Impact of Artificial Intelligence on Mathematics Graduate Employability and Sustainability of Mathematics Education in Nigeria

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Abstract

Artificial Intelligence occurred as a transformative technology in Mathematics which offers both opportunities and challenges to Mathematics education. Studies have shown that AI has positive effect as it can improve students' learning performance but the fear of taking mathematics graduate out of job is at play. This study employed a survey research design to investigate the impact of artificial intelligence (AI) on Mathematics graduates' employability and the sustainability of Mathematics education in Nigeria. A simple random sampling technique was adopted to select one hundred and fifty respondents for the study. One research question was answered while three hypotheses were tested at the 0.05 level of significance by using a questionnaire to elicit information from the respondents. The questionnaire tagged Impact of AI on Mathematics Graduate Employability (IAIMGE) has cronbach-Alpha value of 0.78. A significant difference was discovered in the Mathematics lecturers' opinion on the effect of AI on Mathematics graduate employability and Mathematics education sustainability based on gender and institution location (N=150; df=148; t=3.195; p=.05) and (N=150; df=148; t=3.012; p=.05), respectively. There was also a significant difference in the opinion of the lecturers based on institution type $F_{(2,147)}$=3.182, p<0.05). It was also discovered from the study that most Mathematics lecturers have not been using AI in their teaching, and they mainly believe that the use of AI in teaching Mathematics is a threat to Mathematics graduate employability. Most of them, however, believed that a Mathematics graduate will be of advantage in using AI if they develop their mathematical skill technologically. The study recommended that Mathematics lecturers should imbibe the use of AI in their teaching and instill in their students the opportunity of using their mathematical knowledge to develop AI which will take away any form of threat on their employability for sustainable Mathematics education in Nigeria.

Key Words: Artificial Intelligence, Employability, Sustainability

Introduction

Mathematics education is referred to as the practice of teaching and learning Mathematics in a way of solving problems involving learning the algorithms and formulas necessary for computations (Grootenboer, 2013). It is a platform to learn and teach Mathematics in a better way. The vision of all Mathematics teachers, tutors, and educators all over the world is to provide effective Mathematics education and practical training in the application of Mathematics, which

is capable of opening windows of employment opportunity to Mathematics graduates in the labour market. Golden (2018) opined that there is a global spotlight on Mathematics realization as a gateway to economic progress. The usefulness of Mathematics cuts across man's daily life activities such as tailoring, carpentry, driving, town planning, surveying, photographing, and so on, which indicates the importance of Mathematics as a subject required and to be reckoned with in all fields human endeavors (Salman, 2009). Mathematics is seen to be engaging and taxing; these are very good factors and necessary means of employability, as it provides major background for science and technology, which are required for national development. Mathematics education aims to provide its graduates with professional knowledge, intellectual skills, attitudes, and the ability to apply mathematical concepts to practical situations. Powering the teaching of Mathematics in the 21st century with technologies like Artificial Intelligence (AI) applications have permeated and transformed various disciplines like healthcare, banking, gaming, transportation, including Mathematics education.

Artificial intelligence (AI), according to Haenlein & Kaplan (2019), is a multidisciplinary field that with the intention of developing intelligent machines that can perform tasks which can typically be performed by human being. AI is a software instructor that is designed to perform tasks that typically require human intelligence, such as learning, teaching, reasoning, computing, interpreting, calculating, analysing, and giving perceptions. In the field of Mathematics education, AI offers novel solutions that have the potential to alter how students learn and how teachers teach. AI seeks to create intelligent systems that can perform tasks separately and adapt to various environments (Ayanwale et al., 2024). The influence of AI on Mathematics education is significant in personalised learning, from individualised learning experiences to sophisticated problem-solving tools. One of the primary benefits of AI in Mathematics education is individualised learning. AI-powered platforms can assess individual students' strengths and weaknesses, learning styles, and rates of cognitive growth (Jaiswal & Arun, 2021). AI is a data-driven method that enables educators to adjust learning materials and exercises to the needs of individual students, thus maximizing engagement and optimizing understanding (Gaudet, 2022).

