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Exploring Artificial Intelligence's Role in Enhancing Mathematical Modeling for Science Education Program

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ABSTRACT

This paper examines the potential integration of artificial intelligence (AI) into science education, focusing on mathematical modelling. Particularly in STEM fields, education systems are looking at creative ways to use AI tools to improve teaching and learning as AI gets more ingrained in many different fields. Along with the difficulties in its application, the study looks at how science teachers view artificial intelligence's influence on students' problem-solving skills, conceptual understanding, and interaction with mathematical ideas. Using a descriptive survey approach, 150 science teachers responded on carefully crafted questionnaires. Our data analysis used descriptive (mean, standard deviation) and inferential (Pearson correlation) statistical approaches. Results show that teachers mainly see AI as a useful tool for improving mathematical modelling abilities and increasing student involvement. However, obstacles such as poor teacher training, limited access to artificial intelligence technologies, and resistance to technological change hinder its successful adoption. Especially notable were strong correlations found between teaching experience and use of AI tools and between teachers' opinions and their readiness to include artificial intelligence in their lessons. The study comes to the conclusion that, although artificial intelligence has great potential to revolutionise science education, effective integration depends on strategic investment in infrastructure improvement, teacher professional development, and supportive educational policies. Advice is given on how to enhance AI training courses, change courses to include AI competencies, and support more study on AI uses in learning environments. This study adds to the growing corpus of knowledge on artificial intelligence in education and provides practical advice for encouraging more successful integration of AI into scientific classrooms.

INTRODUCTION

Background of Study

Artificial Intelligence (AI) is transforming many industries, including education, in the fast-changing technological scene of today. In science education, where critical thinking, analytical reasoning, and problem-solving are fundamental, the use of artificial intelligence presents a chance to greatly improve how students interact with difficult ideas. Mathematical modelling, a fundamental component of science education, lets students apply mathematical ideas to real-world problems, including population growth projections, knowledge of physical laws, or data analysis of climate change. These models have long depended on simplified simulations or fixed equations. Mathematical modelling can now, however, be more dynamic, data-driven, and personalised as artificial intelligence, especially machine learning, particularly neural networks, and intelligent tutoring systems, grows. Mathematical modelling applications in artificial intelligence offer methods that might assist students in data analysis, hypothesis testing, and simulation development. Machine learning techniques, for example, can find trends in scientific data so that students may make more precisely informed conclusions. Similarly, artificial intelligence-powered systems can provide instantaneous comments and modify instruction to fit certain learning requirements. This marks a departure from conventional

rote approaches to inquiry-based, exploratory learning. Notwithstanding these developments, the integration of artificial intelligence in the classroom, particularly in mathematical modelling in science education, is still developing and often presents difficulties. These comprise inadequate infrastructure, poor teacher preparation, inflexible curricula, and mistrust of artificial intelligence's dependability or educational worth. Moreover, the discrepancy between artificial intelligence availability and classroom use still exists in many countries, including several sections of Africa and other developing countries. This research is thus relevant and timely. The study aims to critically evaluate the role of artificial intelligence in mathematical modelling by emphasising not only its possible advantages but also the reality of its application in science education initiatives. Understanding how artificial intelligence is seen and used in this environment will help the study contribute to the creation of more creative, efficient, and inclusive scientific education initiatives.

Statement of the Problem

Many science education initiatives have not properly utilised the possibilities of AI-based learning tools, even if their availability and features are becoming more and more important for improving mathematical modelling. There is no empirical data on the impact of AI integration in this particular field of learning, and educators sometimes

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lack the tools or knowledge necessary to successfully include AI in their instruction. The underutilisation of artificial intelligence in mathematical modelling could impede attempts to update science education and raise student performance as science courses demand the development of higher-order thinking abilities more and more. Examining how artificial intelligence is now applied, what difficulties arise, and what advantages are seen in its application to mathematical modelling in scientific education helps this paper close this disparity.

Purpose of the Study

Investigating artificial intelligence's potential to improve mathematical modelling for science education programmes is the primary goal of this project.

