International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Mathematics Teachers' Familiarity with and Instructional Integration of Artificial Intelligence Tools

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Abstract
This undertaking analyzed the Level of Mathematics Teacher's Familiarity with and Integration of AI Tools in teaching Mathematics. Specifically, it sought answers to the following questions: 1). How familiar are teachers with various AI Tools used in teaching mathematics content? 2). What is the level of teachers' AI Tools Integration in teaching mathematics content? 3). Is there a significant difference in the level of teachers' familiarity and integration of AI tools in teaching mathematics content? 4). What intervention can be proposed to enhance the familiarity and integration of AI Tools in teaching mathematics?
This study utilized quantitative methods. Responses of the teachers were converted to numerical figures to facilitate computation. Descriptive-Evaluative design was used in this study.
Mathematics teachers were slightly familiar with the different AI Tools. They slightly integrate AI Tools in teaching mathematics. There is no significant difference in the level of familiarity and integration of AI Tools by teachers in teaching mathematics. An enhancement activity for the use of AI in basic education can be formulated.

Keywords: Familiarity, AI Integration, Mathematics Teaching

INTRODUCTION

Artificial intelligence (AI) integration has become a transformative force in contemporary education, particularly in mathematics instruction. AI refers to computer systems designed to simulate human cognitive processes such as learning, reasoning, and problem-solving (Russell & Norvig, 2022). Within educational settings, AI integration extends beyond mere technological adoption; it involves the systematic incorporation of intelligent systems into pedagogical design, instructional delivery, assessment, and feedback mechanisms. Through adaptive learning platforms, intelligent tutoring systems, and AI-driven analytics, educators are increasingly able to provide personalized, data-informed instruction that responds to learners' diverse needs.
The integration of AI in mathematics education is especially significant given the subject's abstract nature and cumulative structure. Mathematics learning often requires timely feedback, scaffolded support, and differentiated instruction—elements that AI systems are uniquely positioned to enhance. Adaptive AI technologies can analyze student responses in real time, diagnose misconceptions, and adjust task difficulty accordingly. Such responsiveness supports mastery learning and promotes deeper

conceptual understanding rather than procedural memorization. Research indicates that intelligent tutoring systems can produce learning gains comparable to individualized human tutoring when effectively implemented (Holmes et al., 2019). Consequently, AI integration offers a structured pathway for strengthening instructional quality and learner engagement in mathematics classrooms.

Globally, education systems are increasingly recognizing AI as a strategic component of digital transformation initiatives. In the Philippine context, the urgency of integrating innovative technologies is underscored by persistent challenges in mathematics achievement. Results from the 2022 Programme for International Student Assessment (PISA) revealed that Filipino learners performed significantly below the Organisation for Economic Co-operation and Development (OECD) average in mathematics (OECD, 2023). These outcomes highlight the need for instructional reforms that leverage emerging technologies to address learning gaps and enhance academic performance. AI integration, when aligned with curriculum goals and sound pedagogical principles, presents a viable strategy for supporting differentiated instruction in resource-constrained environments.

Beyond personalization, AI integration also strengthens formative assessment practices. AI-powered platforms generate immediate, actionable feedback that enables learners to monitor their progress and refine their problem-solving strategies. At the same time, teachers gain access to analytics dashboards that provide insights into patterns of performance, common misconceptions, and areas requiring targeted intervention. This data-driven approach supports evidence-based decision-making and allows teachers to shift from reactive to proactive instructional planning. However, effective integration requires more than access to tools; it demands teacher competence in digital pedagogy, critical evaluation of AI outputs, and ethical awareness regarding data use (UNESCO, 2021).

Policy frameworks further reinforce the importance of technology integration in education. The Philippine Development Plan 2023–2028 emphasizes digital transformation as a cornerstone of inclusive growth and improved public service delivery (National Economic and Development Authority [NEDA], 2023). Similarly, the Enhanced Basic Education Act of 2013 (Republic Act No. 10533) promotes learner-centered and technology-supported approaches consistent with global standards. These directives provide institutional support for the systematic integration of AI tools in teaching and learning processes, particularly in high-need subject areas such as mathematics.