Studies revealed that the engagement of AI in the teaching of Mathematics saves time in covering a large aspect of the curriculum and significantly reduces the cost of service. The Mathematics AI algorithm machine can also automate complex processes and minimize downtime by predicting maintenance needs (Owan et al, 2023). Integrating Artificial Intelligence (AI) into Mathematics education promotes promising advancements and potential pitfalls in terms of employment. Striking a balance between AI-driven developments and preserving core human

pedagogical principles is critical in the teaching and learning of Mathematics education (Duan, Edwards, and Dwivedi, 2019). In the sphere of Mathematics, AI technologies offer a band of potential benefits such as personalise instruction, adaptive assessment, interactive learning environments, and real-time feedback, among others and challenges like lack of creativity and problem-solving skills, inability to explain, lack of reasoning ability, bias in data and algorithms, absence of emotional intelligence, data privacy security concern and many more (Opopescu, 2022).

Opesemowo and Adekomeja (2024) described the types of AI that are used in enhancing the teaching of Mathematics as Mathway, which is described as the present world's smartest calculator for algebra, graphing, calculus, and more. It is an online problem-solving tool that uses AI to help students solve the most difficult Mathematics problems step-by-step by typing the problems or snapping a photo of the problems into the application. Another one is Photomath, which is a mobile camera solver application that uses AI to provide mathematical solutions, solve complex mathematical problems step-by-step with explanations. Another AI-enhanced Mathematics teaching is Mathematics, which is a computational software system that uses AI to help students explore Mathematics concepts and solve problems. Geogebra is another one, and it allows teaching and learning of Mathematics to be done through this application more smartly. It provides a platform to connect enthusiastic teachers and students of Mathematics. It is a dynamic Mathematics software that uses AI to help students visualize and interact with Mathematics concepts. Khan Academy is an AI-powered mathematics and a top-rated AI for education, which is a personalized teaching and learning system that uses AI to tackle homework challenges, save time in preparation, and provide real-time feedback and guidance. Dream box Learning is an online Mathematics platform that uses AI to give instructions to learners and helps teachers to differentiate and adapt to students' learning needs. Curriculum Associates' i-Ready is an online instructional program for reading of Mathematics instruction, and assessment platform that uses AI to personalize learning. It helps teachers determine students' needs. IBM's Watson-powered Mathematics is an artificial intelligence computer system created by IBM to answer mathematical questions posed in natural language. It is a research–based AI system that provides personalised Mathematics instruction.

Employability, according to Lee Harvey (2000), refers to the possession of abilities, skills, attributes, instincts, and experiences developed through higher levels of learning and knowledge to secure a job, sustain the job, adapt to all challenges, and develop career advancement. Lee Harvey argues that employability is a process of learning and not a product. It is described as the

capacity of any graduate to get a satisfying job, secure the job, keep the job, cope with the changing technology, endure with labour market conditions, and build a career above all challenges. Studies revealed that the knowledge of Mathematics education has always been an encouragement to Mathematics graduates to be gainfully employed in all sectors such as in commerce, industries, accountancy, banking, finance, teaching, agriculture, and so on (Adebiyi, 2021). Graduates of Mathematics are well prepared with certain mathematical skills that are capable of facing and overcoming challenges in any of their chosen careers. They are provided with graduate job skills and the skills required in any workplace. Studying Mathematics develops capacity for logical and traditional thinking as it helps to approach problems objectively, evaluate evidence, make sound judgments based on available data and facts, fostering a well-rounded approach to decision-making (Amador & Lamberg, 2013). Based on these attributes, Mathematics graduates are found employable in nearly all areas of work as a Teacher, Market Research Analyst, Financial Planner, and Insurance Underwriter. Purchasing Manager, Data Scientist. Statistician, Operations Research Analyst. There is no field of human endeavor where the application of the knowledge of Mathematics is not useful. The knowledge of Mathematics is helping workers to collect, compute, analyse, interpret data and solve problems. Its knowledge teaches other important practices which includes approaching tasks methodically, pay attention to detail, and think abstractly. Some profession whichs focused on numbers such as Accountants, Bankers, Cost Estimators, Auditors, and Evaluators, are obvious users of mathematical knowledge. Teaching Mathematics using qualified Mathematics teachers plays a crucial role in inspiring students to learn and pursue careers in science, technology, engineering, and Mathematics (Dragan and Lakshmi, 2020).