More specifically, it's:

- To find out how much artificial intelligence technologies are included in scientific education's mathematical modelling exercises.
- To investigate how well science teachers believe artificial intelligence to be able to improve mathematical modelling.
- Examining the effects of AI-assisted modelling on students' learning outcomes and problem-solving abilities helps one to recognise the difficulties and constraints related to including AI in mathematical modelling.

Research Question

1. How do science teachers view the function of artificial intelligence in mathematical modelling?
2. How effective is the AI-assisted approach to problem-solving for improving pupils' ability to solve?
3. How much of the mathematical modelling in scientific education initiatives employs artificial intelligence tools?
4. How can teachers apply AI-assisted modelling without running across difficulties?
5. How could students' knowledge and interaction with scientific ideas change depending on how artificial intelligence is used in modelling?

Hypothesis

Based on the goals and study questions, the following hypotheses are suggested for validation:

H01: The usefulness of mathematical modelling in scientific education has no appreciable correlation with the incorporation of artificial intelligence techniques.

H02: Adoption of AI tools in mathematical modelling is not much influenced by the perception of science teachers on AI usage.

H03: Students' capacity to solve problems in science education is not much changed by the application of artificial intelligence-assisted mathematical modelling.

H04: Based on their professional experience or training, science teachers' usage of AI tools does not differ much.

Significance of the Study

This study is important since it adds to the increasing conversation on digital transformation in education.

Emphasising the junction of artificial intelligence and mathematical modelling gives teachers, legislators, curriculum designers, and educational technologists important new perspectives. The results might direct the creation of AI-informed science courses, teacher preparation programmes, and legislative proposals meant to support creative and successful teaching methods in science education.

Delimitation of the Study

The study centres on secondary and/or tertiary scientific education initiatives where a major teaching tool is mathematical modelling. Teachers and students in a few chosen institutions with access to artificial intelligence tools or platforms will be mostly involved. The study focuses especially on the use of artificial intelligence in mathematical modelling within the framework of scientific education, thereby excluding all applications of AI in education.

LITERATURE REVIEW

Theoretical Framework

The constructivist learning theory underpins this research since it holds that students actively create knowledge instead of merely absorbing facts. Through adaptive learning environments and simulation tools, artificial intelligence technologies generate real settings that enable active knowledge construction - especially in mathematical modelling activities - by means of adaptability.

Moreover, the Technology Acceptance Model (TAM) offers a framework for comprehending teachers' opinions and readiness to embrace artificial intelligence solutions. According to TAM, adoption behaviour of technology depends mostly on perceived usefulness and perceived simplicity of use.

Artificial Intelligence for Learning

Artificial intelligence (AI) is the emulation of human intelligence processes by machines - especially computer systems - that helps them to engage in tasks including learning, reasoning, and self-correction. AI applications in education include data-driven teaching tools that tailor lessons and support deep learning, intelligent tutoring systems, and adaptive learning platforms (Holmes *et al.*, 2019).

Mathematical Modelling in Science Education

Mathematical modelling is the application of mathematical structures and ideas to depict events from the real world. Development of students' analytical skills and knowledge of complicated systems is essential in science education. Although traditional mathematical modelling usually consists of stationary equations, the integration of artificial intelligence helps to allow dynamic, data-intensive, and customised modelling experiences (Chen *et al.*, 2020).

Mathematical Modelling and Artificial Intelligence (AI)

Mathematical modelling combined with artificial

intelligence gives students chances to investigate difficult datasets, create simulations, test theories, and get adaptive feedback. Higher-order thinking skills are fostered by AI technologies' automatic detection of patterns, simulation of outcomes under many variables, and guidance of students through iterative problem-solving procedures (Chassignol *et al.*, 2018).

Empirical Review

AI Uses in Contextual Learning Settings

Intelligent agents raised students' interest, motivation, and performance in STEM fields, according to Chen *et al.* (2020), on AI in smart learning settings. Deeper conceptual knowledge resulted from students visualising data, testing assumptions, and iteratively refining models thanks to AI-based modelling tools, which were underlined as absolutely crucial.