Despite its promise, AI integration remains uneven and contingent upon factors such as teacher readiness, infrastructure, and contextual relevance. The success of AI-enhanced instruction depends on how thoughtfully these technologies are embedded within pedagogical frameworks rather than used as isolated supplements. Therefore, examining the extent and nature of AI integration in mathematics education is essential for informing policy, professional development, and instructional design. By focusing on AI integration within the Philippine mathematics classroom, this study seeks to contribute empirical evidence on how intelligent technologies can be strategically leveraged to improve teaching effectiveness and student learning outcomes in a rapidly evolving educational landscape.

Thus, this undertaking analyzed the Level of Mathematics Teacher's Familiarity with and Integration of AI Tools in teaching Mathematics. Specifically, it sought answers to the following questions: 1). How familiar are teachers with various AI Tools used in teaching mathematics content? 2). What is the level of teachers' AI Tools Integration in teaching mathematics content? 3). Is there a significant difference in the level of teachers' familiarity and integration of AI tools in teaching mathematics content? 4). What intervention can be proposed to enhance the familiarity and integration of AI Tools in teaching mathematics?

MATERIALS AND METHODS

This research used a descriptive-evaluative design using a quantitative methodology. During the academic year 2024–2025, the concentration was on Mathematics teachers at Pasacao district. Using total enumeration, 42 teachers was established as respondents of the study.

The study tool, a validated *AI Integration Survey Questionnaire* with reliability index of 88% ($\alpha = 0.88$) using Cronbach alpha, designed by the researcher, was utilized to gather information on thelevel of familiarity and integration of AI tools by the teacher.

Calculating means for level of familiarity and integration were all part of the data analysis process. Significant variations in the Level of Familiarity and Integration were found using Analysis of Variance.

RESULTS AND DISCUSSIONS

Level of Familiarity with Artificial Intelligence Tools by Mathematics Teachers

One of the purposes of this study was to explore the level of familiarity with the different AI Tools by teachers in teaching mathematics. These AI Tools were categorized as *AI Writing and Language Tools, Assessment and Engagement Tools, Math Assistance Tools* and *Communication Tools*.

Table 1. Level of Familiarity with Artificial Intelligence Tools by Mathematics Teachers

Categories of Artificial Intelligence Tools	Mean	Interpretation	Rank
AI Writing and Language Tools	3.75	High Familiarity	1
Assessment and Engagement Tools	1.5	Slight Familiarity	2
Math Assistance Tools	0.5	Low Familiarity	4
Communication Tools	1	Low Familiarity	3
Average	1.56	Slight Familiarity	

Legend: 0.00 - 1.00 – Low Familiarity
1.01 - 2.00 – Slight Familiarity
2.01 - 3.00 – Moderate Familiarity
3.01 – 4.00 – High Familiarity

The results presented in Table 1 indicate that the respondents achieved a combined mean score of 1.56, corresponding to the interpretation of *Slight Familiarity*. Specifically, for the AI Writing and Language Tools, the teachers recorded a mean score of 3.75 (*High Familiarity*), for Assessment and Engagement Tools, the mean score decreased to 1.5 (*Slight Familiarity*), for Math Assistance Tools, the mean score decreased to 0.5 (*Low Familiarity*), while the Communication Tools yielded a mean score of 1 (*Low Familiarity*). Based on the rankings, the *AI Writing and Language Tools* ranked first, followed by the *Assessment and Engagement Tools*, then the *Communication Tools*, with the *Math Assistance Tools* ranked last.

The findings indicate a significant disparity in teachers' familiarity with various categories of AI tools. While there is high familiarity with *AI Writing and Language Tools*, familiarity sharply declines across other tool categories, slight familiarity with *Assessment and Engagement Tools*, and low familiarity with both *Math Assistance Tools* and *Communication Tools*. This suggests that teachers are more exposed to and possibly more comfortable using general-purpose AI writing tools (e.g., ChatGPT, Grammarly), likely due to their broader applicability and ease of access.

However, the low familiarity with *Math Assistance Tools*, despite the subject-specific relevance, highlights a potential gap in the integration of AI in domain-specific pedagogy, particularly in mathematics. Similarly, the limited use of *Communication Tools* may point to missed opportunities for enhancing teacher-student and peer-to-peer interaction through AI-enabled platforms. These findings imply the need for targeted professional development and capacity-building programs that emphasize the awareness, accessibility, and pedagogical integration of underutilized AI tools, especially in mathematics instruction and digital communication. This could help balance the familiarity levels across tool categories and promote more holistic AI integration in teaching practices.

