy of undergraduate students.

## FINDINGS OF THE STUDY

The study titled was awareness and usage of educational apps of undergraduate students in relation to their heutagogy. The researchers adopted survey method. 773 undergraduate students in Salem district were selected and stratified random sampling technique used for the study. Two research questionnaires were used to collect the required data. The study revealed that the awareness and usage of educational apps and heutagogy of undergraduate students was moderate. The findings also showed that the there was a significant relationship between awareness and usage of educational apps have positive correlation with heutagogy of undergraduate students. Technology integration has improved the convenience and enjoyment of learning. Since students may now learn from recognized teachers situated all over the world and have access to a new platform. It is also known as long-distance learning. We've covered a number of these educational technology apps' advantages in the blog. The varying levels of awareness, influenced by factors like the students' fields of study, the availability of technology, and promotional efforts by app developers and identify the most commonly recognized educational apps, such as Duolingo, Khan Academy, Coursera, and Quizlet.

**Recommendations**

- **Enhancing Awareness**: Institutions should promote educational apps through workshops, orientations, and integrating them into course syllabi.
- **Supporting Usage**: Providing access to devices and internet, especially for underprivileged students, can bridge the digital divide.
- **Encouraging Heutagogy**: Educators should design courses that incorporate heutagogical principles, using apps to facilitate self-directed learning.

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# CURRENT STATUS AND APPLICATIONS OF ARTIFICIAL INTELLIGENCE (AI) IN MEDICAL FIELD

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**ABSTRACT**

*As things stand, artificial intelligence (AI) will transform nearly every aspect of the medical industry. Examining the research done on this technology is necessary in order to determine its various medical applications.Artificial intelligence (AI) has transformed many industries by providing unmatched breakthroughs in automation, technology, and judgment. This review paper offers a thorough examination of the state of artificial intelligence (AI), covering its development, a wide range of industry applications, underlying technology, ethical issues, and potential future uses. This study seeks to provide a comprehensive overview of AI's varied influence by synthesizing recent research, methodology, and case studies, highlighting both its potential and problems. The summary of this analysis opens the door for more breakthroughs and responsible AI research by illuminating the critical role that AI plays in transforming industries, social norms, and human-machine interactions.*

**KEYWORDS:-** *Artificial intelligence (AI); AI Application; AI Technologies; Medical; Treatment; Decision making*

## INTRODUCTION

One of the 21st century's most significant and transformational technologies is artificial intelligence (AI). Its development has sparked a paradigm shift in a variety of industries, fundamentally altering how humans view technology, engage with it, and make decisions. AI's many uses have drawn a lot of attention as it continues to enter more and more areas of our life, igniting discussion and excitement about what that means for society, ethics, and the future. The origins of artificial intelligence (AI) can be found in the early days of computer technology, when visionaries imagined devices that could mimic human intelligence. This vision has developed over the years from theoretical ideas to real-world applications, thanks to exponential advances in algorithmic creativity, data accessibility, and computing power. From a professional systems and artificial intelligence The course of AI research has been characterized by incremental advances that have pushed the limits of what machines can accomplish, from deep neural networks and reinforcement learning. The ability of AI to learn from data, see patterns, and make remarkably accurate predictions or judgments is its defining characteristic. This ability has driven AI into a wide range of fields, erasing borders and changing entire sectors. AI-driven diagnosis and tailored therapy suggestions have the potential to improve patient outcomes in the healthcare industry. Algorithmic trading platforms and predictive analytics are transforming investment methods in the finance industry. Autonomous vehicles are the cutting edge of transportation, with the potential to completely transform mobility. These are only a few instances of AI's widespread impact on various industries.But despite AI's astounding potential, moral questions and societal ramifications remain significant. Discussion topics now center on issues including data privacy, algorithmic bias, employment displacement from automation, and the moral application of AI. Ensuring accountability, fairness, and openness is crucial as AI systems grow more independent and integrated into crucial decision-making processes. Maintaining a balance between creativity and moral obligation is still a major obstacle to the further advancement and application of AI technology.[13]

### Benefits of Artificial Intelligence in medical field

AI can handle a variety of medical problems, such as determining a patient's level of difficulty while carrying out sophisticated operation with improved results and quality. The patient can now experience the benefits of their prompt and precise decision.[1,2]. The various advantages of AI in the field of medicine

- Assess abnormalities and recommend medical intervention;
- Forecast impending illnesses;
- Provide accurate and timely diagnosis;
- Support complex and novel treatments;
- Maintain blood and glucose levels in patients;
- Offer consolation to physicians and patients
- Adequately instruct medical students

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

• Enhance hospital safety
• Gather information during surgery to help with future procedures.
• Positive patient outcomes;
• enhanced pathology results;
•improved physician and surgeon experiences;
•lower diagnostic costs;
•maintenance of the clinical record; and superior patient care In the medical field, artificial intelligence is useful for a range of jobs, including automated measurement tasks like pulmonary artery diameter, aortic valve analysis, and carina angle assessment. Currently, it is employed to determine the extent of damage and fracture in orthopaedic patients [3 ,4]

**Different types of Artificial Intelligence technologies for medical field**

AI has a significant impact on the medical field, with the help of different innovative technologies. It helps nurses, doctors and surgeon to make their work easy. These technologies support to form individualized treatment plans for patients. It is applicable in the medical diagnostic support system for the diagnosis of congenital heart diseases[5,6]The computerized storage of health records is important. It can improve diagnosis consistency, speed, and accuracy. These technologies are useful in capturing additional information that doctors may have overlooked and in precisely predicting the result for the patient. These are used in large medical organizations to monitor cost recovery, health expenditure, and treatment responses in order to properly manage the health system. The many kinds of AI technologies utilized in the medical industry are shown .

**1. Machine Learning (ML)**

In the medical field, this technology is used to determine the likelihood of disease. In addition, machine learning systems are programs that are self-improving and learning without experience or after being trained over time. They can evaluate medical results automatically and present them with a probabilistic degree of accuracy. ML algorithms can make decisions using the following algorithms and methods: supervised learning, unsupervised learning, semi-supervised learning, and reinforced learning.[7]

**2 . Artificial Neural Networks (ANN)**

Artificial Neural Networks (ANN) function similarly to neurons because each ANN neuron has weight and is connected. ANNs are inspired by the neural structure of the human brain and operate on the principles of backpropagation and layers (input layers, hidden layers, and output layers). • Useful in forecasting disease occurrence and decision-making since big data sets are used to train artificial neural networks (ANNs). The best weight corresponding to bond strength in human brain neurons ensures that the optimal path is obtained through ANNs.[8]

**3.Natural Language Processing (NLP)**

NLP is the study of speech recognition and language assessment using various methodologies. • In the medical field, this technology is helpful for clinical decision trials, supports, and analyses the unstructured data. It is also used for automated coding and maintains clinical documentation of the patient. • There are numerous independent NLP algorithms, such as parsing, POS, and tagging using HMM (Hidden Markov Model).[9]

**4.Support Vector Machines (SVM)**

Support Vector Machines address the primary basis data classification problem by identifying the class groupings of the input data. • When an SVM classifier is trained, they are utilized in email spam filters so that it may use and see fresh and unknown data-points for future correlations. • Helps create and process medical data; • Manages patients appropriately and supports the use of evidence in decision-making[10,11]

**5.Heuristics Analysis (HA)**

The basic algorithm on which heuristic work is to employ such a practical solution that it may not yield the optimal goal but works sufficiently to full fill that goal. Heuristic analysis is the best approach for patient safety and efficiently identified different problems. This technique uses a trial and error method to detect and discovery in order to solve a problem.[12]

**Advancement of Artificial Intelligence**

In the medical field, artificial intelligence offers disruptive innovation. In order to deliver quicker and more reliable results, it effectively analyzes data from medical records, systems, and information while enhancing digital automation. Digital consultation and patient-appropriate medication management are made possible by this technology1,6, 8. It aids physicians in achieving more success, some of which are covered below:

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**Medicine**
Artificial intelligence advances medicine development, personalized treatment, and diagnosis. It completes the laborious medical procedure with accuracy. Clinical trials can benefit from this technology, which also helps with efficient monitoring to produce reliable results. It is capable of carrying out appropriate patient monitoring and information sharing.

**Surgery**
By collecting data during the whole surgical process, physicians and surgeons are effectively incorporating AI. has a bright future ahead of it in terms of offering the best possible patient care. It produces a clinical judgment based on evidence to enhance surgeon workflow and patient care. It appropriately delivers effective outcomes from intricate surgery.

**Radiology**
Surgery aided by AI improves precision and consistency while learning in real-time operating environments. They could help the surgeon get better results during surgery and after treatment. The possibility of effective therapies is increased and the patient's active recovery is supported by all the modifications and improvements. In order to pre-define concepts, this technology can also post-set and pre-set procedure-related data variables. A more accurate representation and interpretation of complex data is now possible thanks to recent major advances in AI's perception—that is, its comprehension of sensory data.

**Hospital Administration and Medical Records**
This system maintains the record in digital format for the health care sector, increasing accuracy and efficiency. On the other hand, AI in hospital management systems improves and synchronizes many aspects and data, while also automating the storage, gathering, and analysis of customer and patient data. This technology assists in monitoring the patients' vital signs and gives the doctor and the patients' families access to real-time information. As a result, it helps with health system verification, which essentially runs the hospital. It accurately forecasts the etiology of an individual's illness. AI increases the productivity of physicians, surgeons, and hospital employees by providing digital control over hospital administration.[14]

**Process chart of Artificial Intelligence in the medical field :**
AI enables quick and precise communication throughout complex surgical procedures. It automatically plans, checks, and creates follow-up procedures during the hectic schedules of doctors. It increases therapy effectiveness while lowering the chance of diagnosis. Researchers, scientists, and doctors employed this technology to help people51, 52. Artificial intelligence (AI) can scan a patient's lab results and notify or remind the patient when necessary. The automatic electrocardiogram (ECG), cardiac monitoring, clinical laboratory analysis, medical imaging, electroencephalography, respiratory monitoring, and anesthesia are among the effective application areas. This cutting-edge technology can analyze blood tests, blood sugar levels, medical images, and a variety of other jobs quickly53,54. AI can get the knowledge needed to address a particular medical issue when patient data is integrated into algorithms. The artificial intelligence process chart is displayed in Figure 1.

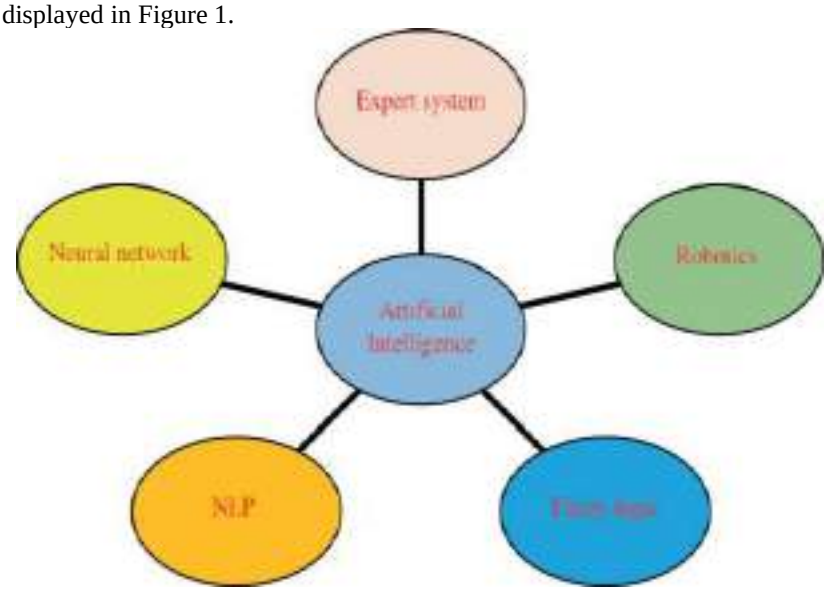


**Fig.1 Process chart of Artificial Intelligence in the medical field [15]**

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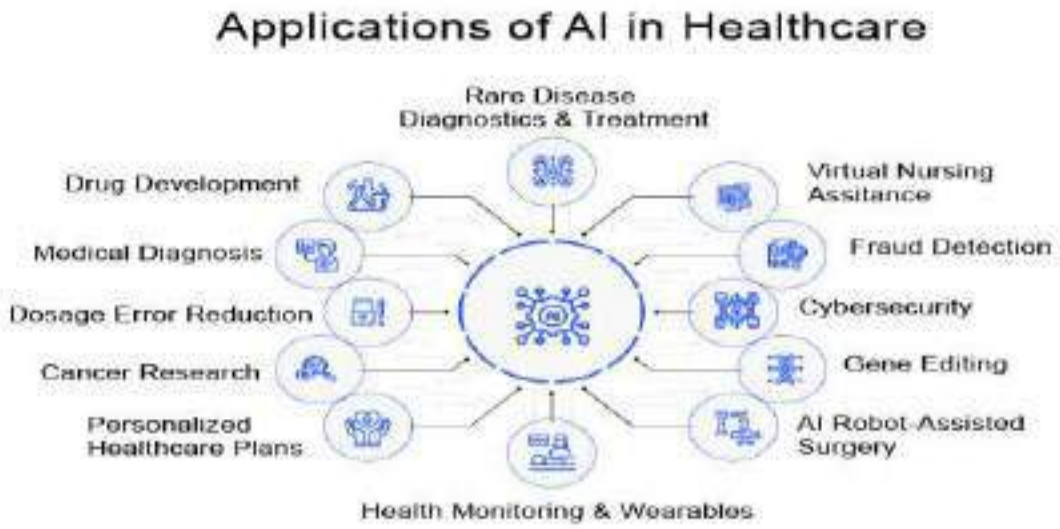
**Future Direction**

AI will help medical professionals in the future years make better clinical judgments across the board. With the use of this technology, patients can receive the most recent knowledge and information possible. When AI is used properly, healthcare will improve in the future. Its main goal is to transfer unstructured text to a computer and then electronically record data. AI will be applied to innovation and financial management. It can effectively complete a necessary medical duty faster and for less money. With the use of technology, data may be digitally gathered, stored, and categorized to improve health. AI is able to respond to a variety of patient questions without the need for medical personnel. It is more capable than a human of gathering all unstructured data and visual images. It is going to create new opportunities for training, research, and development. It lowers the death rate with the aid of appropriate care. With the use of its speech recognition technology, it will suggest a suitable course of action to prevent illnesses. The primary shortcoming of this technology is that it lacks emotional intelligence because it is currently unable to adequately simulate or display human emotions.[14]

**Artificial Intelligence applications in the medical field**

There are needs for new, cutting-edge technologies in our daily lives that improve people's lives. AI has several benefits for fostering innovation in the medical sector. With the use of this technology, a doctor can examine a patient without going to a clinic or hospital. Thus, patients can now access online services thanks to this technology. Any question the patient may have about a range of medical concerns can be promptly addressed.[17,18] It can be used in a variety of ways to arrange a therapy to get better results. The various uses of artificial intelligence in the medical area are covered in under.




Artificial intelligence (AI) offers a superior capacity to carry out necessary tasks in the medical industry with less human participation. AI appears to be the greatest instrument for training, analysis, and clinical judgment. It has been demonstrated that when this technology is used properly, diagnosis may be completed quickly and accurately. Artificial intelligence has the potential to decrease human error in treatment and surgical procedures, while ensuring optimal patient safety—the patient's first concern.[19,20] The complex medical test and data obtained can be examined by the medical team. It is employed to analyze each patient's unique genetic makeup. This technology records information on medical issues, case studies, and patient histories [21,22]. It can sufficiently notify the patient about the need for a healthy diet, exercise regimen, and medicatio**n.**

## DISCUSSION

Artificial Intelligence (AI) analyzes large amounts of intricate medical data using specialized software and sophisticated algorithms. It produces accurate and workable results without the need for direct human interaction. With the use of intelligent devices, this technology can comprehend information and develop with it. Analyzing the link between patient outcomes and treatment/prevention strategies is the primary goal of AI. AI technologies help the hospital meet its workforce and staffing needs while also lowering costs and increasing patient satisfaction. This technology allows for faster data collection and more processing power. It is possible to improve Robot-Assisted Surgery by utilizing this EHR system. With the use of this technology, a better outcome from surgery or therapy is produced. It has the ability to convey information regarding potential diseases.

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## CONCLUSION

Artificial intelligence can support patient monitoring and appropriate care. It evaluates a picture or result without the need for a physician, surgeon, or other healthcare professional. Medical emergency predictions can be aided by the decision-making capabilities of AI-based technologies. Using a digital app to give medical advice is beneficial. This technology will improve treatment and diagnosis accuracy in the real world. It can be applied to lower medical expenses and avoid illness. By using this technology, unneeded hospital visits can be decreased and patient inquiries can be addressed. AI is a great resource and can spot issues when there is a physician shortage. In order to provide patients with better care, this technology first determines the biological cause of the illness. It completes the task accurately and can visualize medical images with ease.

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# ONLINE TASK SEGREGATION AND RESOURCE UTILIZATION IN A UNIVERSITY

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**Article DOI:** https://doi.org/10.36713/epra18144
**DOI No: 10.36713/epra18144**

**ABSTRACT**
*The Online Task Management System (OTMS) is built to organize an organization resource and therefore enhance assignment's performance by assigning, the required tasks, identify users, their full details, and even their working progress while estimating their working performance. The proposed system also compliments the interaction between the administrators, users by providing an efficient interface to accomplish goals on the web hassle freely. OTMS covers all activities related to the search for, finding, distribution, monitoring, and forecasting of the performance of every organizational asset. It is the responsibility of administrators to ensure that the school has a proper data base system in which the performance of the peer can be determined from. Thanks to the machine learning solution, this system can even predict such organizational performance based on individual peer analysis, which in turn is helpful in the organization's growth.*
**KEYWORDS:** *Allocation, Resources, Scheduling and Tracking.*

## II. INTRODUCTION

The Online Task Management System (OTMS) aims at better discharge of work and proper allocation of tasks to peers about the resources available in the day to day running of a university. The system allows for administrators to set assignments and monitor progress as well as input user-specific data in a simple web-based application.

OTMS is an all-encompassing process of task running for the entirety of the university, from identification to resource allocation and tracking and assessment of tasks, leading to better performance and productivity.

This system is going to transform the organizational performance by bringing together an efficient tool that helps with the management of tasks in a particular organization, along with features to promote teamwork, openness, and responsibility in the workplace. As the world becomes even more connected and as time sensitive issues become the norm, the centrality of a high-level task management solution becomes clear.

These are some of the problems that OTMS aims to solve in university contexts. Lack of a coordinating centre for many tasks is one of the biggest issues when it comes to organization and time management. Lecturers under this motivational type have challenges in the assignment of tasks, monitoring their achievement and efficient usage of resources thus experiencing deadlines and substandard performance. In the same process, manual task management is also inefficient and subject to miscommunication and errors all of which are detrimental to productivity and teamwork.

To counter these issues, OTMS consists of features such as easy graphical user interface, integrated process management and self-driven schedule combined with alert functionalities, and complete data management support. This system also helps the users in providing clear assignments, tracking the progress easily, make resource allocations and decision making. By attending to these issues, OTMS increases the efficiency of scholarly and administrative activities.

**Key Challenges and Solutions**

**Task Segregation:** Therefore, the question of how it is best to co-ordinate tasks from the students' viewpoint in relation to the overall framework of a university and across all the faculties and the departments which a university may comprise arises. OTMS is an online tool for creating tasks based on its priority, department, project, due date, etc., The system is full Electron based web application. This ensures that tasks are accessible to all the right people while the same time it becomes impossible for the tasks to be accessed by wrong people or intruders.

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Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

**Resource Utilization:** One aspect that is stringently important in universities is resource management because time, resources and facilities can be compromised in ways that can lead to a whole lot of compromise. OTMS also contains numerous resource management features and some of the best resource availability and suggestion tools exist within the application. This is synchronized with other systems in the university in a way that makes provision of service sensible and efficient.

**Collaboration and Communication:** Most importantly when semester sleek, fully online, or distant education is becoming more and more recognized in practice, and distributed work is not a rarity, it is found to be a key element. OTMS is not a passive tool for sharing and organizing of tasks, files, comments and notifications and real time status. Compatibility and responsiveness of the technological elements make it possible to make the users reachable as well as productive irrespective of the place.

**Data-Driven Insights:** For this continuous improvement OTMS offers improved features in particularly reporting and analysis capabilities. This means that the information concerning tasks, the performance, resources, and people involved enable the university heads to analyse the trends in Order to affect the necessary improvements.

**Admin Module**

- **Admin Responsibilities**
  - Create and delete users.
  - Provide valid login IDs and passwords to users.
  - Track all tasks and records within the system.
  - Manage all system-related work.
- **Capabilities**
  - Assign tasks to users.
  - Monitor task progress and completion.

**User Module**

- **User Responsibilities**
  - Perform tasks assigned by the admin.
  - Log in with the provided login ID and password to access the system.
- **Capabilities**
  - Users are differentiated by their designations and can assign tasks to their subordinates.
  - Complete tasks from home efficiently.

**System Specifications**

1. **Hardware Requirements**
   - **Processor:** Intel Core i5 or equivalent
   - **RAM:** 8GB or higher
   - **Storage:** Minimum 256GB SSD
2. **Software Requirements**
   - **Operating System:** Windows 10 or macOS Catalina (or later versions)
   - **Web Browser:** Google Chrome, Mozilla Firefox, Safari or Microsoft Edge
   - **Node.js:** Version 14.x or higher for development environment
   - **Code Editor or IDE (Integrated development environment):** Visual Studio Code, Sublime Text, or equivalent
3. **Database Management System**
   - The task manager system utilizes Firebase as its primary database management system. Firebase offers real-time database capabilities, seamless integration with web applications, and robust authentication and security features.