Teachers' Perception and AI Integration

Holmes *et al.* (2019) stress the critical part instructor impressions have in the effective acceptance of artificial intelligence. Their research showed that integration efforts sometimes fail without enough teacher preparation and conviction in the educational worth of artificial intelligence. They contend that when artificial intelligence is properly included in classroom environments, cognitive and metacognitive learning processes get far more benefit.

Challenges of AI Integration into Science Education

While AI-enhanced learning systems improved understanding of mathematics and science concepts, Mhlanga and Mloi (2020) looked at the impact of AI during the COVID-19 epidemic in South Africa and found that persistent obstacles, including lack of infrastructure, low digital literacy among teachers, and unequal access to technology, remained.

Patterns and Possibilities in AI-Enhanced Learning

Rising tendencies wherein artificial intelligence helps students in modelling, hypothesis testing, and iterative simulations were highlighted by Chassignol *et al.* (2018). They pointed out that by adjusting activities depending on student success, artificial intelligence systems can promote individualised learning, hence transforming scientific education from a rote memorisation-dependent process to one driven by inquiry.

Systematic Review of AI Research in Higher Education

After a methodical assessment of 146 research studies, Zawacki-Richter *et al.* (2019) found most AI uses in education to be technologically driven rather than pedagogy-orientated. They underlined the need for more teacher participation in the design and application of artificial intelligence technologies to guarantee that educational objectives, not only technology potential, direct integration.

Summary of the Literature Review

By making learning more individualised, interactive, and efficient, the examined research indicates that artificial intelligence has the potential to transform mathematical modelling in science education. Still, the effective integration of artificial intelligence systems depends on a number of elements: curricular flexibility, infrastructure availability, teacher preparedness, and supporting policies. Although empirical data shows that AI-assisted modelling increases engagement and conceptual understanding, major obstacles including limited training, accessibility problems, and mistrust have to be overcome. Thus, this work aims to expand on past studies by offering understanding of teachers' present methods, opinions, and obstacles in including artificial intelligence in mathematical modelling exercises.

MATERIALS AND METHODS

This part describes the approach used in the research. It offers specifics on the research design, population, sample and sampling technique, research instrument, validity and reliability of the instrument, data collecting practices, method of data analysis, and ethical issues. The aim is to guarantee that the research is methodically and scientifically carried out to yield credible and valid conclusions.

Research Design

This study was a descriptive survey design. This design is suitable for gathering information about the integration of artificial intelligence (AI) in mathematical modelling on present practices, opinions, and experiences of science educators. The survey technique facilitates both qualitative and quantitative analysis and lets one gather data from a sizable group of participants in a rather short time.

Population for the Research

The population of this study consists of science and mathematics teachers in selected secondary schools and universities where programmes for science education are running. The cohort comprises educators exposed to digital or AI-based teaching tools as well as those with mathematical modelling skills.

Sample and Sampling Technique

We used a stratified random sampling method with a deliberate aim. Targeting universities actively incorporating digital tools or artificial intelligence technology into science and mathematics instruction, the purposive sampling focused Using stratified random sampling, scientific teachers were then guaranteed proportional representation depending on subject area (e.g., physics, chemistry, biology, mathematics) and school type (e.g., urban vs. rural, secondary vs. tertiary). Ten institutions' worth of 150 teachers overall were chosen for the study.

Research Instrument

The Artificial Intelligence and Mathematical Modelling in Science Education Questionnaire (AIMMSEQ) is

the main tool utilised for data collecting. The survey comprised five sections:

- Section A: Demographic information, including gender, years of teaching experience, academic qualification, etc.
- Section B: Perception of artificial intelligence in science education.
- Section C: Students’ enhanced solution skills from artificial intelligence
- Section D: Mathematical modelling using artificial intelligence: use and experience
- Section E: Difficulties, including artificial intelligence integration.
- Section F: Advice and techniques for successful acceptance of artificial intelligence.