Objective of the Study

The use of AI applications is gradually becoming popular in virtually all fields of study. This application can teach students even without the assistance of a physical teacher. This application is being extended to teaching of Mathematics despite the peculiarity of the subject, which involves relating to figures and full explanation from the teacher. This study therefore seeks the opinion of the Mathematics lecturers on their awareness and usage of AI applications in teaching Mathematics, as well as the impact it has on Mathematics graduate employability and the sustainability of Mathematics education in Nigeria.

Research Question

The research question raised to guide the study was:

1. What is the mean rating on the extent of threat of AI application to Mathematics graduate employability and sustainability of Mathematics education?

Research Hypotheses

The following null hypotheses were formulated to guide the conduct of the study:

1. There is no significant difference in the opinion of a Mathematics lecturer on the impact of AI application as a threat to Mathematics graduate employability and the sustainability of Mathematics education based on gender.
2. There is no significant difference in the opinion of a Mathematics lecturer on the impact of AI application as a threat to Mathematics graduate employability and sustainability of Mathematics education based on institution location.
3. There is no significant difference in the opinion of Mathematics lecturers on the impact of AI application as a threat to Mathematics graduate employability and sustainability of Mathematics education based on institution type.

Methodology

The study adopted a survey research design for proper representation of the entire group. The population of the study comprised six hundred and thirty-eight (638) Mathematics lecturers in all the tertiary institutions in Oyo state, Nigeria. A simple random sampling technique was adopted to select one hundred and fifty Mathematics lecturers, both male and female, from all the universities, polytechnics, and colleges of education in Oyo state. The study consisted of eighty-two (82) male and sixty-eight (68) female respondents, forty-two (42) of the respondents' institutions were recited in the city while one hundred and eight (108) were in less city. Fifty-eight (58) of the respondents were university lecturers, thirty-eight (38) were polytechnic/monotechnic lecturers and fifty-four (54) were from colleges of education. The questionnaire was the only instrument for data collection. The questionnaire tagged Impact of AI on Mathematics Graduate Employability (IAIMGE) was designed in Likert form with two sections. The first section contained the demographic information about the respondents based on their gender, institution type, whether university, polytechnic, or college of education, and institution location, whether city or less city. The second section contained 20 items to seek information from the respondents on the impact of AI on Mathematics graduate employability. The respondents were required to indicate their level of agreement and disagreement with each of the statements in the instrument. The reliability of the instrument was determined using Cronbach's alpha reliability method after administering the instrument to 20 Mathematics lecturers outside the study population. Their responses were subjected to statistical analysis, and the instrument yielded a reliability of 0.78, which was considered adequate and suitable for the study. A mean rating scale

was used in answering the research question, and an independent sample t-test as well as analysis of variance (ANOVA) was used to test the hypotheses at the 0.05 level of significance.

Results

Table 1: Socio-demographic information of the Respondents

Variable	Frequency	Percentage (%)
Gender		
Male	82	54.67
Female	68	45.33
Total	**150**	**100.0**
Institution Location		
City	42	28.00
Less city	108	72.00
Total	**150**	**100.0**
Institution type		
University	58	38.67
Polytechnic	38	25.33
College of Education	54	36.00
Total	**150**	**100.0**

It can be seen from table 1 above that 54.67% of the respondents are male, while 45.33% are female. The table revealed that 28.00% of the respondents' lecture in the institution situated in the city, while 72.00% of them lecture in the institution situated in less city. 38.67% of the respondents' lecture in the university, 25.33% lecture in the polytechnic, while 36.00% lecture in the college of education.

Research Question 1: What is the mean rating on the extent of treat of AI application to Mathematics graduate employability and sustainability of Mathematics education?

Table 2: Table of the mean rating on the extent of treat of AI application to Mathematics graduate employability and sustainability of Mathematics education

S/N	ITEM	SA	A	SD	D	N	X	Decision
1	I'm aware and familiar with Mathematics Artificial Intelligence (AI) applications	30	85	20	15	150	2.58	Accepted
2	I always use the Mathematics AI application to teach my students	34	36	57	23	150	2.11	Rejected
3	I find the Mathematics AI application suitable for Mathematics teaching, grading, and assessment	19	23	83	35	150	2.01	Rejected
4	I find the use of AI applications creative and comfortable	35	46	32	37	150	2.56	Accepted
5	I consider the Mathematics AI application as lacking inherent human values	83	29	35	03	150	3.19	Accepted
6	AI application may eventually replace Mathematics teaching jobs in the future	67	35	18	30	150	2.78	Accepted
7	An AI Mathematics application can be regulated by a Mathematics teacher	55	74	35	36	150	3.12	Accepted