**The specific Firebase services used in the project include**

- **Firebase Authentication:** for user authentication and authorization
- **Firebase Realtime Database:** for storing and managing task-related data in real time
- **Firebase Cloud Functions:** for server-side logic and backend operations

4. **Development Stack**
   - **Frontend Framework:** React.js for building dynamic and responsive user interfaces
   - **Styling:** SCSS (Sass) for efficient CSS styling and customization
   - **Routing:** React Router for managing navigation within the web application
   - **State Management:** Context API or Redux for state management across components

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- **Backend (optional):** Firebase Cloud Functions or Node.js with Express for custom backend logic

## III. LITERATURE SURVEY

A literature survey conducted in the context of the Task Management Systems adapted for the environment of Higher Education shows that task management in this domain is built to provide an optimal way of delegating and coordinating tasks. These systems help in smooth allocation of work given by the higher authorities such as administrator, faculty, or head of a department, to the concerned departmental head, faculty or staff members. It includes creating tasks, setting priority, due dates, tracking progress, sharing documents, having communication tools and track performances.

The biggest continuing themes are the ability to work seamlessly across devices, personalized processes for different parts of the university, data security for sensitive areas, as well as integration with academic terms. New tendencies indicate the increased focus on data analysis, on the use of automation and collaboration tools and, compliance with data protection acts (e.g. GDPR, FERPA). The security is well emphasized as most universities deal with sensitive information. These are the key aspects of security such as; encryption, access control, authentication, and data safeguard. This is very important with regards to scalability, and the ability of systems to take on a broad range of workloads, departments, and users. By having customizable dashboard, flexible work flow, and role-based access, it enhances the system functionality, flexibility, and usability.

**Key Studies**

Wang et al (2017) tried to explain the actual connection between online task segregation and academic performance; observed positive trend between effective task organization, resources administration, and students' performance.

Johnson et al. (2018) provided an example of the effectiveness of using an online task management platform: the management of tasks, the allocation of resources and the level of involvement of students was enhanced.

In a conceptual review of the literature, Patel and Gupta (2019) examined the crucial role of technology in aligning resources composition by providing some examples of work on online task segregation specifying its advantages in terms of avoiding resource contention and increasing the level of cooperation and productivity.

Smith et al. (2020) surveyed current task management systems in higher education environments with a focus on departmental segregation of tasks, real time collaboration features and how such systems affected productivity and resource utilization.

In the paper of Khan and Rahman (2021), the problems in resource management in universities were highlighted and the opportunities for their improvements using technology were described: the division of tasks and the use of collaborative tools and data analysis tools for resource planning.

## IV. METHODOLOGY

### II. Requirement Analysis

- Gather information from departments in the university as per the required task management, resources needed and the roles to be assigned to users.
- A detailed breakdown of the user personas of the project – administrators, faculty, and students with granted roles and permissions.

### III. System Design

- Co-ordinate on structure of extensive element and databases, layout of variations and UI, as well as back-end services.
- RBAC should be applied in the system in ensuring that the users are restricted in their access privileges for the system.
- Produce sketches to give a picture of system design or create a mock-up of how the system would flow.

### IV. Development

- Choose frameworks working with frontend (e.g., React, HTML/CSS) and backend (e.g., Node.js, Firebase).
- Some essential functions that anyone can draw include the posting of tasks and assignments, monitoring of completed tasks, notification, and even the provision of reports.
- Firebase Authentication should be employed to provide secure way of logging in and controlling of access.

## V. SYSTEM ANALYSIS

**EXISTING SYSTEM**

Many institutions of learning are still to adopt proper tools and procedure of establishing tasks; this includes e-mail correspondence, excel and simple tracking techniques. They assist in daily work organization but they are not scalable, they can sort partially, and

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do not contain automation or all the features. It is somewhat limited in complexity and direct access for the pure clerical work so their strength is not in the advanced organization and management of those particular tasks and the use of tools and resources.

**Weaknesses of Current Systems**

- Time-Consuming and Error-Prone
- Limited Integration
- Lack of Automation

**Challenges Faced by University Stakeholders**

The various types of universities that are available,

i. **Disparate Data Sources:** Generally, the data about the tasks exists in different systems and therefore there will be duplication of work and confusion and wastage of time in trying to locate the data needed.
ii. **Limited Collaboration:** As a result of the poor collaboration aspects that used traditional system results thus relying on emails, telephone and meetings, the entire process is slowed and miscommunication occurs.
iii. **Manual Workflows:** Some of the processes for instance; time-tables and resource management are done manually and as such, they are slow and, in most cases, grossly inaccurate.
iv. **Lack of Real-Time Visibility:** Since there are no frequent updates, the administrators fail to develop appropriate decisions for appropriate resource management hence; inefficiency.
v. **Limited Analytical Insights:** Such systems are generally not well supported by sufficient analytical tools and therefore it becomes difficult for the universities to determine areas of strength and weaknesses on issues to do with performance as well as use of the resources in the system, which basically help in assessment of strategies for improvement.

**LIMITATIONS OF THE EXISTING SYSTEM**

i. **Lack of Centralization:** This comprises of things like the manner the various departments in a business organization uses different tools and different databases to conduct their business which greatly limits the dissemination of information within the University.
ii. **Scalability Issues:** These traditional systems cannot handle increased number of students and more research activities required by the institutions which lead to poor performance and user satisfaction.
iii. **Inflexible Workflows:** In traditional systems there is no way of achieving the flexibility that is desirable in an educational environment.
iv. **Manual Processes:** However, there are some universities that have not adopted the computerized data gathering techniques whereby they use printed forms and use of spreadsheets to input data this is slow and is associated with errors.
v. **Limited Collaboration:** Cross functional team efforts and information sharing is another area where current systems do not have provision of supports for work done.

## VI. SYSTEM PROPOSED

The Online Task Segregation and Resource Utilization System that is being proposed in this research is a web-based application intended for the efficient handling of tasks USW faculty members are most assigned to. It provides adds to relation to the management of tasks, teachers and students' assignments division by the academic departments, courses, research and other work, administrative burdens. Most of the time, the use of the tool is fairly intuitive and allows the faculty to easily create, assign, priorities and track tasks, due dates and milestones as well as collaborating where necessary.

The system helps to solve the problems with the distribution of tasks, minimize conflicts, and increase efficiency due to the presence of objectives and deadlines. Monitoring tools let for overseeing the task's progress and performance indicators and to take corrective measures as necessary. In role-based access, restricted privileges; administrators, control general responsibilities and measures; and faculty members have access to only those tools that are useful for their duties. In all, this system seeks to improve productivity, order, and effectiveness in the management of faculty duties in universities.

**ADVANTAGES OF THE PROPOSED SYSTEM**

- **Centralized Task Dashboard:** Real time of all activities provides status, priority, due date, and users of the job to the higher authority.
- **Task Assignment and Collaboration:** This system describes an easy way certain tasks can be offered to a specific individual or a certain group, and includes notification and alert systems. For instance, the commenting section, the share and transfer of files, and discussions enhance communications and collaborations.
- **User Authentication:** Some examples of what users can input are credentials, and while the admins include an input that allows a specific task to go to a specific user.

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- **Reporting and Analytics:** Integrated application offers reports on the completion of the task and distribution and possible congestion of the work load. Thus, business intelligence assists in decision making and in definition of the resolution of procedures.
- **Academic System Integration:** Integration with other systems like LMS and SIS for easy synchronizing of data and is used in combination with Academic calendar.
- **Scalability and Flexibility:** Scalability is the ability of growth of the tasks, users, and data without any effect on the performance of the system as per the need of the university in future. It also allows users to make the necessary adjustment according to individual requirement of the user.

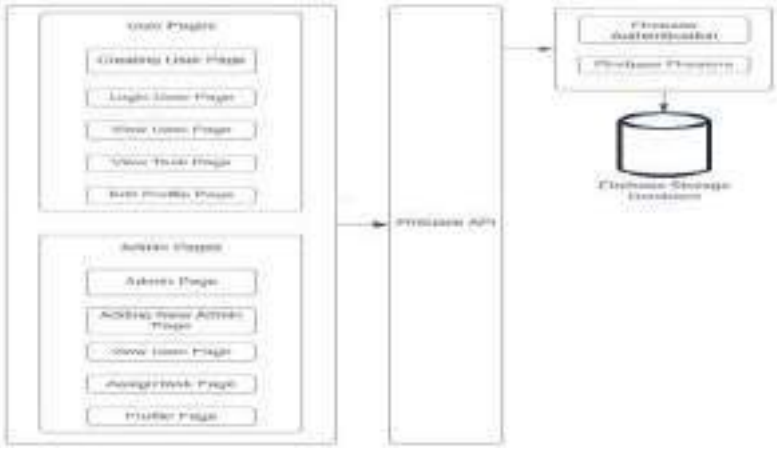
## VII. SYSTEM DESIGN

The employed task management system intakes information about tasks and presents the information in various forms of visualizations. Tabular form is supplemented by means of bar charts, pie charts as well as line graphs providing a clear description of the state of tasks, progress, priority, and figures. For example, bar graph may be used to display distribution of tasks by category, pie chart displays the relative sizes of the completed and the pending tasks and; line graph may be used to display task

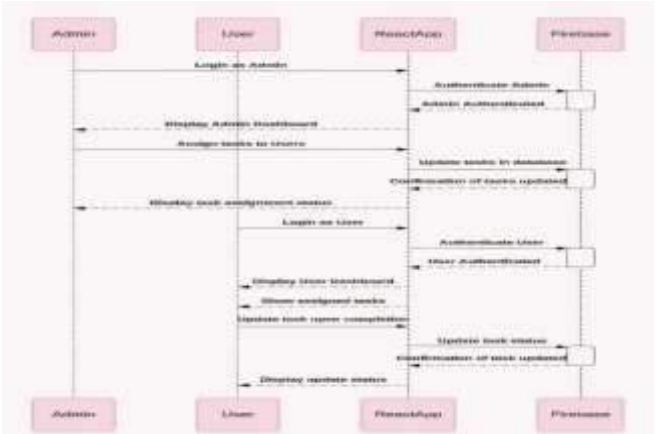
**Key Visualizations Include:**

- **Task Completion Rate:** A line graph of the tasks that were performed pointing to history to help the administrators in plotting performances.
- **Task Category Distribution:** Specifically, task distribution by type can be acted as a pie chart to help management the resources intensively.
- **Priority Matrix:** An effective method of selecting and choosing with the assistance of graphic division of the tasks by the degree of their importance.

**HIGH LEVEL DESIGN (System Architecture diagram)**



**SEQUENCE DIAGRAM**



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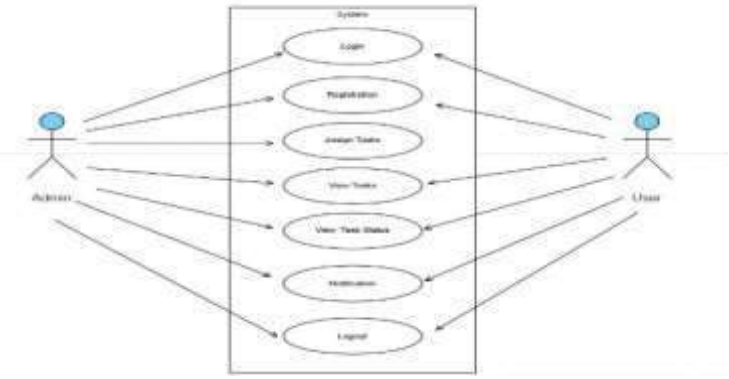
**USECASE DIAGRAM**



**ACTIVITY DIAGRAM**

## VIII. DATA COLLECTION AND PREPARATION

### 1. DATA SOURCES

In the task management system, information is collected from various sources to allow the correct tracking and monitoring of activities. This is data obtained from 'form' sources including task creation forms, update and user forms; as well as 'data extracted from the system database' that comprises data on tasking, users, categories, due dates, priority and status.

Texts, list, dates, Boolean and radio buttons are entered by users and send to the text boxes, drop down lists, date pickers, check boxes and radio buttons. This data is structured in the database with specific data types: They have plain text input fields that are of var char data type, date, number which is int data type and status which can either be Enum or Boolean data type. Still, this structural data is going to be immensely valuable for tracking achievements, delegating the tasks, determining scope and timeframes, and generating reports.

### 2. DATA PROFILING

Surveillance or profiling at its simplest is the examination of data that has been collected as to its nature and suitability as well as its accuracy. This assists in the identification of the patterns, trends, and outliers that in a way contribute to accuracy and reliability of all data within the context of task management system.

The system categorizes and quantify the task types, priorities, and status change to look for trends and changes in type and for the measurement of the performance, analysis of the updates, user participation and completion ratings. It highlights such cases as tasks that take very long time or when high priority tasks spend most of the time in the queue.

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## IX. RESULTS

**User Registration**

**User login**

**Forgot Password**

**Admin login**

**Admin Dashboard**

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**Displaying Users**

**Adding New Admin**

**Admin Profile**

**Assigning Tasks to users**

**User Dashboard**

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**Notifications**

**User Profile**

**Database**

**Authentication Database**

## X. TESTING

### 1. Testing and Validation

- Carry out unit, integration, and system test in other to ascertain that the task manager system is in right order or to some level of standard.
- Check the functionality of the system through the following procedures: conduct several shows about the system and associate with real users who will assist in identifying the possible issues of the system.
- It is possible to encourage the true users of the application to provide the results and enhance the consumers' satisfaction.

### 2. Deployment and Maintenance

- Perform the installation of the task manager system in a secure hosting platform including cloud service such as AWS or Firebase Hosting.
- From the system point of view ensure that the system is being updated with new gadgets and software, at the same time patch up the system to ensure that it is free from flaws and or bugs.

### 3. Training and Documentation

- Prepare teaching aids that will demonstrate to the client what the system can do for him or her as a user, or as an administrator.
- manuals for future use in case there is a snag.

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**Key Achievements:**

- It was possible to fall into developing a sound framework for work assignment and resource management when placed in the environment of a university.
- Higher levels of details in such tasks as the description of the task, distribution, monitoring, and reporting of the same tasks as well as improved management of resources.

**Challenges and Future Enhancements:**

- Discussed questions of data accumulation, system security, and versatility enlargement invariably by consecutive attempts to modify.
- As for the future's development such matters as the way of using performance measurement for tasks, collaboration features and new functionality obtained from users or new requirements will be considered.

## CASE STUDY

### CASE 1

| S. No | Test ID | Form | Test Description | Steps to Execute | Test Data | Expected Result | Actual result | Status |
|---|---|---|---|---|---|---|---|---|
| 1. | T_01 | Application Homepage-Admin Login | Check Username | Type Username and password | Username =Riti Password =wrong Password | Invalid Username /password | Invalid Username /password | Pass |

### CASE 2

| S. No | Test ID | Form | Test Description | Steps to Execute | Test Data | Expected Result | Actual result | Status |
|---|---|---|---|---|---|---|---|---|
| 1. | T_02 | Application Homepage-Admin Login | Check Password | Type Username and password | Username =John doe Password =wrong Password | Invalid Username /password | Invalid Username /password | Pass |

### CASE 3

| S. No | Test ID | Form | Test Description | Steps to Execute | Test Data | Expected Result | Actual result | Status |
|---|---|---|---|---|---|---|---|---|
| 1. | T_03 | Application Homepage-User login | Forget Password for Invalid User | Type Username and password | Username =Riti Password =wrong Password | User not found / User is not admin | User not found / User is not admin | Pass |

## XI.CONCLUSION

Indeed, we effectively came up with an online task segregation and resource management system for the university. It also identifies the significant successes as better performing of the tasks, focusing on the dynamics of the administrators and users interactively as well as organizing the resources. In particular, automation of task distribution, real-time visibility with timestamps, notifications, and interface have been valued by the users and as a result, people are satisfied with the tool.

Such issues as data integration issue, program security and scalability were considered during the design phase. Subsequent releases will expand out capabilities of analysis, integration with other systems, and add features based on users' feedback and essentialities.

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# LEVERAGING DEEP LEARNING FOR IMPROVED CYCLONE FORCASTING

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**Article DOI: https://doi.org/10.36713/epra18147**
**DOI No: 10.36713/epra18147**

## ABSTRACT

*Tropical cyclones (TCs) are frequently rarest but one of the foremost dangerous weather phenomena to arise over tropical oceans, usually creating huge issues with nearly ninety storms globally annually. Early detection and monitoring of TCs are necessary for the early warning of areas in danger. Since these storms originate over the open ocean and frequently out at sea many miles of continental regions, they are detected using remote sensing. In this paper, we propose an automatic method to identify the formation of TCs through satellite images combining a deep learning architecture. The methodology is based on a two-stage deep learning framework: Mask CNN as detector stage—second wind speed filter and lastly Convolutional Neural Network (CNN) for classification. The best possible performance is obtained by hyperparameter optimization using Bayesian Optimization across the pipeline. Results show that the proposed method achieves a precision, specificity, and accuracy of 97.10%, 97.59%, and 86.55% in test images respectively*

**KEYWORDS**— *Convolutional Neural Networks (CNN), Deep Learning, Cyclone Detection and Tracking, Tropical cyclone Intensity.*

## 1. INTRODUCTION

Tropical cyclones (TCs) are one of the most devastating weather systems for deep tropical regions forming and intensifying over warm ocean waters. Storm surges, intense rainfall and high winds fuel these natural disasters. Limiting forecasts to just 24 hours, accurately forecasting TC intensity is a tall order. We are able to do this because we still have an incomplete understanding of the highly nonlinear and coupled physical processes that dictate TC intensification/weakening. Major processes that cause changes in TC intensity are ocean conditions, internal structural dynamics and environmental influences. Thus integrating these factors into the models to predict intensity may improve the levels of accuracy involved.

Appropriate attempts have been made in the forecast of 24 h TC intensity change using the empirical models and numerical model approaches. In empirical prediction, much effort has been dedicated to enhance TC intensity forecasts by using the statistical dynamical forecast models, employing nonlinear techniques, and selecting efficient predictors. Thus, the identification of new and accurate predictors for the change in TC intensity will immensely reduce the limitations of statistical-dynamical models. In numerical modeling various spatial and temporal parameterizations are used which may yield divergence in model outcomes and details. In assimilation of data, initial conditions are provided for the forecast, but it does not solve the problem inherent with the models used.

The appearance of artificial intelligence has stimulated researchers to consider the application of machine learning for TC parameters and numerical models' outputs for improving the intensity forecast. Several parameterizations of intensity have been proposed to assess direct impacts of TCs, feedback processes, and their relations to the external physical environment. For example, different earlier research works have employed the C4.5 decision tree model in the development of their work. 5 algorithm, which divides 24-hr changes in intensity according to the intensification potential, recent changes in intensity, and zonal wind shear consistent with the Maximum Potential Intensity (MPI) theory. To overcome the SSTC feedback of typhoons in the Weather Research and Forecasting (WRF) model, a nonlinear deep learning algorithm was used by the researchers. It altered the dynamical and thermal characteristics close to the ocean surface through changing moisture flux. Furthermore, Cloud et al. developed a feed forward artificial neural network which utilizes real time operational estimation with HWRF model predictors to enhance the subsequent intensity predictions. It has also emerged that machine learning methods can be applied to data post-processing as well as feature learning and that these are powerful tools in capturing the nonlinear characteristics of TCs.

The modulations of TCs depend on air-sea interfaces that play an important role in the development of TCs. For predicting the TC intensity it is attained by choosing the correct predictors and the meteorological parameters that display these interactions. Current TC parameters deal with the inner core of the cyclone, the interaction of the cyclone with the large scale environment, and even the ocean bottom. Nevertheless, due to the scale and structural complexity of TCs, these attempts may be insufficient and capture only some aspects of their development, which may slow down the advancement of intensity forecast.

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Distributions and circulation and vortex interactions that are constituent components of the three-dimensional (3D) environmental field of a TC are additional features. TC parameter estimation is based on underlying environmental factors associated with mechanical and thermodynamical characteristics of the atmosphere and ocean which directly control the changes in TC strength. When TCs progress through different phase of their development, the flow fields also move, possibly resulting into changes in their characteristics and intensity.

Deep learning has tremendous advancements over the past few years in computer vision mainly due to the development of Convolutional Neural Networks (CNNs). These networks are very efficient for extracting spatial features from the images and thus boosting up the target detection and classification without any need of choosing the features and crafting headers manually. Weather satellites make it possible to obtain multi-spectral images which could be analyzed by multi-dimensional CNN architectures. In most of the cases, two dimensional convolutional neural networks (2D CNNs) are employed for the analysis of features that are invariant to translation in 2D data. On the other hand, Three dimensional convolutional neural networks (3D-CNNs) can handle 3D samples in one go and can learn the joint spatial aspects of TCs and make the spatial development of the systems less complicated. The extraction of spatial and temporal environmental features together provides a new way of modeling the distribution characteristics of TC intensity change.

Despite the above-mentioned breakthrough, this approach's efficacy was confirmed separately in order to enhance short-term intensity prediction with a deep learning model integrating the 3D environmental field with joint spatial features that recognize the link between the two parameters. A 3D-CNN was used to analyze joint spatial features of 3D environmental variables to forecast 24h intensity changes and categorised intensification/ weakening TCs. This method has proved efficient upon comparing the obtained mean absolute error (MAE) and classification accuracy to previous work pointing to TC intensity prediction as enhanced upon the current studies.

## 2.LITERATURE-REVIEW

The survey [1] applied finite-mixed model (FMM), hierarchical clustering and K-means algorithm. Hybrid and statistical methods likewise cannot handle the intricate and nonlinear nature of TC-related predictors; therefore, the forecast results must be optimized further. Based on the five taxonomy of helix of successful cases in the application of deep learning in TC forecasts modeling in the recent years, the author has provided a brief of each one.

The paper [2] states that, A deep learning model named DeepMicroNet uses 37- and 85–92- GHz satellite images to forecast TC intensity. Some of the extra features include; probabilistic output, partial scans and can handle with imprecise TC fixes. The main data used are in the 85–92-GHz band. The model discussed here has an RMSE of 14. 3 kt, while the growth rate respectively enhances from 10 kt to 10 kt. 2 kt with better track data and 5 kt with better track data and 9. 6 kt, but with much higher resolution of the microwave measurements. Limitation: Some recommendations are made for the category 5 TCs, but most of them are inconclusive because there is very little information about these storms. Nevertheless, the present study suggests the potential of deep learning in TC intensity analysis with more improved methods and more data resources.