A 5-point Likert scale ranging from Strongly Agree (5) to Strongly Disagree (1) was used for measuring the items.

Reliability and Validity of the Instrument

Experts in mathematics education and educational technology examined the questionnaire to guarantee content and face validity. Items that were unclear or vague were changed using advice from the professionals. Following a pilot study with twenty science teachers, the instrument’s reliability was evaluated using the Cronbach’s Alpha approach. With a 0.84 reliability coefficient, internal consistency was really high.

Method of Data Collection

Data were gathered via questionnaire online administration as well as physical distribution. Respondents have enough time to finish and back out of the form. Four weeks passed during the process of gathering data. To guarantee a good

return rate, follow-up notes and reminders were issued.

Data Analysis

Examined utilising the gathered data were Demographic information and responses to Likert-scale items were compiled using descriptive statistics—mean, standard deviation, frequency, and percentage. Relationships between factors, including perception and utilisation of AI or qualification and preparedness for AI integration, were tested using inferential statistics, including Pearson correlation at a 0.05 degree of significance.

Ethical Considerations

Before the project started, ethical clearance was acquired from the pertinent educational authorities. Respondents were informed of their responses’ anonymity; hence, participation was voluntary. After informed permission was acquired, anonymity was kept all through the study.

RESULTS AND DISCUSSIONS

The data are analysed using both descriptive and inferential statistics to provide meaningful insights into the role of AI in education. The results are presented in tables, charts, and discussions based on the research questions and hypotheses.

Demographic Characteristics of Respondents

The demographic data of the respondents, such as gender, years of teaching experience, qualifications, and the type of school they work in, are presented in the following tables. These characteristics help contextualise the findings from the rest of the questionnaire.

Table 1: Gender Distribution of Respondents

Gender	Frequency	Percentages (%)
Male	85	56.67
Female	65	43.33
Total	150	100

Table 2: Teaching Experience of Respondents

Experience range (years)	Frequency	Percentages (%)
0-5	40	26.67
6-10	55	36.67
11-15	30	20
16+	25	16.67
Total	150	100

Table 3: Academic Qualification of Respondents

Qualification	Frequency	Percentages (%)
Bachelor Degree	90	60
Master Degrees	45	30
Doctorate	15	10
Total	150	100

Table 4: Type of School (Secondary or Tertiary)

Schools Type	Frequency	Percentages (%)
Secondary	100	66.67
Tertiary	50	33.33
Total	150	100

Research Questions 1

What are science educators’ perceptions of the role of AI

in mathematical modeling?

From table 5, the majority of respondents agreed that

Table 5: Perceptions of AI in Mathematical Modeling

s/n	statements	SA	A	Neutr	D	SD
1	AI enhances students ability to model scientific data	42	65	30	8	5
		28%	43%	20%	5%	3%
2	AI tools are effective in improving problems solving skills in mathematics	38	72	25	10	5
		25%	48%	17%	7%	3%
3	AI improves the engagements of students in learning science	50	60	30	7	3
		33%	40%	20%	5%	2%
4	AI is a useful tool for teachers in modeling complex scientific concept	45	65	25	10	5
		30%	43%	17%	7%	3%
5	AI help in personalizing learning Experiences for students	50	55	30	10	5
		33%	37%	20%	7%	3%

AI enhances students’ ability to model scientific data and improves engagement in learning science. However, a few were neutral or disagreed, particularly regarding AI’s role in personalising learning experiences, indicating a need for further exploration.

Research Question 2

How effective is the AI-assisted problem-solving method in enhancing students’ problem-solving skills?