8	Mathematics educators should be worried about the ethical implications of AI.	80	32	24	14	150	3.18	Accepted
9	AI applications can eventually lead to job displacement	60	32	28	30	150	3.22	Accepted
10	AI applications can surpass human intelligence in the teaching of Mathematics	18	12	60	60	150	2.12	Rejected
11	AI application teaching strategies are better than those of Mathematics educators	32	38	49	31	150	2.21	Rejected
12	AI applications have the potential risk of teaching Mathematics in primary & secondary schools	20	38	57	35	150	2.31	Rejected
13	An AI application can be found to be so supportive in teaching all the mathematical concepts	27	25	58	40	150	2.34	Rejected
14	AI applications play a major role in addressing the challenges facing Mathematics education	47	50	26	27	150	2.72	Accepted
15	Mathematics graduates can be employed to develop AI applications based on their mathematical knowledge and experience	120	15	08	07	150	3.13	Accepted
16	An AI application is a threat to the teacher/student relationship in teaching Mathematics	56	57	27	10	150	3.11	Accepted
17	Some mathematical concepts can assist Mathematics graduates to be employed in the development of AI applications	67	45	10	28	150	2.85	Accepted
18	Mathematics students at any level should not be exposed to the use of AI applications as it encourages laziness	45	36	30	39	150	2.52	Accepted
19	Mathematics Education might be difficult to sustain without the use of a Mathematics teacher	32	30	52	36	150	2.11	Rejected
20	Mathematics educators at all levels must be educated on the use of AI applications for global acceptability	56	70	14	10	150	3.23	Accepted
	Weighted Average						**2.67**	**Accepted**

Table 2 shows the mean rating on the extent of treat of AI application to Mathematics graduate employability and sustainability of Mathematics education. The table shows that most lecturers are aware and familiar with Mathematics Artificial Intelligence (AI) applications (M= 2.58); some of them that have been using AI application and they find the use of AI application creative and comfortable (M=2.56); most of them consider Mathematics AI application as lacking inherent human values (M= 3.19); the respondents agreed that AI application may eventually replace Mathematics teaching jobs in future (M= 2.78); they agreed that Mathematics educators should be worried about ethical implications of AI (M=3.18) and that AI applications can eventually lead to job displacement (M=3.22); they believe that Mathematics graduates can be employed to develop AI application based on their mathematical knowledge and experience (M= 3.13) as some mathematical concepts can assist Mathematics graduates to be employed in the development of AI (M=2.72). The respondents agreed that though AI application is a threat to the teacher/student relationship in teaching Mathematics (M=2.85), Mathematics educators at all levels must be educated on the use of AI applications for global acceptability (M=3.23).

Hypotheses Testing

Ho_1: There is no significant difference in the opinion of Mathematics lecturers on the impact of AI application as a threat to Mathematics graduate employability and sustainability of Mathematics education based on gender

Table 3: Independence sample t-test Analysis of Mathematics lecturers' opinion on the impact of AI application based on gender

Group	N	Mean	SD	df	t	Sig.	Remarks
Male	82	56.47	1.17	148	3.195	.000	Sig
Female	68	56.29	2.31				

Significant level of 0.05

Table 3 revealed a p-value (0.000) is less than the alpha value of (0.05) level of significance at df (148). Since the p-value observed is less than the alpha value, it means the difference is significant. It was observed that male lecturers have higher opinions than female lecturers, with a mean of 56.47 and a standard deviation of 1.17. Therefore, the null hypothesis, which states that there is no significant difference in the opinion of Mathematics lecturers on the impact of AI application as a threat to Mathematics graduate employability and sustainability of Mathematics education based on gender, was rejected.