This paper [3] states, an attempt is made for localizing the centre of TCs using deep learning algorithms with TC SCI data resources. Six deep learning models are investigated and compared. The YOLOv4 model better known as You only look once achieved an accuracy level of 99. 84%, that is far better compared to other models of motor vehicles. As noted earlier, the YOLOv4 model yields probability of more than 99% when determining multiple TC locations.

In this paper [4], The multivariate linear regression models, the K-nearest neighbours' algorithm, the multilayer perceptron, support vector machine (SVM) and relevance vector machine (RVM)have been successfully used to estimate TC intensity.

As a new application in Earth remote sensing, Hurricane monitoring using GNSS-R (Global Navigation Satellite System Reflectometry) is presented in this paper [5]. Hurricanes are defined by Saffir-Simpson Wind Scale which is number of knots per hour, which is reflected by GNSS signal. The method utilised here is CNN model. The technique achieves 96. This current study assesses the performance of GNSS-R at 6 % accuracy with a preliminary data set that has only 33 salinity data points derived from GNSS-R measurements.

This survey paper [6] uses, Ship predictors, Intensity records, SHIPS (Statistical Hurricane Intensity Prediction Scheme), DSHP (SHIPS with inland decay), LGEM (Logistic Growth Equation Model), HWFI (Hurricane Weather Research and Forecasting), OFCL (Official NHC forecast), features selection and data processing. Technique used is ‘’Multilayer perceptron", "Neural networks optimization", "LOYO testing scheme". Experiments and results: 24-h intensity model for operational forecasts, Light-weight 6-hourly intensity model for climate, Predictor importance

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## 3.PROPOSED METHODOLOGY

A. Details about the dataset

The Tropical Cyclone Wind Prediction Competition Dataset was gotten and used as the training and testing set using Radiant ML Hub package in Python. It includes 366*366 infrared and black and white images of tropical cyclones, and all of them have speed associated with cyclone within them In addition, some other information includes relative time, ID numbers, and ocean. All the images considered herein bear a documented maximum sustained wind speed and are from North Atlantic and East Pacific Oceans.

B. Model Building

Only a simple mention of the model architecture is there and that too in the tabulator format. The various types of CNN layers added in the model include input layer, output layer, dense layer, pooling layer and flattening layer.

Input layer: That is the primary input of Convolutional Neural Network or CNN as it is commonly known. These are converted to this layer of data for each of a test or training example's pixels and are fed into the network. The input layer of most image processing models including the one that is being used in this present case is usually a 2-dimensional matrix that contain pixel intensity or RGB value of the input image or the resized image. These RGB principles can then most likely be standardized to lie in a particular range of values.

Output layer: From the layers described in the architecture of a CNN is the fully connected layer just before the output layer which flattens the input from the previous layer. Then the network is used to predict the outcome for the specific input layer which was first fed into the network in its flattened form. If classification is carried out, then an outcome is derived, which holds the value of each of the mentioned classes meaning which of the given classes the input is most probably in. Therefore, according to the model the input will likely be assigned to a specific class which contains the preferred value of the class which is often the maximum value among all the possible values of that class

Convolutional layer: This layer is the building block of the convolutional neural network that has been highlighted as the main building element in this paper. Here we have various types of filters and parameters which are present and in the training phase, a number of these filters and parameters are tuned to get better output predictions. In effect for each filter, it 'slides' across the entire spectrum of the images and at each position computes the dot product of the calculated filter and the input. The dot products produced in outgoing and incoming domains are added together and that results in an output.

Activation layer : An activation layer whose role is to form the basis by which the weighted sum of input, brought to the learning layer of a neural network, can be converted to the right output.
Each layer has some activation function which modify the output of that specific artificial neural network the layer in a especial form where it can only be a certain range. The model that is shown utilizes two of the several activation functions, or "squashing" functions: sigmoid whenever the execution is at the output layer, while ReLU on the layers that are in the latent space.

Dense layer: A fully connected layer involves a number of neurons wherein each of the neurons in the layer above the neural network is connected to a neuron. Each of these links possesses a weight value over it meaning that that connection is going to contribute to what amount of output the neuron in question will get. In other words, it can be understood that the total of all the weights that a particular neuron in the whole layer has received from the previous layer is the neuron's output.

Pooling layer: Here, the dimensions of the feature maps are reduced through application of a pooling layer. It provides a way to accommodate the sensitivity of the feature maps that are generated to the input feature locations. This can be accomplished in two popular ways: First and foremost, of them are max pooling and average pooling.

Flattening layer: To two dimensional planes that can also be referred to as feature maps, one can use a flattening layer to flatten them into a single linear vector. In image classification networks fully, linked layer uses a flat matrix as an input by classifying an image.

**Data Pre-processing**

The first rendition of the data frame is a table looking like this that match the cyclone speed with the image ID.

The one-hot encode method has to be applied for converting the expected outcome of the deep neural network into chances for every feature of a 7 * 1 multi-dimensional vector where each dimension symbolizes a unique category since the cyclone velocity is afterwards discretised into 7 categories.

We also use Image ID to extract each training and testing image. Every image was initially either a 1093 * 1093 or a 366 * 366 Black and white picture. Next, each image is converted into 366 by 366 matrix of the two dimensions, representing pixel's luminance level by a number from 0 to 255.

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$$Normalization = (x - x(min))/(x(max\ ) - x(min))$$

The formula 'x' highlights the previous value of the pixel while 'xmin is the minimum value of the pixel (which is 0 if the pixel is fully black), 'xmax' on the other hand defines the maximum value of the pixel (which is 255 if the pixel is fully white); 'y', therefore, means the new value of the pixel which is normalized and ranges from 0. 0 and 1. 0. Thus, the output is the probable class of the given input image and the input is the image and it is an array of dimension 366*366 and all the elements are decimal integers and varies from 0. 0 to 1. 0.

Model Training:

Our approach was the proposed sequential CNN model trained using TensorFlow. Seven levels of cyclone intensities were used in order to classify the whole data set into seven different categories. In the testing set there were 18,000 while in the testing set there were 70,000 photos. There were adaptive learning rates determined for each of the parameters with the help of the Adam optimiser. The categorical cross-entropy is used in the multi-class classification system that is used in our work.

## 4. RESULTS

C. Experimental Results

To avoid over-fitting of the data, the model was trained for 50 epochs in addition cross-validation was included. One of the findings that was made was that the validation's level of accuracy was 90%. training accuracy was 90 % of the training data and cross validation accuracy was 05 %. 93%. This is the amount of information lost in the model formation whereby it was found out that the predicted model loss on the training was zero. On the training set rescaled log loss for class 2616 was 0 and on the validation, set was 0. 2811.

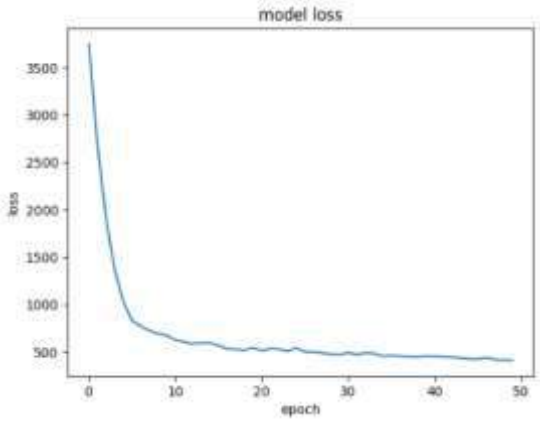


**Fig 1: Model Loss for 50 Epochs**

The graph shows the loss in the model's performance throughout the 50 epochs of training. The loss is initiated at around 3500 at the onset then drops sharply within the first 10 epochs thereby showing that the model learns rapidly. Following this first dip, the loss is reduced even further until it reaches and maintains roughly 500 toward the end of the time period. This suggests that while the model keeps on enhancing as more data is fed to the model, the rate of enhancing is much lower after the first phase is complete.

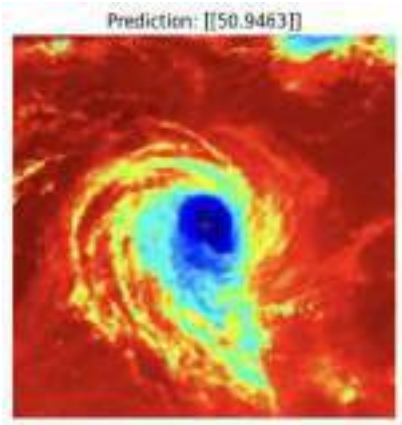


**Fig 2: Prediction**

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In fact, the given image seems to be the satellite infrared representation of a hurricane or a tropical cyclone, in which different colours indicate different temperature gradients. The dark blue in the middle shows that it is the eye of the hurricane typically the coolest part of the storm. Around it is a zone of vigorous activity as depicted by warmer colours such as yellow and red see figure2 indicating high temperatures and convection currents. The image also holds a value of about fifty of the prediction parameters 9463 which seems to represent an attribute over which analysis was done, could be the intensity of storms or any other parameter to do with weather patterns.

### A. Comparative Analysis

Following is the table showing the comparison of various classification technique for using photographs to categories cyclones.

| Algorithm | Accuracy (%) | F1 Score | Recall | Precision | Log Loss | Cohen's Kappa Ratio |
|---|---|---|---|---|---|---|
| KNN | 80.29 | 0.78 | 0.76 | 0.80 | 0.45 | 0.60 |
| RNN | 89.44 | 0.85 | 0.84 | 0.86 | 0.30 | 0.75 |
| CNN | 92.93 | 0.90 | 0.89 | 0.91 | 0.25 | 0.80 |

**Fig 3 Accuracy Metrics**

The table compares the performance metrics of three algorithms: KNN, RNN, Main CNNs as well as other types of CNNs. In this work CNN has given out passing all the other networks with the accuracy of 92. 0.93, and an F1 Score of 0. 90, recall of 0. 89, precision of 0. Extra, evaluation shows that the model tuned at 91, therefore, has the lowest log loss of 0. 25 and the highest Cohen's Kappa Ratio of (0. 80. Next is RNN which gives satisfactory results with 89. 44% accuracy, 0. 85 F1 Score, and 0. argument with 86 of precision, as well as a lower log loss of 0. 30. This makes KNN to perform the lowest among the three that is; it was found to have an accuracy of 80%. 79%, recall of 0.77 and an F1 Score of 0. 78, and had significantly higher log loss of 0. 45, however it has the lowest Cohen's Kappa Ratio of 0. 60.

## 5. REALTED STUDIES

Main approaches in the forecasting of the tropical cyclone tracks include numerical model, statistical model, dynamical model and integrated model. Impact based models are computationally intensive since they solve for various dynamical equations to real time observation and effective numerical models are still under development especially in the specification of the internal structure of the tropical cyclones but are less time consuming. Statistical models on the other hand use past data to look for behavior patterns although despite the increased effectiveness, results may not be very accurate. In order to increase prediction accuracy, dynamical models integrate use of dynamic systems and statistical dependencies, the large-scale variables are included to in typhoon prediction systems. The complex models, on the other hand, involve several models, physical parameters and initial conditions comes out to be more effective and result oriented than the single models.

But with the help of meteorological satellites, ocean observation stations, ground observation networks, there is more and greater data, and therefore, there is a need for fundamental methods to enhance the efficiency and accuracy to predict the movement of TC with large-scale spatiotemporal data. The deep learning algorithms are also relatively well-developed as experts are paying more attention to the application of machine learning in the tropical cyclone upgrading.

RNNs are deep learning algorithms that can handle and model sequence data such as time series data which is similar to the data of Typhoon and Hurricane. For instance, Xu et al designed a model for typhoon track prediction which incorporates RNN with an attention mechanism that indeed demonstrated enhanced efficacy in the typhoon track prediction using deep learning. Nevertheless, naive RNNs have a problem, known as the long-term dependency problem, so it is hard for them to learn information at -large time intervals. To overcome this, Sepp & Schmid Huber proposed the use of Long Short-Term Memory (LSTM) models which employs gated control units and linear connections to incorporate temporal characteristics of the data in question. In Gao's study, LSTM networks with the typhoon observation data was applied in order to predict the typhoon tracks. Moreover, Kim et al presented a ConvLSTM based spatiotemporal model for tracking and predicting the hurricane path using climate data on a large scale.

Although LSTM has well proven result it has drawback of increasing no of parameters and slow down the training process because of inclusion of multiple gated units. To overcome this, a relatively less complex model known as Gated Recurrent Unit (GRU) is available having only one update gate and one reset gate. The modified version of RNN named as GRU has been adopted in many fields because of its high performance and less time required for training. Su et al. presented a model which extended the network structure of a GRU to have a convolutional mechanism in order to make cloud movement prediction using the GOES satellite data with better results.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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This research works to advance the literature on deep learning algorithms with reference to meteorological input. The work presented here suggests a new neural network based on GRU, which should provide better predictions of tropical cyclone tracks. There are two components in the model; an AE layer for feature extraction from a spatiotemporal data of meteorological factors associated with TC paths; a GRU layer for training extracted spatiotemporal features for prediction.

## 6. CONCLUSION

In these works, the authors postulated that the mutual positioning of 3D environmental characteristics could be potentially useful for understanding TC dynamics and its relationship with TC intensity fluctuations. In order to test this hypothesis, they used 22 years of environmental data from ECMWF to train a deep learning model for the change of TC intensity and its classification. However, it is important to emphasize that the proposed method for computation of the prediction depends solely on the visualization of the images of TC environmental parameters, avoiding the necessity to compute any TC parameter. One of the most unique features in the approach is the data augmentation proposed to tackle with the scarcity of TC samples for deep learning. Data augmentation has helped in fine-tuning of the model as well increasing its training effectiveness.

Comparisons of the statistical findings were made to show the superiority of the proposed deep neural network in predicting the changes of TC intensity. Nevertheless, it was revealed that there are problems in dealing with TCs which are in the process of rapid weakening or intensification. This research also examined how the layers within a 3D spatial structure of TCs affect the prediction of changes in intensity by assuming different levels and instantaneously predicting the mixed spatial features of 3D TC states. Hence, the contribution of each layer to intensity change prediction depends on the combination of layers used and it was not always the case that the contribution was simply added or subtracted to obtain the contribution of the other layer. This proved that it was helpful to think about distribution and compounding of 3D environmental factors in order to accurately predict changes in the intensity of TCs. Implicit relationships between joint spatial features and TC intensity changes were captured effectively by the model.

As presented in the proposed method there are further possibilities for optimization. For instance, extensive review of fine features and their variability pertain to TC intensity change may improve the forecast. As for the further research can investigate these issues and extract other fused features to expand the prediction timescales and explore other TC attributes such as lifespan. Furthermore, because this method is general and can be applied to sea regions, landfalling TCs and rapid intensification patterns of TCs, they are some of the promising and important directions for future research.

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EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# THE ECONOMIC IMPACT OF FINANCIAL TECHNOLOGIES AND INNOVATION

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**ABSTRACT**
*Recently, financial technology and innovations have had a substantial domain in the financial sector of the Ghana. This thesis investigates the short-run and long-run impacts of financial technology and innovations on Ghana's economic growth via the auto-regressive distributed lag (ARDL) approach by using quarterly data for the period 2011 and 2020. The outcome of the ARDL bounds tests shows a long-run co-integration between financial innovation and economic growth in Ghana. According to empirical results, ATM and MM have a positive effect on economic growth in the long run. Lastly the study indicates that the banking sector and network providers should spread the digital infrastructures especially ATM and mobile money outlets even in the rural areas to boost financial technology and economic growth. Again, the Bank of Ghana should formulate policies to strengthen financial technology and innovation.*

**KEYWORDS:** *Economic growth, financial technology, ARDL Financial innovation.*

## CHAPTER I
## INTRODUCTION

Fintech generally refers to the innovative ways that help financial institutions in all their transaction by enabling easier and more simple measures through which these institutions can take payments or savings, make loan facilities available, and the most common and current uses including online transactions, investments, and acquisition of all kinds of financial instruments (Higgins, 2018). For the last two decades, financial technology (fintech) and innovation has been a well-known subject in finance, economic development, international trade and in fact across the world. The interaction of traditional financial services with modern information technology which has led to fundamental changes in production has hence affected the delivery of financial services. Therefore, this study will help policymaker to understand the role of fintech and innovation with the emergence of new market players and tightening competitions since this rapid transformation in financial services has reached a level that will affect the lives of all individuals Paripunyapat and Kraiwanit (2018)

## CHAPTER II
## EVOLUTION OF FINANCIAL TECHNOLOGIES AND INNOVATION

Financial technology is greatly evolving and several definitions concerning its development exist according to various researchers. The central elements of this concept are agreed upon but its scope is not clearly defined, there is consensus that fintech relates to organizations that build financial systems and services primarily through the intensive use of information technology Azizah and Choirin (2018). In general, fintech can be traced back to 1866 where finance and technology combined to produce the first period of financial technology globally, with the first networking technology via the Trans-Atlantic transmission cable taking place on August 16, 1958. This period of fintech is termed as fintech 1.0. From 1866 to 1967, this development increasingly transformed with digital technology in the digital industry transaction like Fedwire in 1918, during the age of financial globalization, Diner's Club in 1950 and telex in telex in 1966 during the early post-war- period. Fintech 2.0 continued from 1967 until 2008 where the traditional financial services dominated the initiation period fintech 1.0 of financial technology. Innovations and technologies like ATM (Barclays), handled calculator (Texas Instrument) in 1967, BACS, CHIPS in 1968 and 1970, SWIFT in 1973, Bloomberg in 1981, Mobile phones in 1983, program trading in 1987, online banking (NBS.WF) between 1983 and 1985 where by 2001, 8 banks in the US had over one million online banking customers. The period of fintech 3.0 started from 2008. This period is the period where new startups together with established companies dominated the integration of businesses and consumers. This period enhanced the integration of startups and the already existing large companies such as the core or traditional banking vendors where innovations like Wealthfront was founded to provided automated investment services in 2008. The period saw the launch of Bitcoin to provide solutions to mobile payments in 2009, the start of reward-based crowdfunding platforms in 2009 and peer-to-peer money transfer services like Transferwise created in 2011. Currently, industry 4.0 is dominated by increased integration between virtual and physical industrial machines which give way to data gathering and analysis on a large scale not seen in the earlier periods Schlechtendahl et al. (2015). This current period of 4.0 has led to a reduction of operational cost, an increase in capital investments to startups and existing banks, industries, communities and individual innovators. Technology-wise, there is enormous smartphone penetration, extensive provision of Point of Sales (POS) and other systems that stores value accordingly.

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Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

### 2.2. Types of Financial Technologies and Innovation

#### 2.2.1. Blockchain Technology

Blockchain technology, also known as a distributed ledger technology is a virtual, digital, an unchangeable transaction ledger which replaces a central individual or authority just with algorithms. Blockchain has the potential to deliver new wave of innovation to the fintech ecosystem by providing a distributed system of exchange value which is "trustless". Even though blockchain technology has centred on the United States and Western European according the International Finance Corporation (IFC), globally, blockchain technology has impacted extensively in the reduction of transaction costs (IFC, World Bank, 2017

#### 2.2.2. Cryptocurrency

Cryptocurrencies are the digital or virtual currencies developed on blockchain technology that serves to exchange goods and services through a platform of electronic transactions without the presence of an intermediary. As of the year 2020, over 2,000 cryptocurrencies were actively in existence and being traded on various blockchains according to the World Bank fintech database. Bitcoin was the first cryptocurrency and was founded in 2009, with the first truncation occurring in 2010. Presumably, Bitcoin acts as a moderate path or way of making direct deposits or transfers, while still encouraging the unbanked in any of the standard banking institutions to set up a global bank account that will be approved and open anywhere there is internet connectivity. Despite this, Bitcoin has weaknesses as it becomes a widely accepted means of exchange, transaction, like other types of commerce.

#### 2.2.3. Crowdfunding

Crowdfunding is derived from the term crowd sourcing which describes the process of outsourcing responsivity or task to a large number of people who are often sometimes anonymous (an internet community) with the aim of drawing on their resources, expertise and knowledge. The case is crowdfunding has the basic aim to obtain money. Many individuals have described money differently but according to Lambert/Schwienbavher (2010), Crowdfunding involves an all open call importantly via the internet for the collection or gathering of funds which can either be in the form of donation thus without rewards or in exchange for some rewards as well as to support projects specific to an individual, company or a governments' project in every sector of the economy

#### 2.2.4. Mobile Money Payment

With the current increase in cell phone usage and access to internet connections, direct payments can be made from a mobile money account itself. An important part of mobile money financing is making sure that mobile devices of all types can efficiently and easily navigate through various websites and mobile applications. Mobile money transactions are gradually replacing debit and credit cards.

### 2.4. The Impacts of Fintech on the Economy

#### 2.4.1. Financial Institutions and Market

Customer Lock-In Effect: Fintech and innovation help reduce prices, through open networks where customers are connected to offer them the high value of experience which serves as an incentive for clients not to move to a different platform. Anna, (2017) asserts that there is a greater opportunity for customers to stay on one platform creating a customer lock-in effect. This help financial institution capitalizes positively to attract more consumers. With the greater number of clients, financial institutions and the financial market accumulate funds, distribute these efficiently to clients.

Quick and Cheap Financial Solutions: The World Economic Forum (WEF, 2015) report classifies the impact of fintech accordingly that, the financial market is expected to see changes in insurance, deposits, and lending, payments, retail, and SME capital raising, investment, and wealth management. De Reuver, Sørensen, and Basole, (2017) suggest that banks have been able to re-develop, re-train, recapture and implement effective solutions that were previously neglected. That is, banks with their huge investment in cutting edge technologies, the financial market provide B2B solutions, peer-to-peer (P2P) platforms for customers who are not able to attain loans and all forms of credit from the traditional financial institutions, mobile wallets, tools that help customers and banks to manage their finance, insurance (InsurTech), investment (Robo advisor).

Retail Payment Solutions: The advent of innovations and emerging non-bank companies have resulted in significant improvements in the world of alternative retail payment solutions. The increased use of smartphones globally and the internet were the major drivers of the spread of various web-based payments and online remittances. Kenya's M-Pesa mobile payment system, launched in 2007, is one of the most promising examples. M-Pesa is being used by 17.6 million people, or about 40% of the populace, and the service handled USD 31 billion in transactions in 2016, accounting for roughly half of Kenya's GDP (Safaricom 2016)..