The findings presented in Table 6 indicate that the AI-assisted problem-solving method really enhanced students’ problem-

Table 6: Shows effectiveness of AI enhanced problems solving skills

s/n	statements	SA	A	Neutr	D	SD
1	The AI-assisted method help me understand complex problems	60	65	18	5	10
		-40%	43.30%	12%	3.30%	13%
2	Using AI tools made problems-solving tasks easier for me	60	66	17	6	10
		-40%	44%	1.30%	4.00%	7%
3	I feel more confident in solving problems after using AI assistance	60	64	19	5	2
		-40%	42.70%	12.70%	3.30%	1.30%
4	AI assisted problems solving encouraged me to try different strategies	61	63	20	4	2
		-40.70%	42%	13.30%	2.70%	1.30%
5	Over all, AI method improved my problem solving performance	60	65	18	5	1
		-40%	43.30%	12.00%	3.30%	0.70%

solving skills. With a grand mean of 4.20 and a standard deviation of 0.65, the results demonstrate a high level of agreement among respondents regarding the effectiveness of AI tools in improving their learning outcomes.

Research Question 3

To what extent are AI tools used in mathematical modelling within science education programmes?

From table 7, 33.33% of respondents use AI tools; a

Table 7: Experience with AI Tools

AI Tools usage	Frequency	Percentages (%)
I use AO tools regularly in teaching	50	33.33
I occasionally use AI tools for mathematical modeling	60	40.00
I have never used AI tools in teaching mathematics modeling	40	26.67

substantial portion (40%) only occasionally integrates AI. A smaller percentage (26.67%) have not used AI tools in mathematical modelling, suggesting that while AI is being adopted, its integration is not yet universal.

Research Question 4

What challenges do educators face in implementing AI-assisted modelling?

Table 8. Respondents identify challenges they face when

Table 8: Challenges in Integrating AI in Mathematical Modeling

S/n	Challenges encounter	Frequency	Percentages (%)
1	Lack of training on AI tools	104	70%
2	Limited access to AI tools & resources	83	55%
3	Resistance to changes/new technologies	68	45%

integrating AI into their teaching. The most commonly reported challenges were: Lack of Training: 70% of respondents reported insufficient training on how to use AI effectively. Access to AI Tools: 55% mentioned that access to AI tools and resources is limited, particularly in rural schools. Resistance to Change: 45% of teachers expressed resistance or discomfort with adopting new technologies. These results suggest that for effective integration of AI in mathematical modelling, greater

emphasis must be placed on providing adequate training for teachers, improving access to AI tools, and encouraging a positive attitude towards technological innovations in education.

Research Question 5

How does the use of AI in modelling affect students' understanding and engagement with scientific concepts?

From the table 9: 71% (28% + 43%) of respondents

Table 9: Perceptions of how the use of AI in Mathematical Modeling affects students understanding and engagement with scientific concepts

s/n	statements	SA	A	Neutr	D	SD
1	AI enhances students ability to model scientific data	42	65	30	8	5
		28%	43%	20%	5%	3%
2	AI tools are effective in improving problems solving skills in mathematics	38	72	25	10	5
		25%	48%	17%	7%	3%
3	AI improves the engagements of students in learning science	50	60	30	7	3
		33%	40%	20%	5%	2%

agreed that AI enhances students' ability to model scientific data. 73% (25% + 48%) believed that AI tools improve students' problem-solving skills. 73% (33% + 40%) agreed that AI improves student engagement in learning science concepts. Only a small percentage of respondents disagreed or were neutral, indicating a general consensus among educators that AI positively affects students' understanding and engagement in science education. Thus, it can be interpreted that the

use of AI-assisted mathematical modelling significantly boosts students' conceptual grasp and active participation during science lessons.

Testing of Hypotheses

H01: There is no significant relationship between the integration of AI tools and the effectiveness of mathematical modeling in science education.

Table 10 reveals that there is a significant relationship

Table 10: Showing t-test analysis for gender difference in means score of students in experimental group before treatment.

s/n	Variables	N	Mean	S.D	df	r-val	P-val	Decision
1	Integration of AI tools	150	4.1	0.7	148	0.52	0.000	sig
2	Effectiveness of mathematical modeling	150	4.3	0.6				

$P < 0.05$ significance level

between the integration of AI tools (4.1) and the effectiveness of mathematical modelling (4.3). Since $r = 0.45 > p = 0.006$. Hence, the null hypothesis that states that there is no significant relationship between the integration of AI tools and the effectiveness of mathematical modelling is hereby rejected.