Ho_2: There is no significant difference in the opinion of Mathematics lecturers on the impact of AI application as a threat to Mathematics graduate employability and sustainability of Mathematics education based on institution location

Table 4: t-test Analysis of Mathematics lecturers' opinion on the impact of AI application based on institution location

Group	N	Mean	SD	df	t	Sig.	Remarks
City	42	56.55	1.77	148	3.012	.000	Sig
Less City	108	56.12	2.48				

Significant level of 0.05

Table 4 revealed a p-value (0.000) is less than the alpha value of (0.05) level of significance at df (148). Since the p-value observed is less than the alpha value, it means the difference is significant. It was observed that lecturers lecturing in the city have higher opinions than their counterparts lecturing in the less city towns with a mean of 56.55 and a standard deviation of 1.77. Therefore, the null hypothesis, which states that there is no significant difference in the opinion of Mathematics lecturers on the impact of AI application as a threat to Mathematics graduate employability and sustainability of Mathematics education based on institution location, was rejected.

Ho_3: There is no significant difference in the opinion of Mathematics lecturers on the impact of AI application as a threat to Mathematics graduate employability and sustainability of Mathematics education based on institution type

Table 5: Analysis of Variance of the opinion of Mathematics lecturers on the impact of AI application based on institution type

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	328.882	2	164.441	3.182	.000
Within Groups	3879.833	147	20.748		
Total	4208.716	150			

Table 5 indicates the summary of the analysis of variance of the opinion of Mathematics lecturers on the impact of AI application as a threat to Mathematics graduate employability and sustainability of Mathematics education based on institution type. The F value obtained was 3.182 with the associated probability value of (0.000), which is less than the 0.05 level of significance in favour of the lecturers lecturing in the university. It therefore means that the result was significant and the null hypothesis that there is no significant difference in the opinion of Mathematics lecturers on the impact of AI application as a threat to Mathematics graduate employability and sustainability of Mathematics education based on institution type was rejected.

Discussion of Findings

The study revealed that most lecturers are familiar with AI applications, but many of them have not been using them in their teaching. Those who have been using it find it creative and comfortable, but it lacks human values and a teacher/ student relationship. The study shows that Mathematics educators should be worried about job displacement that the use of AI application can cause by introducing their students to the use of AI application and the opportunity for building of these applications that is open for them as Mathematics expert which is in line with Lee Harvey (2000) who said that the possession of abilities, skills, attributes, instinct, and a range of experiences developed through higher-level of learning and knowledge to secure a job, sustain the job, adapt with all challenges and develop a career advancement.. It is described as the capacity of any graduate to get a satisfying job, secure the job, keep the job, cope with the changing technology, endure with labour market conditions, and build a career above all challenges. The result of the hypotheses revealed a significant difference in the opinion of the Mathematics lecturers, as they have diverse opinions on the effect of the use of AI applications as a threat to Mathematics graduate employability based on gender, institution type, and institution location. This might be as a result that an individual has a diverse opinion on the same issue and no two

people can think the same way on a particular issue, irrespective of the gender, institution type, and location of their institution.

Conclusion

Most of the current working environment are now digitalized, which makes it quite different from the previous working age. The consideration of using technology in the teaching of Mathematics, such as Artificial Intelligence (AI) Algorithms as an alternate pedagogy for teaching Mathematics, also becomes a trending subject for discussion. Technologies provided the groundwork for the AI revolution, which is still shaping our world today, with AI becoming increasingly important. AI has made significant strides and impacts in transforming various aspects of human life, including Mathematics education (Macmillan, 2023). AI offers great promise, and by embracing its software, teachers can transform their teaching practices, enhance student learning outcomes, and become more effective educators, but it also comes with challenges and potential drawbacks, as earlier highlighted. This study explores the positive impact of AI in Mathematics education, examines the possible negative aspects, and discusses the ethical considerations associated with the employability of Mathematics graduates if AI is fully integrated into the teaching and learning of Mathematics. It is important to know that Mathematics education will be ultimately sustained if AI limitations are addressed; this can only be achieved if AI is used with human teachers rather than relying solely on the use of Artificial Intelligence Instruction.

Recommendations

It was recommended based on the study that:

1. The use of AI in teaching Mathematics should be encouraged since some Mathematics lecturers have used it and find its usage creative and comfortable
2. Mathematics educators at all levels should be educated on the use of AI applications and pass same to their students for global recognition
3. Since different people have different ideology on the use of AI to teach Mathematics, its usage should be gradual to allow for natural interest to be developed.
4. Mathematics lecturers should instill in their students the opportunities available for them in using their mathematical knowledge in developing AI applications which will alleviate any form of threat on their employability for sustainable Mathematics education in Nigeria.

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