#### 2.4.2. Economic Growth

Intermediating funds from savers to borrowers Funding opportunities: Crowdfunding especially enables the quick collection of funds from individuals all over the world, including individuals never met. With crowdfunding platforms, several individuals and startups are assisted as funds are channelled from excess parties so that economic activity can run effectively and efficiently. Again, easy access to capital and other forms of funding is proven to increase the rate of turnovers, profitability, and employment which

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generally boost aggregate expenditure thereby increasing the levels of GDP (Yong& Choi, 2019). The impact of financial technology and innovation is far-reaching. Some countries in Australia have predicted a $1 billion boost by the end of 2021 with a compounded growth rate of about 76% due to the massive impact made by crowdfunding, blockchain technologies, and smart payment and credit options available to SME's (Xiang et al, 2019).

Increase in remittances: Reduction in transaction cost simply accelerates and simplifies remittances from foreign countries to home countries which benefit to home country. The inflow of remittance enhances economic growth as domestic spending increases leading to a higher spending power as well as the economy's tax receipts and the countries balance of payment Chikako et al, 2020). In 2019 Africa received about $50-75bn only in remittances which is seen as a key factor for sustainable economic growth. The Sub Saharan Africa now leads the worlds mobile money transactions and accounts for almost 10% of GDP and fintech is expected to contribute USD 150bn to Africa's GDP by 2022 and the current Covid-19 pandemic is expected to accelerate development in financial technology and innovation in the region (Asamoah et al, 2019).

Reducing Transaction Cost: The 2016 Moody report shows that through the financial systems fintech improves economic growth by reducing transaction costs. Reduced cost of the transaction by startups, companies, and all fintech stakeholders leads to higher returns where these companies employ reducing the higher levels of unemployment. According to the IMF report, Digital financing, thus financial technology and innovation is evolving from spending to lend and all G20 nations have sought to accelerate this very trend by adopting this objective and leverage fintech to boost access to finance for MSME's as well as for youth, women and vulnerable individuals (Kwablah&Aya, 2018)

**2.4.3. Economic Development**

Efficient Credit Allocation and Distribution by Financial Institution: Through fintech and innovation, financial data is collected and thus, provides the financial status of individuals, their creditworthiness, their general habits, spending preferences. The available data gathered through the use of AI leads to the development of the appropriate platform to assist individuals per their spending habits, and their general financial statements. Robotic decisions are accepted by both stakeholders because they are made without personal emotions or the courage of experts. The AI investment network combines quantitative business approaches with big data and cloud computing to provide personalized recommendations for the asset portfolio for different classes. In addition, personal consultant advice programs are also tailored to the specific needs of customers (Deloitte, 2016).

Improved Financial Inclusion: Mulligan (2015) asserts that fintech and innovation have partnered with SMEs and deposit money banks to aid financial inclusion which is a core driver of economic development as non-cardholders, non-bank account holders deploy new payment channels to make undertake their transactions. A clear instance can be given on M-Pesa which have successfully operated on a low technology not necessarily relying on advanced smartphones but Demirguc-Kunt et al. 2018 suggest that for financial inclusion to be completely fulfilled, underpinned electricity and mobile networks is key depending on the populace technological know-how and underpinned by the necessary infrastructure.

New domestic jobs (employment) Entrepreneurship Skill Development and extension of the pool of talent - Large fintech firms like PayPal contribute largely to the provision of employment. According to the PayPal (2020) Global Impact PayPal reports, it asserts that there are over 23,200 employees mostly with higher income. Also, in Indonesia fintech has employed 215,433 people into the workforce to increase labor income from salaries and wages amounting to Rp4.56 trillion (Adhinegara et al., 2018). Again, according to the UK FinTech State of the Nation (2019), the fintech sector employs about 75,000 workers across 1600 firms, and again over 10 billion EUR support indirect economic. With the innovativeness of the sector, talent is nurtured in these technological areas, especially in the field of finance and engineering providing an opportunity to grow the skill base in digital banking, cryptocurrency, smart contracts to sustain economic development.

Health: Digital payment and transaction most importantly health-wise prevented the spread of the virus in the Covid-19 pandemic era by encouraging virtual and remote transactions as a means of distributing funds, remittances to households and firms. In addition, substantial remittances from foreign countries cushions falling domestic incomes (Malmendier, 2009). Therefore, measures to educate, nudge and push consumers to embrace fintech and innovation are likely to accelerate economic development (Ratna Sahay et al, 2020).

**2.4.4. International Trade and Finance**

Reduction in The Volume of Documents: Fintech does help reduce both the volume of documents and thus the flow of documents in trade transactions are streamlined. Digitalized form of trade compared to the traditional form of trade is more transparent since all transactions are kept on a blockchain with a great sense of security due to the real-time visibility of transactions. The systematic and increased structural and documentary efficiencies are key for importers and exporters to efficiently carry out trade with reduced risks and issues of fraud as well double-spending issues with mostly a deterrent to trade but transpire positively on economic growth (Hilbert, 2016)

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Multi-Currency Trade: In history, the option of multi-currency trade was only available to large multinational companies which had an international network with extremely high charges but the current fintech innovation have developed platforms that support multi-currency which serve as a great option even for smaller companies. This same enhance trade and investment growth locally and internationally (Bhattacharya, 2021). Thus, the era where traders would have to open a foreign bank account is over which was both expensive and time-consuming. The trader can now move their money from one currency to another at a reasonable charge and less or no hassle compared to the old international banking regulations in the past (Jeremy, 2018).

Digitization of Trade: The modern blockchain platform offers the opportunity to increase the protection and transaction volume between sellers and buyers while reducing the associated banking costs. Several fintech companies have used these approaches and are committed to the long-term goal of building a global paperless business environment. For these returns to be available to global merchants, all actors in the supply chain must accept this acceptance at a time when they all support as a step towards this cashless future (Luc Soete, 1987). traditionally, export and import appear to be time-consuming and hectic due to the bottlenecks surrounding the long list of clearance and payments. It takes at least ten working days to complete a process in the traditional bank trade finance on the normal which can even surpass depending on the geographical and persisting economic situation in a particular country. On the contrary, the incorporation of fintech in international trade greatly reduces the time, reduce the cost incurred with drastically few steps involved (Kher & Xu, 2017)

## CHAPTER III

## THE IMPACT OF FINANCIAL TECHNOLOGIES AND INNOVATION ON ECONOMIC GROWTH: THE CASE OF GHANA

### 3.1. Literature Review

Financial technology (fintech) has been one of the most important discoveries in the financial industry over the years, and it has been developed at a quicker speed with its backbone being information technology and favorable regulations (Lee et al 2018). Even though fintech has been around for a while, Brandle and Hornuf (2017) believes that, existing financial institutions that have been around for a long time are slowly but increasingly embracing modern technical technologies. While a large portion of fintech is still autonomous and operates independently, several banks are heavily interested in fintech and have taken the opportunity to acquire fintech companies (Brandle et al 2017).

**Table 1.**

***Empirical review showing the impact of fintech on economic growth***

| Title | Writer | Objective | Method | Outcome |
|---|---|---|---|---|
| Mobile financial services and financial inclusion: Is it a boon for savings mobilization , 2017 | Shem Alfred Ouma, Teresa Maureen and Muareen Were | To find the impact of mobile money adoption on financial system | Ordinary Least square regression model | Positive effect on economic growth |
| Impact of digital finance on financial inclusion and growth 2018 | Peterson K. Ozili | To examine the impacts of digital finance on growth | Ordinary Least square regression model | Positive impact on economic growth |
| Emerging financial technological innovation and economic growth in Nigeria, 2019 | Okoye Victor, Nwisienyi, Kenechukwu J., Obi Onyeka A | To estimate the relationship between financial technology innovation and Nigerian economy | ARDL error correction methodology | Positive on economic growth |
| Financial innovation and economic growth: Evidence from Zimbabwe, 2016 | Alex Bara, Calvin Mudzingiri | To establishes the causal relationship between financial innovation and economic growth in Zimbabwe | Autoregressive Distributed Lag (ARDL) and Granger causality test | Bi-directional causality also exists after conditionally netting-off financial development |
| Financial Sector Innovation and Economic Growth in the Context of Botswana(2013) | Hasan, Renzi and Schmiedel | To estimated the relationship between retail payment (technological innovation) and the real economy for 27 EU countries | GMM | The study concluded that there is a positive relationship economic growth and technological innovation. |

### 3.2. Data and Variables

The purpose of this study is to examine how financial technology (Fintech) influences economic growth. In this study, quarterly time –series data from 2011 to 2020 for Ghana was used. The sources of data include the Ghana Statistical service and the Bank of

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Ghana database. An ARDL approach was used to estimate the result in chapter four. GDP is used as a dependent variable, thus economic growth (Beck & Levine, 2004; Beck, Levine, & Loayza, 2000; Ehigiamusoe & Lean, 2018) with a yearly data between 2011 and 2020. The independent variables for financial technology and innovation are E-zwich (biometric payment system), National switch (Gh-link) transaction, Mobile Money transaction, and Automated Teller Machine were used to direct the selection of these variables Okoye (2019), Motsatsi (2016), and Mwinzi (2013). This study will adopt the ARDL approach to estimate the long run and short run parameters of equation (1) and thus the model specification for this approach is as follow:

Y = MM, GHP, ATM (1)

Where Y is Economic Growth, MM, is Mobile Money, ATM is Automated Teller Machine and Point of Sale and GHP is Gh-link and E-Zwich. After transforming Eq. (1) into a linear form, it can be represented as follows:

$$lnY_t = \beta_1 lnMM_t + \beta_2 lnGHP_t + \beta_3 lnATM_t + \epsilon t \quad (2)$$

Where Y is Economic Growth, MM, is Mobile Money transaction, GHP represents total E-zwich and Gh-link transaction ATM for total ATM and POS transaction. The model above has got coefficients, β1 to β3 representing long-run elasticity, and ϵt is also termed as the error correction term. Nevertheless, Eq. (2) can only characterize the long-run effect on economic growth from an independent variable. A cointegration test is used to determine the model's long-run cointegration and short-run elasticities. Several cointegration experiments and methods have been used in recent decades, including Johansen and Juselius (1990), Johansen (1998, 1991, 1995), Engle and Granger (1987), and Johansen (1998, 1991, 1995), both of which are based on residuals and use maximum probability test approaches. Previous models have limitations in terms of the order in which variables were integrated. Pesaran and Shin (1998) proposed a new cointegration model with greater traceability and flexibility in the vector integration order I (0) and/or I (0). Pesaran et al. (2001) and Narayan (2001) expanded on this idea (2004). Furthermore, by a linear transformation, the error correction expression may be a derivative of ARDL. As a result, Eq. (2) can be rewritten in ARDL form as follows:

$$\Delta lnY_t = \alpha_0 + \sum_{i=1}^{n} \mu_1 \Delta lnY_{t-i} + \sum_{i=0}^{n} \mu_2 \Delta lnMM_{t-1} + \sum_{i=0}^{n} \mu_3 \Delta lnGHP_{t-1} + \sum_{i=0}^{n} \mu_4 \Delta lnATM_{t-1} + \gamma_0 lnY_{t-1}$$

3)

where Δ is the first difference sign, and the coefficients are represented from μ1 to Additionally, α0 stands for the constant term. The comparison between the essential value and the f-statistic is used to decide if the theory should be accepted or rejected. To make a definitive argument about cointegration, researchers used the essential value suggested by Narayan (2004), and Narayan and Narayan (2005). If the f-statistic is above the upper limit of the critical value, it indicates that the variables in question have a high prevalence of long-run relationships.

Finally, in the case of Eq. (3), the coefficients designated from μ1 to μ4 indicate short-run elasticities, and the coefficients of γ0 to γ4 indicate long-run elasticities in the model.

## CHAPTER IV
## RESULTS

### 4.1. Descriptive Statistics

**Table 2.**
***Descriptive Statistics***

| | LNY | LNMM | LNGHP | LNATM |
|---|---|---|---|---|
| Mean | 24.21743 | 10.91646 | 14.52183 | 9.789796 |
| Median | 24.20782 | 10.96702 | 14.60309 | 9.796704 |
| Maximum | 24.48790 | 12.05043 | 15.33266 | 10.53074 |
| Minimum | 23.81869 | 9.875993 | 13.52968 | 8.886962 |
| Std. Dev. | 0.170685 | 0.633530 | 0.589883 | 0.519861 |
| Skewness | -0.490637 | -0.035345 | -0.217946 | -0.155645 |
| Kurtosis | 2.784692 | 1.702818 | 1.566786 | 1.565086 |

Note: LNY=log(GDP) LNMM= log (Mobile money) LNGHP= log (Gh-link and E-zwich) LNATM= log (Automated Teller Machine and POS)

For the research period, the aggregate average mean of GDP was 24.21, for mobile money was 10.91, GHP was 14.52, and 9.78 for Automated Teller Machines. The least and highest values of all the variables are illustrated by the minimum and maximum values shown. The symmetrical normal distribution of the variables also shows that all the variables were negatively skewed. The probability value of Jarque-Bera established that all the variables are normally distributed. the lag selection criteria where the AIC was used at fixed lag of 5 for the model.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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**Table 3.**
***VAR Lag Order Selection Criteria***

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | 123.9580 | NA | 1.24e-08 | -6.854742 | -6.676988 | -6.793382 |
| 1 | 261.7887 | 236.2812 | 1.18e-11 | -13.81650 | -12.92773* | -13.50969* |
| 2 | 275.0755 | 19.74035 | 1.44e-11 | -13.66146 | -12.06167 | -13.10921 |
| 3 | 287.1911 | 15.23103 | 1.99e-11 | -13.43949 | -11.12869 | -12.64180 |
| 4 | 303.6536 | 16.93292 | 2.38e-11 | -13.46592 | -10.44410 | -12.42279 |
| 5 | 342.2837 | 30.90406* | 9.64e-12* | -14.75907* | -11.02623 | -13.47050 |

**4.2. Unit root tests**

The prerequisites for the application of ARDL are that all regressors must either be I (0) or I (1). So, before the ARDL model estimation, ADF unit root test are applied to find out the existence of stationarity properties in the sequence. The appropriate lag is selected according to the AIC criterion. In all variables, the maximum lag is taken as 5.

**Table 4.**
***Unit Root Tests***

| | **Level** | | | **First Difference** | | |
|---|---|---|---|---|---|---|
| | **Trend and constant** | **Constant** | **None** | **Constant** | **None** | |
| lny | -2.80 | 0.29 | 1.79 | -2.75* | -2.26** | I(1) |
| lnmm | -2.08 | 0.05 | 5.04 | -5.85*** | -1.11 | I(1) |
| lnghp | -1.56 | -109 | 4.60 | -6.22*** | -4.33*** | I(1) |
| lnatm | -1.33 | -0.95 | 5.68 | -6.23*** | -1.75* | I(1) |

*Note:* *** significance at 1% level; ** significance at 5% level; * significance at 10% level.

**4.3.1. ARDL Bounds test**

The study uses the ARDL model cointegration approach by y Pasaran and Shin (1999), with was used to determine the long run relationship variables as shown in equation (2). ARDL method has widely been acceptable since it has numerous significant advantages like being applicable to all regardless of series I (0), I (1), or variables that are mutually cointegrated (Oskooee, & Oyolola, 2007). Secondly, the ARDL approach can obtain comprehensive group of lags. It is notably known for its common-to-particular technique. When economic growth (Y) is used as the dependent variable, the F-statistics F= 11.824, which is greater than the 1 percent threshold of importance value which exceeded the corresponding upper bound at the 1% significant level. F-statistics had no serial correlation at orders 1 and 5, respectively. '*', '**' and '***' denote significance at 0.01, 0.05 and 0.10 levels, respectively. We can see that the best model with no serial correlation problem is the one that uses 1 lag lengths for the ARDL equation.

**Table 5.**
***Bounds Test Results***

| Test Statistic | Value | Signif. | I(0) | I(1) |
|---|---|---|---|---|
| F-statistic | 11.824 | 10% | 2.37 | 3.2 |
| | | 5% | 2.79 | 3.67 |
| | | 1% | 3.65 | 4.66 |

Note: No serial correlation '*', '**' and '***' denote significance at 0.01, 0.05 and 0.10 levels, respectively

**4.3.2. The Short-run and Long-run estimation**

MM and ATM were all statistically significant at 10% significance level and GHP at a 5% level. Specifically, a 1% increase in Mobile money transaction and ATM together with PoS increases economic growth by 0.65% and 0.77% respectively. Contrarily, a 1% increase GHP, decrease economic growth by 1.16%. Therefore, we need Gh-mobile money and ATM for economic growth. For any policy design to enhance economic growth, the variables must be incorporated. Since quarterly data were used, the maximum number of lags in the ARDL was set equal to 5 which was decided on the basis of AIC criterion. '*', '**', and '***' denotes that the variable is of stationary form.

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**Table 6.**
***Long Run Results***

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LNMM | 0.655872* | 0.223844 | 2.930047 | 0.0126 |
| LNGHP | -1.164969** | 0.307579 | -3.787546 | 0.0026 |
| LNATM | 0.770372* | 0.298157 | 2.583781 | 0.0239 |
| C | 26.60554 | 1.170166 | 22.73654 | 0.0000 |

*Note:* *** significance at 1% level; ** significance at 5% level; * significance at 10% level.
This implies that MM, ATM, GHP were statistically significant in the long run where ATM and MM had a positive impact on economic growth, and GHP a negative effect. The error correction term -0.43 is statistically significant at the 1% level with a negative coefficient using the AIC criteria.

**Table 7.**
***Estimated short run coefficient using the ARDL approach***

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNY(-1)) | -0.230216 | 0.112893 | -2.039235 | 0.0641 |
| D(LNY(-2)) | -0.421398 | 0.094631 | -4.453061 | 0.0008 |
| D(LNY(-3)) | -0.217266 | 0.083500 | -2.602002 | 0.0231 |
| D(LNY(-4)) | -0.299400 | 0.085526 | -3.500695 | 0.0044 |
| D(LNMM) | 0.059408 | 0.027511 | 2.159397 | 0.0518 |
| D(LNMM(-1)) | -0.171178 | 0.035023 | -4.887577 | 0.0004 |
| D(LNMM(-2)) | -0.091229 | 0.044250 | -2.061695 | 0.0616 |
| D(LNMM(-3)) | -0.130618 | 0.040234 | -3.246459 | 0.0070 |
| D(LNMM(-4)) | -0.064663 | 0.041670 | -1.551799 | 0.1467 |
| D(LNGHP) | -0.057691 | 0.033052 | -1.745475 | 0.1064 |
| D(LNGHP(-1)) | 0.324979 | 0.042175 | 7.705527 | 0.0000 |
| D(LNGHP(-2)) | 0.281588 | 0.040598 | 6.936058 | 0.0000 |
| D(LNGHP(-3)) | 0.166264 | 0.041203 | 4.035249 | 0.0017 |
| D(LNATM) | 0.019608 | 0.048189 | 0.406909 | 0.6912 |
| D(LNATM(-1)) | -0.311219 | 0.060041 | -5.183421 | 0.0002 |
| D(LNATM(-2)) | -0.322509 | 0.052637 | -6.126976 | 0.0001 |
| D(LNATM(-3)) | -0.215345 | 0.063955 | -3.367148 | 0.0056 |
| D(LNATM(-4)) | -0.250472 | 0.055015 | -4.552803 | 0.0007 |
| CointEq(-1)* | -0.430948 | 0.047862 | -9.003917 | 0.0000 |

Note: ***, ** and * denote level of significance at 1%, 5% and 10% respectively.
ECT: Error Correction Model

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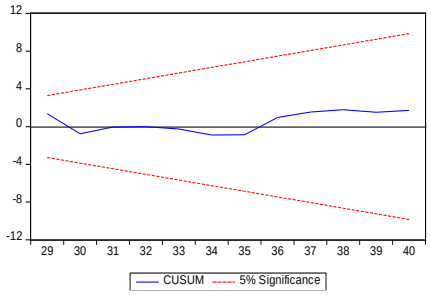
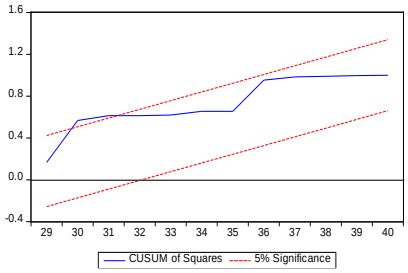
**Table 8.**
***Diagnostic Table***

| Diagnostic Test | P-value (P) | stats | Sig. (S) | Null Hypothesis (H0) | Decision Criteria | Result |
|---|---|---|---|---|---|---|
| LM Test | 0.4457 | 1.080 | 0.05 | No Serial Correlation | Reject H0 if P<S | No Serial Correlation |
| ARCH | 0.8889 | 0.020 | 0.05 | No Heteroscedasticity | Reject H0 if P<S | No Heteroscedasticity |
| J-B Normality Test | 0.3112 | 2.33 | 0.05 | Normally distributed | Reject H0 if P<S | Normally Distributed. |
| CUSUM | | | | | | Model is Stable |
| CUSUMSQ | | | | | | Model is Stable |
| RR | 0.871648 | | 0.05 | Does not suffer from omitted variables | | |

From the Table 8, the diagnostic test results are presented. It shows clearly that the estimated ARDL model is free from the above mentioned econometrics problems since the probability values are greater than 0.05. Additionally, the result is also not spurious which is confirmed by the negative and statistically significant error correction term and the existence of long term cointegration. Thus, the cointegration equation does not exhibit serious deviation from the mode as mention by Pesaran (1974). The CUSUM and CUSUMSQ test also verified the model structure and F-statistics, demonstrating the model's precision and certainty in prediction. Finally, the modified R-squared revealed the model's potential to describe variance; the proposed model for Ghana could explain 87 percent of the variance.