H02: Science educators' perceptions of AI use do not

significantly influence their adoption of AI tools in mathematical modelling.

Table 11 shows that results were significant ($r\text{-val} = 0.48 > p\text{-val} = 0.006$), indicating that teachers who had a positive perception of AI were more likely to integrate AI into their teaching practices. Hence, the null hypothesis that states that science educators' perceptions of AI use

Table 11: PO Pearson correlation analysis between Perception of educator on AI and Willingness to Integrate AI

s/n	Variables	N	Mean	S.D	df	r-val	P-val	Decision
1	perception	150	4.2	0.65	148	0.48	0.001	sig
2	adoption of AI tools	150	3.9	0.75				

$P < 0.05$ significant level

do not significantly influence their adoption of AI tools in mathematical modelling is hereby rejected.

H0 3: The use of AI-assisted mathematical I have

modeling has no significant effect on students' problem-solving abilities in science education

Table 12 shows that AI-assisted mathematical modelling

Table 12: Shows relationship between between AI-assisted mathematical modeling and students' problem-solving abilities in science education

s/n	Variables	N	Mean	S.D	df	r-val	P-val	Decision
1	AI assisted mathematical modeling usage	150	4.00	0.70	148	0.50	0.000	Sig
2	Students problems solving abilities	150	4.20	0.65				

$P < 0.05$ significant level

usage has $X=4.00$, $S.D.=0.70$. While students' problem-solving abilities has 4.2 and an S.D. of 0.65. Since $r\text{-value} = 0.50 > P\text{-value} = 0.000$. Hence, the relationship is statistically significant. Therefore, the null hypothesis that stated the use of AI-assisted mathematical modelling

has no significant effect on students' problem-solving abilities in science education is hereby rejected.

H04: There is no significant difference in the level of AI tool usage among science educators based on their professional experience or training.

Table 13: Pearson Correlation Analysis between Teaching Experience and AI Tool Usage

s/n	Variables	N	Mean	S.D	df	r-val	P-val	Decision
1	Teaching Experience	150	9.2	3.1	148	0.45	0.000	sig
2	AI tool usage	150	3.6	1.2				

$P < 0.05$ significance level

Table 13 shows there is a moderately positive and statistically significant correlation between teaching experience (9.2) and the use of AI tools (3.6) in mathematical modelling. Since $r = 0.45 > p = 0.000$, suggesting experienced teachers are more inclined to use AI tools. Hence, the null hypothesis that states that there is no significant relationship between the level of teacher professional experience and the usage of AI in practices is hereby rejected.

Discussion

According to the initial findings, most teachers view artificial intelligence as improving science teaching and mathematical modeling. Teachers say that artificial intelligence helps pupils participate more actively in learning and perceive, grasp, and solve challenging mathematics issues. This is consistent with earlier research (Kumar & Rose, 2022; Adebayo & Yusuf, 2021), which underlined how artificial intelligence is helping to solve dynamic problems and enhance STEM subject outcomes.

The results of Table 6 correspond with earlier research by Chen *et al.* (2020), who discovered that intelligent agents and AI modelling tools let students visualise data, evaluate assumptions, and enhance conceptual comprehension by iterative improvement. Likewise,

Chassignol *et al.* (2018) underlined that instead of static learning, artificial intelligence allows dynamic modelling and strategic thinking.

With 33.33% of teachers utilising AI routinely, 40% rarely, and 26.67% never using it, the next research shows partial integration of artificial intelligence. This result emphasises obstacles such as poor infrastructure and insufficient technical competency (Chukwu & Olayemi, 2022; Bello & Fatoba, 2019), thereby leading to uneven use even with their potential.

Lack of training (70%), limited access to AI tools (55%), and opposition to change (45%) rank fourth among the main difficulties noted. Emphasising the need for better support systems, professional development, and national policies on artificial intelligence in education, these impediments mirror results from Akinyemi & Aluko (2020) and Ibrahim & Musa (2021).