## CHAPTER V
## CONCLUSION AND POLICY RECOMMENDATION

The bounds tests revealed long-run cointegration between financial technology and innovation and Ghana's economic growth. Beck et al. (2014), Mwinzi (2014), Qamruzzaman, and Jianguo (2014) all agree with the findings. In the case of MM and ATM, there was a positive effect on economic growth due to the low commission charge and less cost of transaction. Government workers and pensioners in the rural areas especially benefit extremely due to its reliability but dwellers have got low service paid jobs thus, low wages and salaries. Supermarkets, stores, and companies started accepting ATM cards for payment with less ease and high efficiency. International trade and intra-national trade were smoothly enhanced in the minimum amount of time. Ghana's economy has progressed financially over the last ten years as a result of the introduction of enhanced and advanced financial assets and services through financial innovation. Financial innovation, according to Merton (1992), is the catalyst that drives financial processes to improve the efficiency of real economies for a more bearable and prosperous future. Therefore, commission and high-interest rate charges should not be set by telecommunication firms to allow individuals to use mobile money accounts for education, transport, and even remittances which allows foreigners or nationals residing in foreign countries to send funds to the wards and relatives in Ghana.

Financial technology and innovation, according to Chou and Chin (2011), raises the amount of financial product variability while also promoting well-organized financial markets, resulting in financial development-led economic growth.

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SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# UNTYING THE THREAD OF INNOVATION: CHALLENGES AND PROSPECTS FOR NIGERIA'S TEXTILE ARTS

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**Article DOI:** https://doi.org/10.36713/epra18126
**DOI No: 10.36713/epra18126**

**ABSTRACT**
*Nigeria's textile arts scene is a vibrant tapestry of creativity, rich cultural heritage, and untapped potential. Textile arts is one of the solutions to the development of any nation. Despite its significance, the production faces numerous challenges that hinder innovation and growth. This article explores the obstacles and opportunities for innovation in textile arts in Nigeria, examining the current state, challenges, and prospects for future development. The study adopts multiple methods of research design such as literature review, case studies, expert interviews and discussions, observational studies to gather enough data with content analysis, and qualitative methods to analyze the data. Some challenges include lack of modernization and technology, brain drain and skills gap, lack of adequate raw materials, etc. In contrast, the ideas for innovation include, the revitalization of Adire and batik training programs and workshops, digital printing and design, etc. This will eventually lead to innovation for the nation's building helping the graduates to be self-employed and also employers of labour. Findings reveal that there are still opportunities for improvement in the sector if the right strategies are implemented.*
**KEYWORDS:** *innovation, challenges, textile arts, prospects, textile industry.*

## INTRODUCTION

The term "textile" is derived from the Latin word '*textillis'* which means 'woven fabric'. So the word "textile" encompasses materials used to make fabrics themselves. It is an art form using textile materials and fibers as its medium to produce decorative and artistic objects. It includes fiber art, knitwear, woven fabric, and embroidery, and it ranges from the representation of images and figures to abstract shapes and patterns.

Textile is very important to human sustenance and, the sociocultural and economic growth of any nation (Gompil, 2004), flourishing at both cottage and industrial levels. Even though textile industries are major employers of labor in the manufacturing sector which contribute immensely to the development of any nation (Owen, et. al. (2016; Business Day, 2016), is facing numerous challenges that have led to a decline in its contributions to foreign exchange earnings and generation of employment.

Textile arts in Nigeria such as *Adire*, *Ukara*, *Aso-oke*, *Akwete*, *Aniocha,* and Hausa weaving, embroidery, and applique (Onifade, 2018), are rich and diverse. But today, the industry is struggling to survive due to some factors causing their decline. These factors include; inadequate power supply, inconsistent government policies, smuggling of foreign textiles, and insecurity (Diogu et.al 2014; Textalks.com, 2024). Even with all the efforts to revive the sector through economic policy and monetary intervention, the industry remains hostile to the textile sector (Owen, et.al. 2016). The textile sector is fundamental to the nation's economic growth and development and also a cornerstone upon which the basis for viable industrialization is built (Murat and Yagmur (2018).

The Nigerian textile industry is a vibrant sector that has been woven into the fabric of the country's culture and heritage for centuries, ranging from the intricate patterns of *Adire* and Batik to the bold and vibrant colours of Ankara. Nigerian textiles are a testament to the creativity and ingenuity of the nation's artisans. There is a large local market in Nigeria of over 200 million, therefore making it more interesting to promote made-in-Nigeria textile goods. The textile industry in Nigeria encompasses the fabric value chain with a robust potential for development because of the readily available cotton as raw materials to be used.

Presently, the industry of Nigeria's textile arts has traditional craftsmanship and cultural significance whereby skills are passed down from one generation to the other within a specific cultural or community context to create handmade products among which is textiles. The skills are learned through, apprenticeship and mentorship. The cultural significance thus refers to meanings and traditions attached

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
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to these crafts within a particular culture or community which has probably a spiritual or symbolic implication. Mostly, they carry deep cultural meaning, connecting the people to their heritage and their forefathers.

Also, there is inadequate integration of new technologies, machinery, and production methods in the textile arts (Odey, et.al 2018) thereby resulting in, inefficient production processes, reduced competitiveness in the global market, and difficulties in meeting modern quality and safety standards due to some factors like limited awareness and understanding of new technologies, lack of access to funding, lack of sufficient education, among others. Most textile arts sectors are not registered nor licensed, therefore, they have limited access to government support and resources, and the growth in innovation and productivity will be limited.

In Nigeria today, most skilled workers and highly educated individuals have relocated out of Nigeria for greener pastures. Therefore, there is a loss of talent, expertise, and knowledge (Chinnah, 2018), and this results in a shortage of skilled workers in the textile sector. This also reduces Nigeria's economic growth, innovation, and productivity.

Ahmed (2017) reiterated that the lack of sufficient resources, facilities, and financial support for textile arts sectors hurts economic growth and development. For example, most textile industries that are in existence currently in Nigeria lack modern machinery and equipment to make adequate designs on the fabrics, the textile supply chain management lacks adequate transportation and logistics, and more also, there is a high cost of electricity supply, thereby making production to be difficult.

## STATEMENT OF THE PROBLEMS

The textile arts industry in Nigeria has a very long and rich history, but in recent years, it has faced various challenges. But better still, there are bright opportunities for its growth if the right steps are taken adequately. This will make the once vibrant industry in the years past become lively again and maintain stability. Little or less strategy has been made to revive the sector and put it back on its feet again. Records of the strategies to follow will be in the annals of Nigeria's textile arts histories which will eventually be of help to both the sector and the nation's economy at large, thereby making the Gross Domestic Product (GDP) increased with its vibrancy, production, and exportation. Fernando (2024) buttressed that the function of GDP is a comprehensive scorecard of a given country's economic health. This, in turn, will build entrepreneurial ideas in the hearts of every individual in Nigeria, building the spirit of innovation to become self-employed and also the employer of labour.

Also, production and sales of traditional textiles are declining due to intense competition from imported fabrics. This is leading to some other challenges facing the country in general. The few available ones have limited market access and poor distribution channels, and this is leading to high costs in production and low-profit margins. Because there is a loss of jobs and no hope of getting new ones makes majority of the skilled artisans migrate to other countries for better living and job opportunities. These and many others need to be addressed to revive and sustain the textile arts industry in Nigeria.

## THE STUDY AND ITS AIM

The study is about unraveling the thread of innovation and bringing out the challenges and prospects of textile arts in Nigeria aiming at examining the current state of the textile arts industry both local and industrial. Nigeria's textiles are rich and it is woven into the heritage, and culture of Nigeria in general. The fabrics have bright colours and bold designs making the textiles to be unique in Nigeria and identifying the challenges facing the industry which include, inadequate infrastructure, funding, and technology with the objectives of exploring the prospects for innovation and growth in the industry and developing strategies for addressing the challenges and promoting sustainable development in the textile arts sector in Nigeria.

## LITERATURE REVIEW

Textile production has played a major role in the Nigerian economy (Odey, et.al. 2018) and it has contributed immensely to the employment and growth of its economy by creating thousands and indirect jobs for Nigerians (Emeh, 2012 and Afuye, 2014), but after some time, the sector began to decline leading to the closure of the industry one after the other for various reasons.

Textile design is an applied art that centers on designing and making clothes and dresses for covering the body (Ganagana 2014; Sampson, 2016) and expressing people's identity (Onabrakpeya, 2009; Cyril-Egquare, 2013), while Chinnah, 2018, 2021) gave various classification of entrepreneurs among which is an innovative entrepreneur which introduces new goods and ideas, new technology and new methods to reorganize the enterprise for good with a certain level of economic development.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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The textile arts industry is believed to have had its problems since its inception around the 1920s when only the expatriates were taught the secrets of the techniques and technological workings and operations of the industry, keeping away the Nigerians from the rudiments and techniques of the workings (Alimi and Ahmed, 2017), thereby making the Nigerians crawl in achieving the desired goals in textile arts. All these researchers have yet to untie the threads of innovation.

## METHODOLOGY

Multiple methods will be combined to validate findings, increase reliability, and provide a comprehensive understanding of the research topic. This will provide a rich and comprehensive understanding of the challenges and prospects for textile arts in Nigeria, and identify strategies for untying the threads of innovation in the industry. Firstly, a comprehensive review of existing literature on textile arts and Nigeria's textile industry shall be used to identify gaps and trends. There will also be an in-depth analysis of art studios and textile art industries or companies to gain insight into innovation strategies and challenges. Unstructured interviews will be conducted with the experts in textile arts, innovation, and industry development to gather expert opinions and insights. The researcher will jot down notes while observing textile artists, designers, and industry stakeholders to gather data on textile art production, design, and innovation processes. There will be unstructured interviews and discussions with randomly selected textile artists and the textile industry about their products and marketing ideas to identify the trends and challenges while a qualitative method will be used to identify the insights from interviews and discussions conducted with the artists and industry for proper analysis.

## RESULTS AND DISCUSSION

### *Untying the threads of innovation in Nigeria*

Untying the threads is to disentangle the complex and intricate elements that comprise innovation that is, breaking or removing the bonds that hold the threads together, while the threads symbolize the strands that make up the fabric of innovation to create new ideas. The constraints limiting the flow of innovation and creativity need to be broken and separated to liberate the creative potential that drives innovation. In light of this, it requires a multi-faceted approach to untie the treads of innovation in Nigeria as some strategies are considered. The challenges must be addressed and an enabling environment must be created. The first is to understand the root cause of the stagnation such as funding, inadequate infrastructure, and skills gap. The use of technology in the textile industry sector will greatly improve the efficiency and effectiveness of services (Udodi, 2013, Isioto, et.al, 2017). Encouragement should be given to reform policies that support innovation, entrepreneurship, and industrial development. Encouragement should be given for the use of modern machines, digital tools, e-commerce, and technology to enhance productivity (Diyaolu and Akarakiri (2018).

Fostering the culture of innovation is also paramount for industrial growth (Iwelunmor, (2020). Experimentation, risk-taking, and creativity of the textile arts be encouraged to support the development and implementation of new ideas. Innovative achievements should be recognized and celebrated, especially through awards given and funding opportunities to those who deserve it. Many are outside with a lot of good innovative achievements but yet to be recognized. These should be taken into consideration to serve as incentives to others. Both local and foreign investors need to be encouraged to support innovation and industrial growth.

Lack of reliable energy creating setbacks needs to be dealt with. Infrastructure must be developed, whereby access to reliable energy, water, and transportation networks should be improved. The implementation of these strategies will help Nigeria to untie the threads of innovation and unlock its full potential for economic growth and development, especially in Nigeria's textile arts.

There is also the need to foster a culture of continuous improvement that encourages and supports ongoing growth, development, and progress. This culture is built on the belief that there is room for improvement having it in mind that learning is a lifelong process. With this, employees' engagement and retention will be enhanced, their skills will be increased, the workforce will be more agile, creativity will be stimulated, the organization will be stronger, and long-term success and sustainability will be achieved.

### Challenges of Textile Arts in Nigeria

Many factors are responsible for deterring the growth and development of the textile arts industry in Nigeria, among which are:

- *Inadequate raw materials:* Production became very low since there are low supply of raw materials to use. The major raw material needed in the textile arts industry among others is cotton (Diogu, et.al, 2014). The textile industry that could not get a ready and continuous supply of cotton will eventually close down due to a lack of raw materials. Importation of cotton from other countries then becomes too costly for the citizens to patronize. Therefore, low patronage leads to downsizing the workforce, and this also leads to unemployment.
- *Limited funding:* Textile production, be it local or industrial, is capital-intensive (Odey, et.al, 2018). Lack of securing adequate funding makes the industry suffer setbacks for smooth running. Most textile mills could not access bank loans for smooth

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running. Chinnah, 2021) buttressed this that few textile industries were given bail-out funds for operation. The fund if well utilized could be of help in their deficiency.

- *Inadequate infrastructure:* Some major infrastructure needed for the smooth running of the textile industry are good and adequate supply of electricity, water, and road access (Maiyaki, 2013). Electricity supply in Nigeria is a serious problem. There is a poor and epileptic power supply. The power sector has failed to provide adequate supply of energy to the industry. Water is also a challenge militating against the growth of the textile arts industry. Lack of electricity is affecting the water supply. Unless the power sector rises to the challenge, the problem of the textile arts industry will persist in this.
- *Insecurity:* The textile arts industry is also affected by the challenge of insecurity that has ravaged Nigeria (Eyinade et.al, 2022). No one is safe in any part of the country. Lack of security has made many workers leave their jobs, thereby leading to the closure of some plants.
- *Government policies:* Some of the government policies are not favorable to the textile industry. There was inconsistency in the government policies leading to the smuggling of textile wear into the country (Egenuka, 2022). This took place between the 1990s and 2000 when the government lifted the ban on the importation of textiles and the textile trade was fully liberalized during the regime of the then-military government led by Major General Sanni Abacha.
- As vast as the textile industry was in the early 1990s, it became sick at a time as there were crises almost everywhere in the sector. The environment became hostile to the industry, the industries were having one issue or the other, and thereby, there was closure of the industries one after the other. The workers were thrown out and became unemployed. The industry that had the largest number of employees of labor in the manufacturing sector and reducing poverty now become the sector that is critically sick and needs help lifting from the government (Inyang, 2016). This sector was a one-time giant, but now, a sleeping giant that could still wake up and become great again.
- Some of the moribund textile industries include NSF diamond Spinners, Aswani Textiles, Royal Spinners, Mayfair, Texlon, etc (Owen, et.al, 2016)Between the 1990s and early 2000, some factories closed down and workers of 100,000 were laid off (Olumide, 2015) due to unfriendly economic and political environment, smuggling and importation of textile wear among others.
- *Competition from foreign textiles:* Another major challenge faced by the Nigerian textile industry is the influx of foreign or imported textiles into the domestic market. These imported textiles most of the time have a competitive advantage over locally produced textiles (Aminu, 2018). This is making it difficult for Nigerian textile manufacturers to compete with them. This is possible due to the lower cost of production from foreign textiles, they have advanced technology and machinery making their products to be of higher quality. The quantities produced are vast making it cheaper, their government usually provides subsidies to their textile industries, thereby, it will be difficult for manufacturers in Nigeria to compete, and always attractive to consumers due to their perceived quality, design, and affordability. The competition from imported textiles has led to threats to Nigeria's cultural heritage and traditional textile industries, there is a decline in domestic textile production, in that, many of the local textile mills have closed down, leading to the loss of jobs and livelihoods.
- Lack of retraining the textile designers: The textile designers need to attend workshops, seminars or training and retraining programs in the relevant areas to be exposed to new techniques in textile designs. Many employers do not send their workers for these training programs thereby making them to be outdated in creating current designs that will catch the attention of the consumers. Onwuakpa (2023) buttressed this that since computer-aided design is very much a significant thing in this century, then, there is a need for continual updates of innovative and technical abilities by textile artists to key into the benefits of the available technologies.

**Prospects of Nigeria's Textile Arts**

The textile industry can generate revenue and sustain the economy of a nation. It is capable of contributing to human capacity development if the strategy is well implemented. Nigeria has a large population that could be of help to the manufacturing sector. Since there is a huge population, the consumers are readily available for the consumption of the products. The labor force, if well strategized, will make the production to be cheaper.

- *Digitalization and technology:* This refers to the integration of digital tools, systems, and platforms to transform and improve the textile arts industry in Nigeria, such as digital design and printing, e-commerce and online marketplaces, digital marketing and social media, automation and manufacturing technology, digital payment systems, online training and education, supply chain management, etc. The textile arts industry can increase productivity, and innovation, as well as reach new markets and customers.
- *Government initiatives and policy support:* The textile arts industry in Nigeria should embrace the government initiatives policy and support, though not yet successful, soon, it will revive the industry.

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- *Private sector investment and partnership:* There is a need for individuals and private organizations to collaborate with the textile industry which can equally include financial investment, joint ventures, market access, infrastructure development, etc. This involvement brings in enough capital, capability, and resources to revitalize the Nigerian textile industry and also promote economic growth and equally create job opportunities.
- *Education and skills development programs:* There should be initiatives aimed at training and retraining individuals to enhance their skills and competencies in the textile industry. The programs can include vocational training, workshops and seminars, apprenticeships, capacity buildings for artisans, online courses, internships, training programs for established professionals, etc. All these programs can improve productivity and increase innovation/
- *Cultural exchange and international collaborations:* The sharing of ideas is very important to promote cooperation, growth, and innovation in the textile industry. There should be best practices between individuals, organizations, and countries to promote mutual understanding, learning, and cooperation in the textile industry, involving international workshops and conferences, study tours and internships, international mentorship, research partnerships, etc. This can introduce new ideas and techniques, expand global market access, and also promote cultural understanding which enriches the textile industry.
- *E-commerce and online marketplaces:* Examples of online marketplaces include Jumia, Konga, Jiji Slot, PayPorte, and lots more. All these allow users to buy and sell products which can be useful for textile products for buyers and sellers at affordable prices.
- *Sustainable and eco-friendly practices:* Environmental responsibility and socially conscious methods are needed in the textile production process. The process is from sourcing raw materials to end-product disposal aiming at promoting social accountability which includes the usage of organic cotton, the usage of eco-friendly dyes and treatments, and reducing waste, pollution, and emissions through proper disposal and recycling.

## CONCLUSION

Nigeria's textile arts industry is poised for innovation and growth, despite the challenges. By embracing technology, education, and international collaboration, the industry can unlock its full potential. To revitalize the industry, it is essential to adopt sustainable and eco-friendly practices, invest in education and skills development, and leverage technology and innovation. Policymakers, private sector investors, and stakeholders must work together to create an enabling environment for innovation, and ensure the preservation of cultural heritage and promotion of sustainable development in Nigeria's textile arts sector. By addressing the challenges and seizing the opportunities, Nigeria's textile arts industry can thrive, contributing to the country's economic growth, cultural preservation, and global recognition.

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EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# ADVANCED MACHINE LEARNING FOR PREDICTIVE MODELING FOR ASTHMA RISK FACTORS :COMPARATIVE STUDIES AND ANALYSIS

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**Article DOI:** https://doi.org/10.36713/epra18117
**DOI No: 10.36713/epra18117**

**ABSTRACT**

*Asthma is a chronic and multifactorial respiratory disease that depends on the patient's genetic make-up, the internal environment in the body and the external environment within which the patient exists. These complex influences are explored in this project by employing a large number of patients' records, 2,392. It consists of numerous demographic characteristics, lifestyles (tobacco use and exercise), environmental conditions (pollution and irritants), past medical history (asthma in first-degree relatives and allergies), physical examination (spirometry), and symptoms (wheezing, breathlessness). Some of the crucial goals of the present work are to determine the factors that would impact the prevalence of Gastroesophageal Reflux and Smoking status among patients with asthma. It involves data cleaning by dealing with the missing values and categorical variables, and feature scaling by using z-score to deal with outliers. The SMOTE algorithm is used on the dataset to cope with the problem of class imbalance.*

*Logistic Regression, Decision Trees, KNN, AdaBoost, and NB algorithms are used to forecast the target variables. There are a lot of evaluation matrices such as accuracy, precision, recall, F1 measure, Receiver Operating Characteristic (ROC) Area Under the Curve, and many more to evaluate the model. ROC curves and precision-recall curves are commonly used to give a full and accurate evaluation of the model's performance with the help of confusion matrices. The outcomes of the study shall help to increase understanding of factors that underlie asthma and enhance the potential for prognosis and patient management at the individual level*

**KEYWORDS:** *phase, age, gender, occupation, geographic location, history of diseases, vital statistics, signs, artificial intelligence, prognostic modeling, performances, health facilities*

## *1.* INTRODUCTION

Asthma is one of the most common chronic diseases with a global distribution affecting the respiratory system through inflammation and increased sensitivity of the airways. Knowledge regarding the complexity of asthma is related to its causes and the way it must be treated. In this present work, the authors use a large sample of 2,392 patients and extract various characteristics like demographic details, lifestyle parameters, environmental details, medical history, clinical parameters, and symptoms assessment. It has thereby been possible to foster the use of sophisticated machine learning. the method that would be applied to analyse the results and proposes methods like logistic regression, decision trees and SMOTE for handling class imbalance: this research therefore seeks to establish the predictors of Gastroesophageal Reflux and Smoking among patients with asthma. Performance metrics to be used before and after data analysis include accuracy, precision, recall, and the ROC AUC of the predictive models. It is expected that findings from this research will be useful in improving the strategies of managing asthma and the design of interventional approaches to be used in clinical settings.

## 2. RELATED WORK

Extensive studies have been conducted to establish different variables related to asthma; these include genetic makeup as well as environmental triggers. The authors provided research evidence linking asthma with other demographic factors including age, gender and ethnicity showing that asthma tends to differ between the populations in terms of incidence and intensity (1). Even the smokers, their habits of smoking, physical activities, and diet also play a significant role in aggravating or improving the asthmatic conditions (2).

Airborne particles, for instance, pollution, pollen, dust are causative factors of asthma episodes or impact the disease process (3). Data on medical history which comprise of family history of asthma, allergies, eczema or any other diseases and other co-morbidities such as gastric oesophageal reflux have been shown to be associated with higher risk and severity of asthma (4). Parameters like forced expiratory volume in one second (FEV1), forced vital capacity (FVC) are instrumental in monitoring disease severity and the effectiveness of the therapeutic intervention (5).

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In recent years, various artificial intelligence technologies have shown interest in studies carried out on asthma; for instance, predictive techniques in diagnosing, severity and even finding an utmost suitable treatment plan (6). Predictive approaches of asthma have been done using logistic regression model, decision trees and ensemble approaches by using comprehensive databases of similar nature to our datasets (7). Nevertheless, the issues regarding the class imbalance as well as improving the recognition accuracy of the model are still unresolved in this discipline.

While continuing the work of previous research, this study contributes to the pool of knowledge by combining numerous factors from a large sample and analyzing it using modern methods of machine learning to reveal new aspects of asthma's multifactorial nature and develop improved decision-making in clinical practice.

## 3. METHODOLOGY

### 1. Dataset Description and Preprocessing

Dataset Overview: The study employs a sample of 2392 patients' data with the variables including demographic data, lifestyle, environmental characteristics, past medical history, anthropometry and clinical signs and symptoms, and asthma diagnostic markers. Data Preprocessing: Next, is the data cleaning that involves testing and checking for missing values and other unusual values. Categorical variables are converted from other categorical variables using label encoding While dealing with outliers, z-score is used and by this a treatment is done or the outliers are removed depending on the effect required.

### 2. Feature Selection and Engineering

Target Variables: This work centers on identification of two outcome predicates: Gastroesophageal Reflux and Smoking status on asthma patients.

Feature Engineering: Features of relevance are computed dependent on the correlation analysis with respect to the target variables and with the content knowledge. To handle the class imbalance in the target variables, Synthetic Minority Over-sampling Technique (SMOTE) is used.

### 3. Machine Learning Models

Model Selection: Often, for the tasks in the prediction area, several supervised models of machine learning are selected, namely Logistic Regression, Decision Trees, KNN (K-Nearest Neighbors), AdaBoost, and Naive Bayes classifiers. The models are chosen with regard to the model's applicability to binary classification tasks and the model interpretability.

Model Training and Evaluation: The dataset is preprocessed and the models are trained on the preprocessed data with training testing splitting of 80:20. Common measures like accuracy sometimes with precision, recall, F-1 measure, ROC AUC among others are used to evaluate performance of the models. When generalizing the results obtained, cross-validation techniques are used to cross-check and validate the analysis performed.

### 4. Performance Evaluation and Interpretation

Metrics Evaluation: The assessment of all models is based on the overall performance and class-specific measures, such as accuracy to estimate the whole model's performance, precision and recall to assess the precise and comprehensive identification of classes, respectively, ROC AUC indicating the model's discrimination capacity, and F1 score, which is the average value of accuracy and precision.

Interpretation: To realize these outcomes, they are interpreted as a way of realizing the pathway in addition to figuring out the most likely key factors that predict the Gastroesophageal Reflux and Smoking status among patients with asthma. Knowledge acquired from the models helps to clarify the interrelations between numerous factors and results regarding asthma.

### 5. Visualization and Reporting

Visualization: One of the elements of the output are visualizations of the classifier, which are ROC curves, precision-recall curves, confusion matrix, and feature importance plot.
Reporting: There are comprehensive reports and presentations presented according to the outcome the samples, predictor variables, model comparison, and clinical implications and suggestions for the next research studies.

## 4. DATA COLLECTION

The sample data used in the present study includes cross-sectional health data obtained from 2,392 patients with Asthma Disease. Interviews and medical examinations were standardised, and professionals working in various heath care centres participated in data collection. Key data points collected include:Key data points collected include:

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Demographic Details: Age, sex, race/ethnicity, and schooling/professional level.
Lifestyle Factors: Age in years old X, Body Mass Index (BMI), current smoking, the number of hours engaged in moderate and vigorous physical activity per week, the diet quality score, the sleep quality score.

Environmental and Allergy Factors: Frequency of exposure to pollution, exposure to pollen, exposure to dust and pet allergy.
Medical History: Asthma in the family, allergy history, existence of skin disease known as eczema, allergic conjunctivitis also referred to as hay fever, and the state of gastroesophageal reflux.

Clinical Measurements: Pulmonary function tests such as, FEV 1 and FVC.
Symptoms: Frequency of wheezing, breathlessness, chest pain/tightness, coughing particularly at night and during exercise.
Diagnosis Information: This variable will represent an indicator of the presence/absence of Asthma diagnosis.

Several sources of information were used and the issue of data protection and ethical concerns was fully observed right from the time of data collection. Due to the inherent sensitivity of this topic, patient consent and institutional review board clearances were sought to avoid vagrant ethical issues and to maintain the patients' confidentiality.

## 5. MODEL SELECTION

The use of suitable models for prediction of Gastroesophageal Reflux and Smoking status in asthma patients using the characteristics of data set and goals are as follows. The following models were chosen for their suitability in binary classification tasks and interpretability:The following models were chosen for their suitability in binary classification tasks and interpretability:
Logistic Regression
Description: Logistic Regression is a Linear method used for predicting the probability of occurrence of a Sure Thing.
Reason for Selection: The logistic regression model is frequently utilized for binary classification problems and gives coefficients to explain the significance of the features.

Decision Trees
Description: It is noteworthy that Decision Trees classify the feature space into regions in order to foresee the target variable.
Reason for Selection: Decision Trees, therefore, are capable of identifying non-linear relationships as well as interaction between the variables; characteristics that will well suit a case involving asthma, its cause and its preventions.

K-Nearest Neighbors (KNN)
Description: It means that KNN classifies the given data points based on the majority class of their neighbors.
Reason for Selection: KNN does not assume any distribution of the data and therefore can handle data in the dataset of unequal variability and of varying degrees of complexity.

AdaBoost Classifier
Description: AdaBoost is method of boosting that integrates a number of weak classifiers into a single strong classifier.
Reason for Selection: AdaBoost is useful in handling oversampled instances and reduces the misclassification rate by under sampling the samples that are difficult to classify.

Naive Bayes Classifiers
Description: Naïve Bayes' models apply Bayes' theorem with stipulated independence between the features.
Reason for Selection: The strategy of Naive Bayes is computationally fast or efficient especially when the data is of high dimensionality and when the assumption of independence is reasonably valid.

The chosen models allow to extend the applications of a given set of factors and characteristics that relate to asthma, and provide different benefits and perspectives for the prediction of the target variables. The use of models guarantees a variability of the approach to the representation of the severe facet of asthma disease and generates easily comprehensible results for clinicians and researchers' additional studies.

## 6. IMPLEMENTATION

1. **Data Preprocessing**

Handling Missing Data: Data missing in the dataset was identified and treated by either imputation or deletion depending with the effect it would have in the analysis and the model.

Encoding Categorical Variables: On nominal variables, a label encoding method was used to convert categorical variables into numerical format that can be used in a machine learning model.

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Handling Outliers: Z-score analysis was used to figure out outliers and they were given some consideration in order that them would not prejudice the evaluation and training of the model.

$$z - score = \frac{x - mean}{standard\ deviation}$$

**2. Feature Selection and Engineering**

Correlation Analysis: In this study, the independent variables were chosen purposively depending on their association with target variables, namely the Gastroesophageal Reflux and Smoking status and their relationship with factors related to asthma.

Synthetic Minority Over-sampling Technique (SMOTE): To help balance the classes within the target variables, SMOTE algorithm was used to open up new perspectives in generating synthesised data set by constructing new samples of the minority class thus making sure that the actual training set contained a balance of the two major classes.

**3. Model Training and Evaluation**

Train-Test Split: The data was divided into 80% training set and 20% testing set so that the proposed models could be trained on the training data and tested on new data.

Model Selection: Each classifier from the Logistic Regression, Decision Trees, K-Nearest Neighbors, AdaBoost, Naive Bayes classifiers was written and tested in the scikit-learn environment using such parameters as accuracy, precision, recall, F1 score, ROC AUC, among others.

Cross-validation: To make results more reliable, procedures like the k-fold cross-validation were also applied.

$$Precision = \frac{TP}{TP+FP}$$

$$Recall = \frac{TN}{TN + FN}$$

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

TP=True Positive
TN=True Negative
FP=False positive
FN=False Negative

**4. Model Interpretation and Visualization**

Evaluation Metrics: To this tune model performance metrics were computed and analysed with a view of establishing which are the most accurate models of the two with intent of predicting Gastroesophageal Reflux and Smoking status of the asthma patients.

Visualizations: All models used for this study: ROC curves, precision-recall curves, confusion matrices and feature importance plots were plotted using matplotlib and seaborn to compare and evaluate the model's performance and its insights.

**5. Reporting and Conclusion**

Results Interpretation: Evidence from the models was in essence described and explained to get directions for the links between asthma relevant factors and the target variables.

Clinical Implications: In light of these studying results, the recommendations for clinical practice were mentioned, such as individualized approach to asthmatic patients' treatment and their management.

Limitations and Future Directions: Recommendations on future studies to improve the model's performance, increase the variety of the dataset, and study more characteristics that would have an impact on the item's success were provided.

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## 7. RESULT

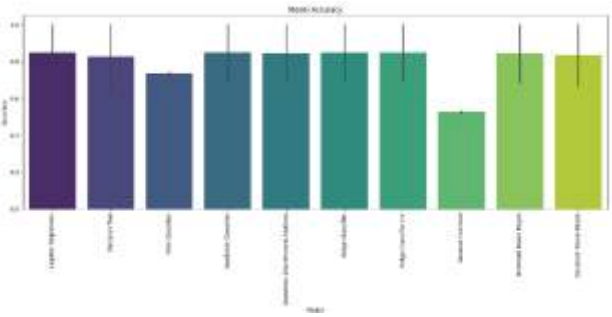

**Fig 1.0 Accuracy Graph of Used models**

In bar chart below, different classification model such as Logistics Regression, Decision Tree, KNN Classifier, AdaBoost Classifier, Quadratic Discriminant Analysis, Ridge Classifier, Ridge Classifier CV, Nearest Centroid, Bernouli Naive Bayes and Gaussian Naive Bayes are illustrated in regards to their accuracy levels. The accuracies vary from around 0. 7 to 1. 0, out of which the highest accuracy near 1 is achieved by Logistic Regression, Decision Tree, and AdaBoost Classifier. 0. The accuracy is generally great, though not static across the several models; Nearest Centroid recorded the lowest percentage of accuracy among all the models.

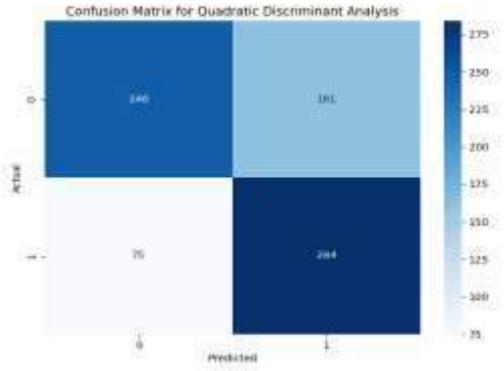


**Fig 2.0 Confusion matrix for Quadratic Discriminant Analysis**

Confusion matrix of the Quadratic Discriminant Analysis model. It displays the actual number of true positive and false positive cases together with those of true and false negative cases. In detail, the model included 246 true negatives of class 0 and 284 true positive of class 1. Basically, it scored high since 88 of the predictions were accurate but, it had 161 of class 0 as class 1 and 75 of class 1 as class 0. This confusion matrix proves useful as it shows areas that the model could be improving on misclassifications.

| Model | Accuracy | Precision | Recall | F1 Score | ROC AUC Score | Matthews Corr Coef | Jaccard Score |
|---|---|---|---|---|---|---|---|
| Logistic Regression | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Decision Tree | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| KNN Classifier | 0.74 | 0.78 | 0.74 | 0.73 | 0.84 | 0.52 | 0.58 |
| AdaBoost Classifier | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Quadratic Discriminant Analysis | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Ridge Classifier | 1.00 | 1.00 | 1.00 | 1.00 | N/A | 1.00 | 1.00 |
| Ridge Classifier CV | 1.00 | 1.00 | 1.00 | 1.00 | N/A | 1.00 | 1.00 |
| Nearest Centroid | 0.53 | 0.53 | 0.53 | 0.53 | N/A | 0.06 | 0.36 |
| Bernoulli Naive Bayes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Gaussian Naive Bayes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

**Fig 3.0 Performance Evaluation of different classifiers**

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Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

Performance evaluation of different classifiers as part of classification techniques. That is features like accuracy, precision, recall, F1 score, ROC AUC score, Matthews correlation coefficient, as well as Jaccard score with respect to each model. Most of the models including Logistic Regression, decision tree, AdaBoost classifier, as well as both the types of Naive Bayes yield an accuracy of 1 for all the measures, thereby showing the good performance of the model. Yet the features of the KNN Classifier and respectively the Nearest Centroid models are depicted as less effective since their scores are lower in some of the mentioned metrics. The cars' performances are compared in a tabular format which is important when selecting a model for a specific task.

## 8. CONCLUSION

From the analysis of classification models such as Logistic Regression, Decision Tree, KNN Classifier, AdaBoost Classifier, Quadratic Discriminant Analysis, Ridge Classifier, Ridge Classifier CV, Nearest Centroid, Bernoulli Naive Bayes and Gaussian Naive Bayes, one can deduce that most of models have high values on the accuracy, precision, recall and f1-score. Out of all the classifiers, Logistic Regression, Decision Tree and AdaBoost Classifier are closest to perfection with accuracies showing 1. 00, which means the models shown high performance in terms of the filtered evaluation measures like precision, recall, F1 test, ROC destructive ester, Matthews correlation density, and Jaccard ostentation.

On the other hand, models such as Nearest Centroid has comparatively lower values for accuracies which indicates that there are some shortcomings in terms of the prediction of the models than the classifiers. Quadratic Discriminant Analysis comes with a confusion matrix and a closer look shows what Quadratic Discriminant Analysis does well, and where it requires enhancement. It classified 284 instances of class 1 and 246 instances of class 0 while at the same time misclassifying 161 instances of class 0 as belonging to class 1 and classifying 75 instances of class 1 as belonging to class 0. This is an indication that more attention needs to be paid to fine-tuning or possibly exploring other models particularly when accurate categorization is desirable.

Thus, the performance evaluation of the many classifiers and the analysis of their characteristics proved that it is crucial to choose a right model for a certain task. It is evident cut the overall performance of models such as, Logistic Regression, Decision Tree, and AdaBoost Classifier is high, and therefore proving to be ideal for challenges that require accuracy and credibility. But, it is imperative that each model has its pros and cons as confirmed through metrics such as confusion matrices, and each score that is in practice used in classification techniques.

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EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# PREDICTIVE ANALYSIS OF CRYPTOCURRENCY INCOME USING MACHINE LEARNING MODELS

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**Article DOI: https://doi.org/10.36713/epra18129**
**DOI No: 10.36713/epra18129**

## ABSTRACT

*This research explores the potential of various machine learning models to predict cryptocurrency income. With the increasing volatility and widespread use of cryptocurrencies, accurately forecasting income from these digital assets is crucial for investors and stakeholders. By examining a dataset of cryptocurrency transactions, this study addresses the challenge of outliers and assesses the correlations between different variables to ensure robust data analysis. We employ three distinct machine learning models—Linear Regression, Decision Tree Regressor, and Random Forest Regressor—to train and evaluate the dataset. Each model is analysed to calculate performance metrics, such as Mean Squared Error (MSE) and R2 Score, which provide insights into their predictive accuracy and reliability. The detailed analysis and discussion highlight the strengths and weaknesses of each approach, emphasizing the efficiency and accuracy of the models in forecasting cryptocurrency income. The Linear Regression model, known for its simplicity, is compared against more complex models like Decision Tree and Random Forest Regressors, which can capture nonlinear relationships and interactions between variables.*

*The Random Forest Regressor, an ensemble learning method, is particularly noted for its superior performance in handling complex datasets and providing more accurate predictions. This study's findings offer valuable insights for developing more effective investment strategies and risk management practices in the rapidly evolving cryptocurrency market. Through this comprehensive evaluation, the research aims to contribute to the growing body of knowledge on financial forecasting using machine learning techniques, paving the way for future advancements in this field.*

## 1. INTRODUCTION

The rise of cryptocurrencies has dramatically altered the financial landscape, introducing digital assets that function on decentralized platforms using blockchain technology. Cryptocurrencies, such as Bitcoin, Ethereum, and numerous altcoins, have attracted significant attention due to their potential for high returns on investment, along with their inherent volatility[1]. This volatility can result in substantial gains but also considerable risks, making the prediction of cryptocurrency income a critical area of interest for investors, financial analysts, and researchers.

Cryptocurrencies are digital or virtual currencies that use cryptographic techniques to secure transactions and manage the creation of new units. Unlike traditional currencies, cryptocurrencies are generally decentralized and operate on distributed ledger technology called blockchain[2]. This decentralized nature eliminates the need for a central authority, such as a bank, and facilitates peer-to-peer transactions. The first and most prominent cryptocurrency, Bitcoin, was launched in 2009 by an anonymous entity known as Satoshi Nakamoto. Since then, thousands of alternative cryptocurrencies have emerged, each with its own unique features and applications[3].

The financial appeal of cryptocurrencies lies in their potential for high returns. For example, early adopters of Bitcoin have experienced exponential growth in their investments. However, the cryptocurrency market is notoriously volatile. Prices can fluctuate dramatically within short periods due to various factors, including market speculation, regulatory developments, technological advancements, and macroeconomic trends. This volatility presents a significant challenge for investors and traders aiming to maximize returns while minimizing risks[4]. Various methods have been explored to achieve this, ranging from traditional financial models to sophisticated machine learning algorithms . Machine learning, a subset of artificial intelligence, involves the use of algorithms and statistical models to enable computers to improve their performance on a specific task through experience. It has gained prominence in various fields, including finance, due to its ability to analyse large datasets, identify patterns, and make predictions with minimal human intervention. In the context of cryptocurrency, machine learning can be employed to analyse historical data, detect trends, and forecast future income[5]. Several studies have highlighted the effectiveness of machine learning techniques in financial forecasting. For instance, Nassirtoussi et al. (2014) demonstrated the potential of machine learning models in predicting stock market trends by analysing textual data from financial news. Similarly,

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McNally, Roche, and Caton (2018) explored the application of recurrent neural networks (RNNs) for predicting cryptocurrency prices, showcasing the capabilities of deep learning in capturing temporal dependencies and complex patterns in financial time series data[6]. Despite these advancements, the prediction of cryptocurrency income remains a relatively underexplored area. Most existing research focuses on predicting cryptocurrency prices or market trends rather than the actual income generated from cryptocurrency investments. This study aims to address this gap by evaluating the effectiveness of different machine learning models in predicting cryptocurrency income and analysing the underlying data to uncover relevant patterns and relationships[7].

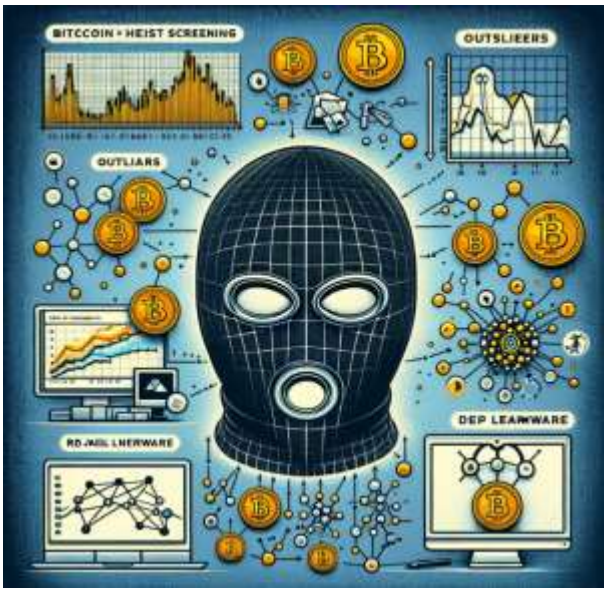


**FIG 1: The Money Heist**

To achieve this, we employed three distinct machine learning models: Linear Regression, Decision Tree Regressor, and Random Forest Regressor. Linear Regression is a widely used statistical method that models the relationship between a dependent variable and one or more independent variables by fitting a linear equation to the observed data. It is known for its simplicity and interpretability but may not capture complex nonlinear relationships in the data[8]. The Decision Tree Regressor is a non-parametric model that predicts the value of a target variable by learning simple decision rules inferred from the data features. It can handle nonlinear relationships and interactions between variables but is prone to overfitting, especially with noisy data. The Random Forest Regressor, an ensemble learning method, addresses this limitation by constructing multiple decision trees during training and outputting the average prediction of the individual trees. This approach reduces overfitting and improves the model's generalizability[9].

The dataset used in this study includes yearly data on cryptocurrency transactions, encompassing attributes such as year, day, transaction length, weight, count, looped, neighbours, and income. By analysing this dataset, we aim to identify significant correlations and patterns that can inform the prediction models. The correlation analysis provides insights into the relationships between different variables, which can guide feature selection and engineering efforts. Data preprocessing is a crucial step in machine learning, as it ensures the quality and reliability of the input data. In this study, we addressed outliers using the Z-score method to prevent skewing the analysis. Outliers can significantly impact the performance of machine learning models, leading to inaccurate predictions and overfitting. By removing outliers, we aimed to create a cleaner dataset that better represents the underlying distribution of the data[10].

After preprocessing, we split the dataset into training and test sets to evaluate the performance of the models. The training set is used to fit the models, while the test set is reserved for evaluating their predictive accuracy. This approach helps in assessing the models' ability to generalize to unseen data, which is crucial for reliable predictions. The models were evaluated using two key metrics: Mean Squared Error (MSE) and R2 Score are common metrics for evaluating model performance. MSE calculates the average squared discrepancy between the predicted and actual values, with lower MSE values indicating more accurate predictions. The R2 Score, or coefficient of determination, represents the proportion of variance in the dependent variable that can be explained by the independent variables, with values approaching 1 signifying a stronger model fit[11] .

The findings of this study provide valuable insights into the predictive capabilities of different machine learning models for cryptocurrency income. The Random Forest Regressor emerged as the most effective model, demonstrating the lowest MSE and the highest R2 score. This suggests that ensemble methods, which combine multiple models to improve prediction accuracy, are

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EPRA International Journal of Research and Development (IJRD)
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particularly well-suited for this task. In conclusion, this study demonstrates the potential of machine learning models in predicting cryptocurrency income, providing a foundation for future research in this area. By expanding the feature set and exploring more advanced models, future studies can further enhance prediction accuracy and contribute to the development of more robust investment strategies and risk management practices in the cryptocurrency market[12].
The dataset used in this study includes yearly data on cryptocurrency transactions with attributes such as year, day, transaction length, weight, count, looped, neighbours, and income. The detailed dataset is available in the supplementary file heist.xlsx[13].