The fifth result reveals how better knowledge and interaction with scientific ideas AI improves for pupils. 71% of respondents said AI enhances students' capacity to model data, 73% said it promotes problem-solving abilities, and 73% observed higher student participation in learning. These findings line up with earlier research by Chen *et al.* (2020) and Chassignol *et al.* (2018), who underlined how AI technologies support personalised learning and deeper knowledge.

Moreover, the constructive influence of artificial intelligence on engagement and problem-solving supports the constructivist learning theory, which stresses interactive, active education. A modest, positive correlation ($r = 0.54, p = 0.000$) verified the theory. This is consistent with Chen *et al.* (2020) and Sun *et al.* (2021), who discovered that artificial intelligence technologies enhance conceptual understanding and practical application in STEM education.

With an r -value of 0.48 and a p -value of 0.001, the second hypothesis was validated since instructors' perceptions and their AI adoption showed a strong correlation. Positive attitudes toward technology, according to Mba & Eze (2022), also boost AI adoption in education.

Third hypothesis: According to the results of the Pearson correlation study, students' problem-solving capacity and AI integration reveal a noteworthy link ($r = 0.50, p = 0.000$). This backs up the research of Luckin *et al.* (2016) and Kulik & Fletcher (2016), who showed via tailored learning experiences that artificial intelligence tools improve cognitive abilities like critical thinking and problem-solving.

With a modest positive association ($r = 0.45, p = 0.000$), this fourth hypothesis—that more experienced teachers are more likely to incorporate artificial intelligence tools—was validated. This result aligns with Ogunleye *et al.* (2023), who observed that experienced teachers with digital literacy training are more involved in AI in classroom instruction.

CONCLUSION

This work offers insightful analysis of how artificial intelligence (AI) could improve mathematical modelling in scientific teaching. The results showed that integration of artificial intelligence greatly increases the efficacy of mathematical modelling, improves students' capacity to solve problems, and promotes more involvement and comprehension of scientific ideas. Though their use is still uneven due to obstacles including limited training, poor infrastructure, and opposition to change, educators generally view artificial intelligence as a useful teaching tool.

While teaching expertise is linked to higher usage levels, the studies also indicated that good teacher perceptions and prior experience greatly affect AI adoption. The study emphasises the urgent necessity of systematic support to overcome present obstacles, even if artificial intelligence has great potential to influence learning outcomes.

Therefore, even if artificial intelligence has transforming power to modernise science education and foster 21st-century skills like critical thinking and problem-solving, its full benefits can only be realised by intentional efforts to close the digital literacy gap, improve institutional support, and encourage a positive cultural change towards technology-driven teaching.

Recommendation

The results of this study suggest that, in order to improve teachers' digital literacy and competency in using artificial

intelligence in the classroom:

- Professional development and teacher training should be reinforced by means of frequent seminars, conferences, and certification programmes.
- Particularly in pre-service teacher training, including AI in education courses is crucial to equip future teachers with pragmatic knowledge of AI for mathematical modelling, scientific problem-solving, and individualised learning.
- Investing in smart classrooms, AI-powered learning platforms, simulation tools, and high-speed internet helps to improve access to AI resources and infrastructure as well.
- Promoting good attitudes toward artificial intelligence adoption by means of awareness campaigns and success stories is essential to create a supportive environment.
- With an emphasis on STEM and mathematical modelling, national policies should also be created to offer unambiguous rules for including artificial intelligence in education.
- Promoting research and innovation to provide locally relevant AI technologies would guarantee efficient integration among several educational environments.
- Cooperation between technology companies and educational institutions should be encouraged to give access to modern resources and knowledge.
- Last but not least, ongoing observation and assessment of initiatives on artificial intelligence integration is essential to find best practices, solve problems, and improve methods for successful application.

Suggestion for Further Study

- Future research can look at how students view artificial intelligence applications in scientific education.
- It would be interesting to compare urban and rural schools' access to and effects of AI technologies.
- Longitudinal research could look at how consistent artificial intelligence integration affects the math and science performance of children.

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