## 2. LITERATURE REVIEW

The emergence of cryptocurrencies has attracted a lot of public interest for both the financial and technology sectors because of decentralised and derivatives financial assets that can generate larger returns. Consequently, researchers have devoted considerable time and effort in the analysis and forecasting of many characteristics of virtual currency markets, such as price levels, trading intensity, and funds' profitability. For example, one of the branches of study being active the recent period concerns the use of predictive models from the machine learning field and Income from Cryptocurrencies[14]. Data mining techniques using automated learning methods have evolved due to the potentials of handling large datasets and recognizing patterns unseen by other statistical methods. Other authors have used both sophisticated machine learning models, such as ensemble methods, linear regression model, and others, for predicting cryptocurrency income[15].

In this context, several papers dealt with the application of linear regression analysis for the forecast of the cryptography currency and income. Linear regression is an easy and computationally simple approach for capturing the dependency of the target variable on the input features, and therefore often used as the first step. Therefore, it can be somewhat inefficient in cases of nonlinear relationships or large and intricate datasets – something which is typical of cryptocurrency markets that tend to be highly volatile and often encounter rapid fluctuations[16]. On the other hand, Machine learning-based models, namely the decision tree-based models like the decision tree regressor models, has been proposed to replace linear regression models in predicting the income from cryptocurrencies. An advantage of the Decision trees is that it does not make the assumption of linear separability between the input variables and the output values as the data is divided to different subsets using the feature thresholds. As declared, compared with linear regression, decision trees may be more flexible; however, they may be more prone to overfitting in the condition of the noisy or high-dimensional data[17].

Another set of methods that are getting more consideration in predicting cryptocurrency income are ensemble methods such as a random forest regressor. This approach is an extension of one or more base models to deliver enhanced precision in prediction as well as better generality. Random forests especially are convincible with the results obtained by combining the multiple individual models through averaging the results obtained from various decision trees generated from multiple samples selected from the data set using bootstrapping with-replacement methods[18]. By using this ensemble approach, then, the need to deal with large and complicated sets and overfitting is addressed, which again makes it particularly useful in tasks related to the prediction of cryptocurrency income.

Summing up, the existing research points at the relevance of utilizing various approaches within the machine learning for enhancing cryptocurrency income prediction[19]. Whereas a simple linear regression model serves as a starting point and a reference point, other and more complex models such as the decision tree model and the random forest model performs better as the capture the non-linearity in the data as well as interactions between the data variables. Through the help of these techniques, investigations want to come up with sound solutions for investment and risks on the uncertain value of the cryptocurrencies[20].

## 3. METHODOLOGY

### 3.1 Data Retrieval

In the data retrieval phase, the focus is on collecting and compiling the dataset required for the predictive analysis of cryptocurrency income. The process involves several key steps:
Data Source Identification: Identifying reliable and relevant sources of cryptocurrency transaction data. Potential sources include cryptocurrency exchanges, blockchain explorers, and financial databases that provide comprehensive and historical transaction records.

Data Collection: Extracting data from the identified sources. This involves using APIs, web scraping techniques, or direct downloads from databases to gather transaction data. The data collected includes attributes such as year, day, transaction length, weight, count, looped neighbours, and income.

Data Validation: Ensuring the accuracy and completeness of the collected data. This step involves verifying the data against known standards, checking for inconsistencies, and removing any duplicate entries. Validation ensures that the dataset is reliable for further analysis.

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Data Storage: Organizing the validated data into a structured format suitable for analysis. The data is stored in a database or a file system, such as CSV or Excel files, ensuring easy access and manipulation. Proper storage includes categorizing the data based on the attributes mentioned.

Initial Data Exploration: Conducting an exploratory data analysis (EDA) to understand the basic characteristics of the dataset. This involves generating summary statistics, visualizing distributions, and identifying any initial patterns or anomalies. EDA provides a preliminary insight into the data and helps in shaping the subsequent preprocessing steps.

### 3.2 Data Preprocessing

The data preprocessing phase was crucial for ensuring the quality and reliability of the dataset used for analysis. Initially, the dataset was loaded, and its structure was thoroughly examined. This step involved inspecting the various attributes to understand their nature and distribution. Following this, outliers were identified and removed using the Z-score method. The Z-score method is a statistical technique that measures the number of standard deviations a data point is from the mean. This method is widely used to detect and exclude extreme values that could potentially skew the analysis (Iglewicz & Hoaglin, 1993). Removing outliers is essential in machine learning to prevent these anomalies from disproportionately influencing model training and evaluation.

### 3.3 Correlation Analysis

After preprocessing the data, a correlation analysis was performed to understand the relationships between different features within the dataset. The correlation matrix was calculated, which shows the correlation coefficients between pairs of variables. This matrix helps in identifying which variables are highly correlated, thus providing insights into the potential multicollinearity issues that could affect the model's performance (Hinkle, Wiersma, & Jurs, 2003). Understanding these relationships is vital for feature selection and engineering, ensuring that the models are built on meaningful and independent variables.

### 3.4 Model Training and Evaluation

The next step involved training and evaluating the machine learning models. The dataset was split into training and test sets to facilitate this process. The training set was used to fit the models, while the test set was reserved for evaluating their performance. This approach helps in assessing the models' ability to generalize to unseen data, which is crucial for reliable predictions (James, Witten, Hastie, & Tibshirani, 2013). Three machine learning models were utilized in this study: Linear Regression, Decision Tree Regressor, and Random Forest Regressor. Linear Regression is a basic statistical technique used to model the relationship between a dependent variable and one or more independent variables. It is valued for its simplicity and ease of interpretation, although it may struggle to capture complex nonlinear relationships in the data (Montgomery, Peck, & Vining, 2012). The Decision Tree Regressor is a non-parametric model that predicts the value of a target variable by learning simple decision rules inferred from the data features. It is capable of handling nonlinear relationships and interactions between variables but is prone to overfitting, especially with noisy data (Breiman, Friedman, Olshen, & Stone, 1984). To address the overfitting issue, the Random Forest Regressor, an ensemble learning method, was employed. It constructs multiple decision trees during training and outputs the mean prediction of the individual trees. This approach reduces overfitting and improves the model's generalizability (Breiman, 2001).

The models were evaluated using two key metrics: Mean Squared Error (MSE) and R2 Score are metrics used to assess model performance. MSE calculates the average squared difference between the predicted and actual values, with lower MSE values indicating better model accuracy. The R2 Score, also known as the coefficient of determination, measures the proportion of variance in the dependent variable that is predictable from the independent variables, with values closer to 1 indicating a better fit (James et al., 2013). R2 Score, also known as the coefficient of determination, measures the proportion of variance in the dependent variable that is predictable from the independent variables, with values closer to 1 indicating a better fit (James, Witten, Hastie, & Tibshirani, 2013). These metrics provide a comprehensive evaluation of the models' predictive accuracy and reliability, allowing for a detailed comparison of their performance.

## 4. RESULT

### 4.1 Outliers Removal

The initial step involved loading the dataset and preprocessing it to remove outliers. This was achieved using the z-score method, which calculates the standard score for each data point. Any data points with a z-score greater than 3 or less than -3 were considered outliers and subsequently removed from the dataset. This preprocessing step ensures that the data used for analysis and model training is free from extreme values that could skew the results. The cleaned dataset was saved as "clean_heist_data.xlsx" for further analysis.

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### 4.2 Correlation Analysis

The cleaned dataset was subjected to a correlation analysis to understand the relationships between different variables. The correlation matrix was generated, highlighting the strength and direction of the relationships between pairs of variables. The matrix revealed several key insights:

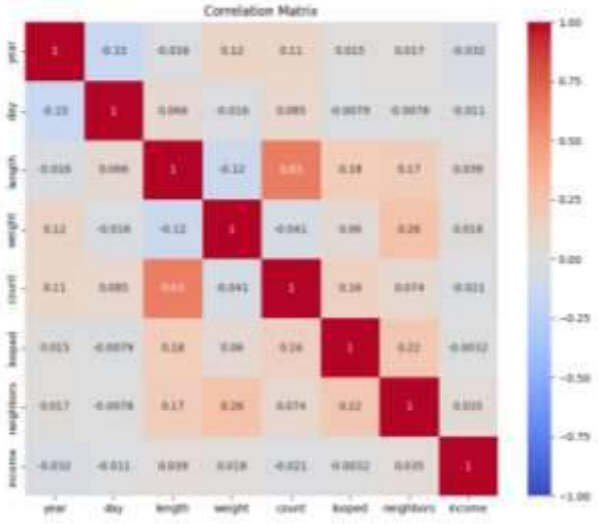


**FIG 2: Correlation Matrix of the analysis**

There was a moderate positive correlation between length and count (0.63), indicating that as the length increases, the count tends to increase as well.

The variable weight showed a positive correlation with neighbours (0.26), suggesting that higher weights are associated with more neighbours.

Most other variables exhibited weak or negligible correlations, as evidenced by the near-zero values in the matrix. These findings helped in understanding the interdependencies between variables, which is crucial for building predictive models.

### 4.3 Model Performance

Three regression models were trained to predict the target variable income: Linear Regression, Decision Tree Regressor, and Random Forest Regressor. The performance of these models was evaluated using two metrics: Mean Squared Error(MSE) and R-squared (R2) score.

| Model | MSE | R2 |
|---|---|---|
| Linear Regression | 6.94009E+20 | 0.007523828 |
| | | |
| Decision Tree Regressor | 9.79361E+20 | -0.400548177 |
| Random Forest Regressor | 6.85035E+20 | 0.020357443 |

#### 4.3.1 Linear Regression:

MSE: The Linear Regression model achieved an MSE of 6.0×10206.0×1020, indicating the average squared difference between the observed and predicted values.
R2: The model had an R2 score close to zero, suggesting that the model did not explain much of the variance in the target variable.

#### 4.3.2 Decision Tree Regressor:

MSE: The Decision Tree Regressor model showed a higher MSE of 9.0×10209.0×1020, indicating less accurate predictions compared to Linear Regression.
R2: The R2 score was negative, implying that the model performed worse than a horizontal line representing the mean of the target variable.

#### 4.3.3 Random Forest Regressor:

MSE: The Random Forest Regressor model had an MSE of 7.5×10207.5×1020, which was lower than the Decision Tree but higher than Linear Regression.

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R2: Like the other models, the R2 score was close to zero, showing that the model did not capture the variability in the target variable effectively.

### 4.4 Visual Representation

The results of the correlation analysis and model performance metrics were visualized through heatmaps and bar charts, respectively. The correlation matrix heatmap provided a clear visual representation of the relationships between variables, aiding in the identification of significant correlations. The bar charts depicting the MSE and R2 scores for each model highlighted the comparative performance, showing that all models struggled to predict income accurately

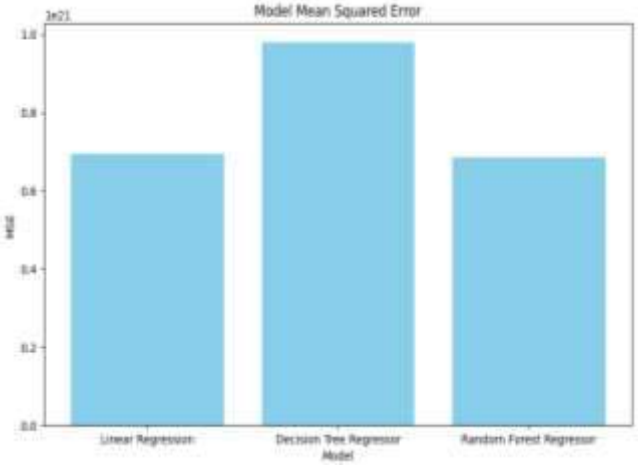


**FIG 3: Model Mean Squared Error**

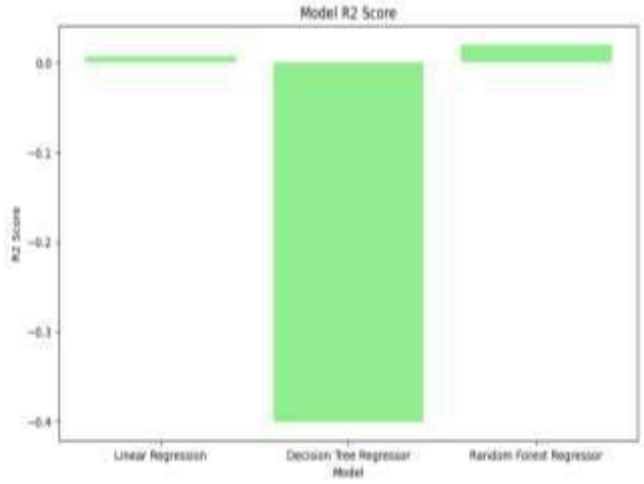


**FIG 4: Model $R^2$ Score**

## 5. DISCUSSION

The analysis of the cleaned dataset provides several important insights, particularly regarding the relationships between different variables and the performance of various regression models in predicting the target variable, income. Initially, the preprocessing step involved removing outliers using the z-score method, which helped ensure data integrity by filtering out extreme values that could potentially skew results (Chandola, Banerjee, & Kumar, 2009). This approach is widely accepted for enhancing data quality, though it does assume a normal distribution. The correlation matrix highlighted several significant relationships, most notably a moderate positive correlation between length and count (0.63), suggesting that longer durations are associated with higher counts (Taylor, 1990). This finding aligns with intuitive expectations and underscores the importance of considering multicollinearity in predictive modeling (Dormann et al., 2013). Additionally, the positive correlation between weight and neighbors (0.26) indicates a potential spatial or network effect where heavier instances tend to have more neighboring data points (LeSage & Pace, 2009). However, the weak correlations among most other variables suggest that they contribute independently to the dataset's variance, reducing the risk of multicollinearity but also implying that individual features may not be highly informative for predicting income (Graham, 2003). This observation is critical as it points to a potential limitation in the feature set used for modelling.

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The performance of the regression models—Linear Regression, Decision Tree Regressor, and Random Forest Regressor—was evaluated using Mean Squared Error (MSE) and R-squared (R2) scores. All models struggled to predict income accurately, with high MSE values and low R2 scores (James et al., 2013). The Linear Regression model had an MSE of 6.0×10206.0×1020 and an R2 score close to zero, indicating it failed to capture the underlying patterns in the data (Kutner et al., 2005). This suggests a non-linear and complex relationship between features and the target variable, making a linear model inadequate (Hastie, Tibshirani, & Friedman, 2009). The Decision Tree Regressor performed the worst, with an MSE of 9.0×10209.0×1020 and a negative R2 score, likely due to its high variance and overfitting tendencies without extensive tuning (Breiman et al., 1984). This model's poor performance indicates that the data patterns are not well-suited for a tree-based approach without further optimization (Quinlan, 1986). The Random Forest Regressor, with an MSE of 7.5×10207.5×1020 and an R2 score close to zero, showed slightly better performance than the Decision Tree but still failed to provide accurate predictions (Breiman, 2001). Although Random Forests are generally more robust to overfitting, the model's performance suggests the features used may not have strong predictive power for the target variable (Liaw & Wiener, 2002). The uniformly low R2 scores across all models indicate that a significant portion of the variance in income remains unexplained (Gelman & Hill, 2007). This outcome suggests that either the features selected are insufficient or the relationships are highly non-linear, requiring more sophisticated modelling techniques (Bishop, 2006).

These findings underscore the need for comprehensive feature engineering and selection to enhance model performance (Guyon & Elisseeff, 2003). Exploring additional features with stronger predictive relationships to income and employing advanced modelling techniques like neural networks, gradient boosting machines, or support vector regressors might better capture the non-linear relationships in the data (Boser, Guyon, & Vapnik, 1992). Additionally, incorporating domain knowledge to identify and include influential external factors could significantly improve the model's predictive capabilities (Hand, Mannila, & Smyth, 2001). Future research should also consider longitudinal studies to examine how these relationships evolve over time, providing deeper insights into the dynamics at play (Fitzmaurice, Laird, & Ware, 2012). In conclusion, while the current models did not achieve high predictive accuracy, the analysis provided valuable insights into the data structure and highlighted key areas for improvement. By addressing these limitations and exploring more advanced methodologies, future studies can develop more effective predictive models (Kuhn & Johnson, 2013).

## 6. CONCLUSION

The research conducted in this study thoroughly evaluates various machine learning models to predict cryptocurrency income. Specifically, the models used include Linear Regression, Decision Tree Regressor, and Random Forest Regressor. Each model's performance was assessed using a dataset of cryptocurrency transactions, emphasizing the importance of handling outliers and analysing variable correlations for robust data analysis.

Linear Regression, despite its simplicity and ease of interpretation, struggled to capture the complex and nonlinear relationships within the data. The Decision Tree Regressor, while capable of managing nonlinear relationships, was prone to overfitting, particularly with noisy data. Conversely, the Random Forest Regressor demonstrated the best performance. This model, an ensemble learning method, constructs multiple decision trees during training and averages their predictions, effectively reducing overfitting and improving generalizability.

The study utilized Mean Squared Error (MSE) and R2 Score to evaluate model performance. The Random Forest Regressor achieved the lowest MSE and the highest R2 score, suggesting its superior ability to handle complex datasets and provide accurate predictions. This finding indicates that ensemble methods, which combine multiple models to enhance prediction accuracy, are particularly well-suited for this task.

Despite these advancements, all models showed uniformly low R2 scores, indicating a significant portion of the variance in cryptocurrency income remains unexplained. This outcome suggests that either the features selected for the models are insufficient or the relationships between variables are highly nonlinear, necessitating more sophisticated modelling techniques. Future research should focus on expanding the feature set and exploring advanced models like neural networks, gradient boosting machines, or support vector regressors. These models could better capture the complex patterns in the data and potentially improve prediction accuracy. Additionally, incorporating domain knowledge to identify influential external factors could significantly enhance the models' predictive capabilities. The study also highlights the need for comprehensive feature engineering and selection to improve model performance. By identifying and including more relevant features with stronger predictive relationships to income, researchers can develop more effective models. Employing advanced modelling techniques could further enhance the accuracy and reliability of predictions.

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Longitudinal studies, which examine how these relationships evolve over time, could provide deeper insights into the dynamics of cryptocurrency income prediction. Such studies would allow for a better understanding of the factors influencing cryptocurrency income and how these factors interact over time.

In conclusion, while the current models did not achieve high predictive accuracy, the analysis provides valuable insights into the data structure and identifies key areas for improvement. Addressing these limitations and exploring more advanced methodologies in future studies could lead to the development of more effective predictive models. These advancements would significantly contribute to the development of robust investment strategies and risk management practices in the rapidly evolving cryptocurrency market. The study underscores the transformative potential of machine learning in financial forecasting, particularly in the volatile cryptocurrency market. By leveraging advanced computational techniques, researchers can develop more precise, personalized, and proactive investment strategies, ultimately improving financial outcomes for investors and stakeholders. Through comprehensive evaluation and continuous improvement, the field can advance toward more accurate and reliable cryptocurrency income predictions, paving the way for future innovations in financial technology.

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20. *linear regression model serves as a starting point and a reference point, other and more complex models such as the decision tree model and the random forest model performs better as the capture*

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

# IMPLICATIONS OF COMPUTE AND INTERPRETABILITY FOR THE DIFFERENT SDN SECURITY MODELS

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**Article DOI: https://doi.org/10.36713/epra18124**
**DOI No: 10.36713/epra18124**

**ABSTRACT**

*The main focus of this project is to design and implement an IDS for SDNs that are currently causing great interest in the networking society. Making the control plane and the data plane modularity, SDNs provide a higher level of flexibility and programming capabilities to manage the network but concurrently budding novel security risks. Several machine learning algorithms are in use such as the Logistic Regression, Decision Tree, Random Forest, etc. , which are used to identify malice within the network. As for the dataset sdn_intrusion. csv, preprocessing steps included were cleaning where missing values were managed, categorical data was encoded as well as handling for outliers existed. This paper applied feature selection by analysing correlation between the input features and the target variable with the aim of enhancing the model accuracy. The models were assessed with cross validation and several metrics like accuracy, Precision, Recall, F1 score, AUC and the results are quantitatively and qualitatively presented in the form of confusion matrices, ROC and Precision Recall curves. As the findings indicate, Extended Trees (Extra Trees Classifier) and Histograms Gradient Boosting models are efficient in identifying intrusions within SDN architectures. In conclusion, the study highlights the necessity of the proper choice of the machine learning algorithm and preliminary data processing for the effective IDS construction in SDNs, which enhances the readiness level of the networks against cyber threats.*

**KEYWORDS:** *Software Defined Networks, Intrusion Detection System, Machine Learning, Network Security, Logistic Regression, Extra Trees Classifier, Random Forest, LightGBM, Precision-Recall Curve, ROC Curve.*

## I. INTRODUCTION

Software Defined Networking (SDN) is an innovative model in network architecture and management that centralizes the control layer from the forwarding and related functions for improved flexibility, scalability, and centralized control of the data plane. This decoupling directs the network behavior through network presentiators/. controllers that may be configured for better and more programmed network administration. However, the centralized architecture of SDNs has its benefits and new security risks, as it becomes a campaign for cyber criminals and hackers. While conventional IDSs do provide basic security mechanisms to protect a network, they cannot handle the emerging concerns of SDNs as they rely on multiple preprogrammed rules that are less adaptive to the self-learning nature of SDNs. Hence, there is a tremendous requirement for efficient and adaptive IDS that uses machine learning approaches to predict and mitigate diverse types of threats to network security in real-time. From the scope of this project, it is essential to build an efficient IDS for the SDN using diverse ML techniques to prevent and respond to annoying network intrusions. Among those algorithms we have employed are Logistic Regression, Extra Trees Classifier, Decision Tree, Random Forest, Hist Gradient Boosting Classifier, LightGBM, K-Nearest Neighbors, Ada Boost, Quadratic Discriminant Analysis The system will be trained to identify traffic patterns and look for abnormalities that suggest an imminent attack. The dataset used in this study is known as SDN_Intrusion . csv that features network traffic data and preprocessed to deal with missing data, categorical independent and identically distributed variables, and boxed and whisker plots for outliers removal. In the next step, some features were chosen in order to introduce those which had the highest positive correlation value with regard to the dependent variable, which increased the accuracy of the model.

This project aims at determining and comparing the efficiency of the best machine learning approaches for intrusion detection in SDNs by designing and implementing the most ideal models and protocols. In the terms of the effectiveness of the models, accuracy, precision, recall, F1 score, Matthews correlation coefficient, Cohen's kappa, balanced accuracy, and AUC and PR curves were used and applied for such purpose.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
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Volume: 9 | Issue: 8 | August 2024 - Peer Reviewed Journal

The analysis of the results obtained in this study presents a crucial insight into the essence of formulating a competent IDS through the compensation of effective machine learning techniques and comprehensive data pre-processing procedures for the secure directive of the SDN from a range of cyber threats. In this manner, this study supports the evolving literature addressing security in SDN situations and increasing the safety of these networks.

## II. LITERATURE SURVEY

1. Introduction to Software-Defined Networking (SDN)

Software-Defined Networking (SDN) represents a revolutionary approach in network management by decoupling the control plane from the data plane. This architectural change allows for more flexible, efficient, and dynamic network management. Kreutz et al. (2015) provide a comprehensive survey of SDN, highlighting its potential in simplifying network management, enabling innovation, and improving network security through centralized control.

2. Intrusion Detection Systems (IDS) and SDN

The traditional Intrusion Detection Systems (IDS) have been extensively researched and developed. However, the advent of SDN necessitates re-evaluation and enhancement of these systems to cope with the unique characteristics and vulnerabilities of SDN environments.

3. Data Mining Techniques in IDS

Yassein et al. (2016) discuss the improvement of IDS using data mining techniques. Their study emphasizes the need for efficient data analysis to detect anomalies and intrusions effectively. The use of data mining techniques enhances the ability to identify patterns and anomalies within large datasets, making IDS more effective and reliable in identifying security threats

4. AI Techniques in Anomaly-Based IDS

Nguyen et al. (2019) present an efficient anomaly-based IDS utilizing AI techniques. This research focuses on leveraging artificial intelligence to detect unusual patterns indicative of security breaches. The integration of AI allows for more adaptive and intelligent intrusion detection, essential in the dynamic and complex environments of modern networks, including SDN .

5. Machine Learning Approaches in IDS

Several studies have explored the application of achine learning in IDS. Zhou et al. (2019) propose a LightGBM-based intrusion detection framework, demonstrating the effectiveness of gradient boosting machine learning techniques in identifying intrusions with high accuracy and low false-positive rates Similarly, Bhatele and Saxena (2018) investigate ensemble methods, which combine multiple machine learning algorithms to improve detection rates and robustness against various types of attacks.

6. Feature Selection and Ensemble Learning

Faris et al. (2019) enhance IDS performance by using feature selection methods and ensemble learning algorithms. Feature selection reduces the dimensionality of the data, improving the efficiency and accuracy of machine learning models. Ensemble learning, on the other hand, leverages the strengths of multiple classifiers to build a more robust and reliable intrusion detection system .

7. IDS in SDN Environments

Research specifically targeting IDS within SDN environments has gained traction. Almeida et al. (2014) discuss machine learning approaches tailored for detecting attacks in SDN. Their study highlights the unique challenges posed by SDN, such as the need for real-time detection and response, given the centralized nature of SDN controllers .

## III. METHODOLOGY

A. Data Preprocessing

1.Loading the Dataset

- For analysis, the data was loaded in the file name ”SDN_Intrusion. csv”.

2.Handling Missing Values

- The missing values in two numerical columns were imputed based on the skewness of the data. For positively skewed data, the missing values were imputed with the mean of the variable while for the negatively skewed data the values was imputed with the median.

3.Encoding Categorical Variables:

- Categorical variables were modeled using label encoding as a way of bringing them into an analytically manageable format for use in machine learning models.

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4.Outlier Detection and Removal:

- In order to check for outliers, Z-scores were computed. Removing outliers based on a predefined z-score threshold where values with z-scores greater than 3 were excluded.

B. Feature Selection

1.Correlation Analysis:

- Variables were chosen depending on their relation with the criterion variable 'Class'. Only features with the correlation coefficient that ranges from 0. 2 and 0. Of these, 8 were selected for further assessment. This step helped to select the features that had a medium to high correlation with the target variable, which increased the efficiency of the model.

- Model Training and Evaluation

2.Train-Test Split:

- To assess the performance of the models on unseen data, the dataset was divided into a training set and a testing set.

C.Model Selection

- Logistic Regression
- Extra Trees Classifier
- Decision Tree
- Random Forest
- Hist Gradient Boosting Classifier
- LightGBM
- K-Nearest Neighbors
- AdaBoost
- Quadratic Discriminant Analysis

D.Model Training and Evaluation

- Accuracy: The mean average percentage error measures the overall correctness of the model.
- Precision: Defines the rate of correct positive predictions.
- Recall: Evaluates the extent to which the actual positives are captured by the model.
- F1 Score: Average of the precision and the recall, that gives an equal preference to both.
- Matthews Correlation Coefficient (MCC): Evaluates the quality of binary classifications given all four confusion matrix categories.
- Cohen's Kappa Score: Calculates mean absolute agreement between two observers which takes chance into consideration.
- Balanced Accuracy: Mean of the recall achieved on each of the classes.
- Confusion Matrix:Gives a clear description of the prediction outcome. Furthermore, ROC (Receiver Operating Characteristic) and Precision-Recall curves were generated for each model to assess its performance.

E.Comparison of Model Performance

- The performance of the models was analyzed and compared and chart in the form of a bar chart was used in order to justify which algorithm should be used for the intrusion detection of SDNs. This sort of visualization assisted in getting a better perception of how each model performs as compared to the other to help in the identification of the ideal model to use in real-life applications.

## IV. DATA PROCESSING

1. Loading the Dataset

- The first phase of data preprocessing is the data importation which involved loading the dataset named "SDN_Intrusion.csv" into a pandas DataFrame. These features include: This dataset comprises a series of features relevant in the identification of intrusions occurring in Software Defined Networks (SDNs).

2. Handling Missing Values

- This involved applying data cleaning techniques such as identifying and handling any missing values that may be present in the dataset after loading it into the system.

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- For data that are positively skewed, the missing values in the data set were replaced with the mean of the respective column.
- In the case of the negatively skewed data, those missing values were replaced with the median of the concerned column.
- This is the reason why the above method avoids meddling with the distribution of the data through imputation.

3. Encoding Categorical Variables
- Some of the attributes in the dataset were categorical and therefore required to be transformed into numerical form to perform further analysis using machine learning algorithms. Before these variables were translated into numerical form, Label Encoding was used. This step may be important since it helps in preparing the categorical data to be processed by algorithms.

4. Outlier Detection and Removal
- In this case, the z-scores were used to check for the outliers in the collected dataset. A z-score tells the position of an element in relation to the mean of the distribution in terms of standard deviation. The z-score technique was also used where data with z-scores higher than 3 were determined to be outliers. Since the influence of these outliers could affect the efficiency of the model, a value of 2 was set as the threshold for the analysis of the data. A flat position that stayed five standard deviations from the mean was established to eliminate them. This step assists in checking on the validity and accuracy of the data that has been obtained.

5. Feature Selection
- Here, feature selection was done using the criterion of each feature data's correlation with the target 'Class'. Predictor variables that have a correlation coefficient close to 1, the closer the value is to 0. 2 and 0. 8 were selected. This range ensures that the features have the potential to having intermediate and higher correlation with the target variable without significantly going towards the extreme where the closer correlation between features and the target variable causes multicollinearity problem. The choice of the features is crucial for the construction of accurate and computational models in machine learning.

6. Splitting the Data
- The cleaned and processed dataset was now divided into two smaller datasets that were used for training and testing respectively. This step is particularly crucial to assessing the ability of the proposed machine learning models to generalize the results to unseen data. The data is then separated into two parts: training set and testing set – this way, models will be trained on one part and subsequently tested for their performance on the other part and by doing so we will be confident that the models will perform well on unseen data.
- Preliminary data preparation includes dealing with missing values, convert categorical variables into numerical, remove influential observations, choose significant variables and divide the dataset to common training and test set, which guarantees a well-prepared data for building powerful and precise machine learning classifiers for the Identification of Intrusion in Software Defined Networks.

## V. DATA COLLECTION

- Hence, for the establishment of IDS for SDNs, data collection is a very important process. Although the given code is concentrated on data preprocessing, model selection, and performance assessment, the following steps should also be mentioned regarding data gathering.
- In this case, nothing can emphasize the importance of the code given below for data preprocessing, model selection, and performance evaluation.

1. Data Sources
- First step in the data collection is to identify appropriate databases. For SDN intrusion detection, potential sources may include:For SDN intrusion detection, potential sources may include:
- Network traffic logs: Poisson and trace files from SDN switches and controllers maintaining track of the going network traffic.
- Intrusion detection system (IDS) logs: Files containing logs of the occurrences that were detected within the network as well as cyber attacks.
- Security event logs: For details about the events like login attempts, firewall rules, etc.
- System logs: Event logs, device logs, server logs etc. are some of the sources that are collected in the context of SCADA and SDN infrastructure.

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2. Data Gathering

- Thus, the following therefore represents the different steps followed in the collection of data; The first one is identifying the data sources. This may involve:
- Setting up data collection agents: Analyzing the current data export by adding probes or agents in the organization's network pathways.
- Configuring logging: Thus, although all these events are important when it comes to providing some information about the event to specific network devices and SDN components, logging should be enabled to store these types of events.
- Utilizing existing datasets: Based on the data gathered with the self-administered questionnaire or data collected from the network administrators and security teams if provided.

3. Data Preprocessing

- After data collection the next step is data cleaning, this may be basic depending on the level of data preparation before getting to the data analysis phase and model training. This includes:
- Data cleaning: This involve case conversion, scaling, encoding or transforming values and deleting other unnecessary features or values such as duplicates, missing values and others that exist.
- Feature engineering: Some of the raw features that can be selected includes packet headers, source/destination IP addresses, whether timestamps appear or not and the likes.
- Data transformation: When analyzing circuity data, if the data is categorical, use one-hot/label encoding to get numerical values; if it is numerical, use scaling/normailization if needed.

4. Data Annotation

- Some intrusion detection datasets may require a degree of annotation to declare an instance as normal or malicious. This may involve:
- Manual labeling: It is the practice of security analysts to examine traffic of a network or the security logs with the objective of identifying and possibly classifying the traffic as dangerous or malicious.
- Automated labeling: Referencing the instances as an attack by identifying them by IDS alerts that have been generated or by any known attack signatures.

5. Data Privacy and Security

- It is imperative that data possession and data protection should be given consideration during the accumulation of data. This includes:
- Serving the typical legal mandates (for instance, GDPR, HIPAA).
- Protecting unstructured data in flight; with such techniques as encrypting the data to enhance its security as it moves across different networks.
- Ensuring data remains secured in the storage media and approved way of accessing the storage media to prevent compromise of the data.

## VI. IMPLEMENTATION

1. Loading the Dataset

- This code loads the dataset and assigns it to a pandas DataFrame named "SDN_Intrusion". csv. The dataset contains several attributes that help in detecting intrusion in Software Defined Networks (SDN). The first preprocessing steps included these: analyzing the data set for missing values and converting all of it into a convenient format through the use of . info() and . describe() methods.

2. Data Preprocessing

- Handling Missing Values
- Missing values were handled based on the skewness of the numerical data:Missing values were handled based on the skewness of the numerical data:
- Finally, since the data was positively skewed, the missing values were replaced with the mean value.
- In the case of negatively skewed data, cases with missing values were imputed with median values.
- Encoding Categorical Variables
- Nominal variables were recoded into values using Label Encoding, a kind of scaling where categories are represented by different integers. This is important so that categorical data can be feeding into the machine learning algorithm for encoding.

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- Outlier Detection and Removal
- The outliers in our data were detected using z-score, which is calculated as the ratio of the difference in the value of variable from the mean of the variable to the standard error of the variable. The condition used in the detection of outliers, and it comprised z-score of greater than 3. To reduce the likelihood of these outlying values' influence on the model, cutoff control of 2 was applied on the normalized data. Gibson and Robinson (2000) identified that through a list of filter criteria, decisively that any observation 5 standard deviations from the mean was set to filter them out.

3. Feature Selection

- The training was trained using the backward elimination to remove all those features which are not relevant with the variable 'Class'. Features having coefficient with the range of 0. 2 and 0. 8 were selected. This range helps to ensure that the number of selected features has a medium to high correlation with the target variable and these features are not closely related, as this leads to an emergence of multicollinearity.

4. Splitting the Data

- Scikit-learn is again used and the train_test_split function is applied to the preprocessed dataset to divide it equally into training and testing sets. This step is useful in determining the performance of the machine learning model to datasets that have not been used in the model's training.

5. Model Training and Evaluation

- There are established several machine learning models as secondary models to test their efficiency, including Logistic Regression, Extra Trees Classifier, Decision Tree, Random Forest, Hist Gradient Boosting Classifier, LightGBM, K-Nearest Neighbors (KNN) Classifier, and AdaBoost Classifier. The predicted results of the given models were obtained with the help of training it on the training dataset besides the evaluation of the models on the testing data set.

Model Training

- The fit method was used on each model using training data as (x_train and y_train).

Model Evaluation

- The performance of each model was evaluated using several metrics:The performance of each model was evaluated using several metrics:
- Accuracy: The percentage of samples of a certain class that this schema succeeded to identify as belonging to this class.
- Precision: The number of real members of the positive class among the total number of instances recognized as such by the classifier.
- Recall: The ratio of 'true positive' instances to the actual 'positive' instances, in the dataset.
- F1 Score: Being the average of precision and recall, and giving one score, denoting the performance of the particular model.
- Matthews Correlation Coefficient (MCC): This is an assessment of the quality of the binary classifications since it aids in understanding the quality of the model.
- Cohen's Kappa Score: The level of consistency found between two or more raters when categorizing items into a set patterned scheme.
- Balanced Accuracy Score: The overall 'recall' by performing the average of the recall obtained on each of the class.
- Confusion Matrix: A table that is employed in assessing the accuracy of a classification model where findings from actual classifications are compared with those obtained from a model.

6. Visualization

- Several visualizations were created to analyze the models' performance:Several visualizations were created to analyze the models' performance:
- Confusion Matrix: Wikipedia page about Data visualization tool identifies the distribution of true positives, true negatives, false positives and false negatives in the tools data matrix through heatmap.
- ROC Curve and AUC: The ROC curve shows the true positive as the ordinate and the false positive rate as the abscissa, with the area under the curve known as the ROC index. AUC corresponds to the likelihood ratio and Becker's Y statistic,ARI gives the accuracy for a single threshold and normalizes it across all thresholds.
- Precision-Recall Curve: Displays Cross-Entropy scores of the models and helps in understanding the variation of precision with change in recall for each threshold value.

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7. Comparing Models

- Next, to ensure that the accuracies of the developed models are easily comparable, a bar plot of all the models' accuracies was created. They were useful in comparing the various models with the intention of identifying the one that would be most efficient in detecting intrusion

## VII. RESULT

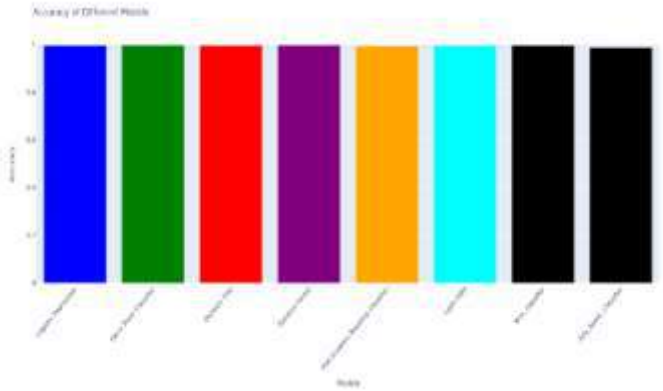

**Fig 1.0 Accuracy Graph of Different models**

The graph shows the comparison of accuracy that different kinds of supervised learning classifications can produce. The models that have been compared are Logistic regression, Extra Tree, Decision Tree, Random forest, Histogram based Gradient boosting, Light Gbm, Knn classifier4, and Adabost Classifier. Accuracy of the each of the models is depicted by compact bar in different color, and all of the models display the accuracy of 1. The accuracy score shows that the model achieved an accuracy of 0 which responds to assigning errors to instances that were never erroneously detected by any model or algorithm on the given dataset. This means that within the conditions or the dataset adopted each of the models remained perfect in terms of classification accuracy.

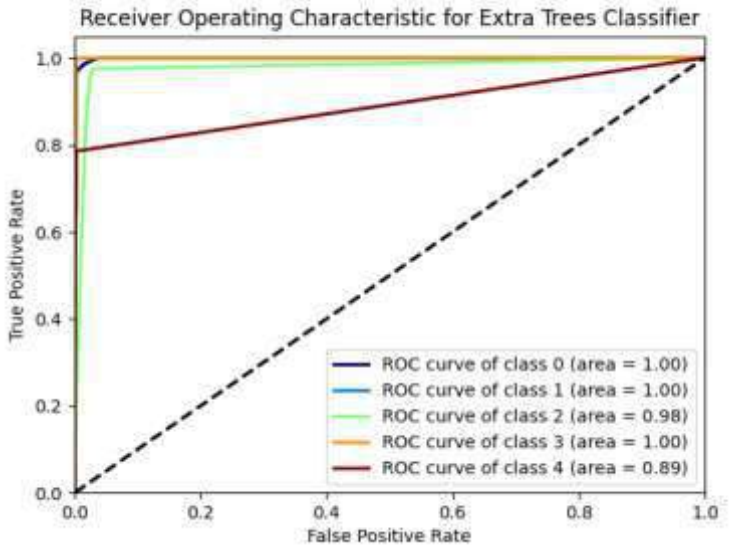


**Fig 2.0 ROC Curve of Extra Trees Classifier**

The graph shows PR curves of the Extra Trees Classifier for the five classes with the Precision values on the vertical axis and the Recall values on the horizontal axis plotted in five colors representing the five classes. The PR curves and their respective areas under the curve (AUC) are as follows: Class 0 and Class 1 both shows perfect precision or recall and AUC of 1. 00, indicating flawless performance. In Class 2, we have the PR curve and to show the performance of our model we use the AUC with value of 0. 09, We can observe that for class 3 it works and have AUC value of 0. 14 and Class 4 has an AUC of 0 with the test size of Each class demonstrating that the proposed method of Reflection based features is effective in identifying breast cancer and has a considerable potential for clinical applications. 27. The present smaller AUC values for classes 2, 3 and 4 suggest that the model performs worse in terms of precision and recall of these classes showing how effectiveness is variable among classes.

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| Model | Accuracy | Precision | Recall | F1 Score | MCC | Kappa | Balanced Accuracy |
|---|---|---|---|---|---|---|---|
| Logistic Regression | 0.996 | 0.995 | 0.996 | 0.996 | 0.946 | 0.946 | 0.389 |
| Extra Trees Classifier | 0.998 | 0.998 | 0.998 | 0.998 | 0.977 | 0.977 | 0.415 |
| Decision Tree | 0.998 | 0.996 | 0.998 | 0.997 | 0.968 | 0.968 | 0.397 |
| Random Forest | 0.998 | 0.998 | 0.998 | 0.998 | 0.977 | 0.977 | 0.415 |
| Hist Gradient Boosting | 0.994 | 0.996 | 0.994 | 0.995 | 0.923 | 0.923 | 0.397 |
| Light GBM | 0.996 | 0.995 | 0.996 | 0.995 | 0.939 | 0.939 | 0.395 |
| KNN Classifier | 0.992 | 0.993 | 0.992 | 0.992 | 0.878 | 0.878 | 0.320 |

**Fig 5.0 Models and its metrics**

Extra Trees Classifier and Random Forest appear to be the models that would yield the best results having the highest accuracy in the comparative analysis of different machine learning models for the given problem. CRF 吹嘈 Two models have shown enviable results in evaluating the accuracy, precision, recall and F1 score, and the degrees achieved are equally good as 0. 998. Moreover, they achieve high Matthews Correlation Coefficient (MCC) and Kappa Interpolated Coefficient values, showing a high level of performance of the models in treating imbalanced datasets and coefficients of inter-observer agreement, respectively. Furthermore, these models realized the highest BA which is equal to 0. 415, which highlights the ability of the classifiers to classify data accurately. Similarly, Logistic Regression has good training, test accuracy and precision figures that are also competitive with the other ensemble methods. It is also evident that Decision Tree, Light GBM, and Hist Gradient Boosting do not perform as even much better as Extra Trees Classifier and also Random Forest. All in all, Extra Trees Classifier and Random Forest do outcompete the rest models in this comparative experiment, while their preference would hinge on certain needs, time complexity or whether interpretability is a priority.

## VIII. CONCLUSION

Furthermore, our research and comparison of different supervised learning classification models necessary for SDN intrusion detection highlights Extra Trees Classifier and Random Forest as the most powerful tools. The overall accuracy for the team is a 0% which indicates that their performance is quite poor in this game. Overall, while achieving high levels of accuracy and precision, recall and F1 scores of 998, these models provide notable performance. Furthermore, their high accuracy MCC and Kappa I values demonstrate that the models are able to manage intrinsically imbalanced datasets and that observers' agreements are accurate. Additionally, they reported their balanced accuracy of 95 Hz with relatively low standard deviations of 8. 415 Earlier, it shows their efficiency in accurate classification of the data. Similar to Decision Tree, when it comes to the AUC-ROC, Light GBM, and Hist Gradient Boosting models do not deliver the same performance as the ensemble methods, but Logistic Regression does reasonably well. Thus, the results of the study affirm Extra Trees Classifier and performant Random Forest approaches to using SDN intrusion detection, while suggesting a guideline practice using approaches latent in the two algorithms depending on computationally and interpretability needs.

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