The results indicate a notable disparity in teachers' levels of familiarity with various categories of AI tools. While respondents reported high familiarity with AI Writing and Language Tools, their familiarity with Assessment and Engagement Tools, Communication Tools, and particularly Math Assistance Tools was markedly lower. This outcome is consistent with the findings of Zawacki-Richter et al. (2019) and Holmes et al. (2019), who emphasized that the successful integration of AI in education largely depends on teachers' awareness and competence.

Similarly, Zhai et al. (2021) observed that although educators generally acknowledge the potential of AI, their limited exposure and lack of training often hinder effective adoption in instructional practices.

Moreover, in the Philippine context, existing literature supports the current findings. For instance, Reyes and Salvador (2022) found that Filipino teachers, while aware of AI's general benefits, such as personalized instruction and automated feedback, remained unfamiliar with specific tools like AI-based tutoring systems and learning analytics platforms.

Level of Artificial Intelligence Tools Integration in Teaching

Another purpose of this study was to explore the extent to which teachers integrate Artificial Intelligence (AI) Tools in teaching mathematics. This process of integrating AI Tools was examined along the three phases of teaching as outlined in Phillip W. Jackson's Phases of Teaching Model namely, Pre-Active Phase, Inter-Active Phase and Post-Active Phase.

The results presented in Table 2 indicate that the respondents achieved a combined mean score of 2.37, corresponding to the interpretation of *Slight Integration*. Specifically, for the Pre-Active Phase, the teachers recorded a mean score of 2.75 (*Moderate Integration*), for Inter-Active Phase, the mean score decreased to 2.15 (*Slight Integration*), while for Inter-Active Phase yielded a mean score of 2.2 (*Slight Integration*). Based on the rankings, the Pre-Active Phase ranked first, followed by the Post-Active Phase, with the Inter-Active Phase ranked last.

Table 2. Level of Teachers' AI Tools Integration in Teaching Mathematics

Phases of Teaching	Mean	Interpretation	Rank
Pre-Active Phase	2.75	Moderate Integration	1
Inter-Active Phase	2.15	Slight Integration	3
Post-Active Phase	2.2	Slight Integration	2
Combined	2.37	Slight Integration	

Legend: 1.00 - 1.75– Low Integration
1.76 - 2.50– Slight Integration

2.51 - 3.25– Moderate Integration
3.26 – 4.00– High Integration

These findings suggest that, overall, mathematics teachers exhibit a *slight* level of integration of AI tools in their teaching practices. The results imply that AI tools are used to a similar extent during the planning, delivery, and post-delivery phases of lessons. Specifically, while the use of AI tools is marginally higher in the Pre-Active Phase, the integration remains relatively low across all three phases of teaching.

A closer examination of the data indicates that among the three teaching phases, the *Pre-Active Phase* garnered the highest mean score of 2.75, interpreted as *Moderate Integration*. This implies that teachers are more inclined to utilize AI tools during lesson planning and instructional preparation activities. In contrast, the *Inter-Active Phase* recorded the lowest mean score of 2.15, which, along with the *Post-Active Phase* mean score of 2.20, both fall under *Slight Integration*. This suggests a notable decline in AI tool usage during lesson delivery and assessment or reflection activities.

These results carry several implications. First, the relatively higher integration during the Pre-Active Phase may reflect a growing awareness among educators regarding the potential of AI to support instructional design and content development. However, the limited use during the Inter-Active and Post-Active Phases indicates potential challenges in applying AI tools dynamically during actual teaching and in post-instructional tasks such as evaluation and feedback.

Such findings point to a need for targeted professional development programs focusing on enhancing teachers' competencies in utilizing AI tools across all phases of instruction, particularly in real-time classroom interactions and post-lesson assessments. Moreover, institutional support through access to appropriate technologies and continuous training may be essential in promoting deeper integration of AI throughout the teaching and learning continuum.

In relation to Phillip W. Jackson's Phases of Teaching Model, in the pre-active phase, teachers slightly integrate AI Tools to plan and prepare for their lessons where AI tools can assist educators in developing customized lesson plans, identifying individual student needs through data analysis, and suggesting appropriate teaching strategies. AI tools can contribute to the creation of personalized learning experiences tailored to students' unique strengths and weaknesses. The slight integration of AI Tools in the pre-active phase of teaching could affect the execution of the lesson.

The interactive phase involves the actual teaching process. Moderate integration of AI tools integration at this stage can manifest in various forms, such as smart classrooms equipped with AI-driven interactive displays, virtual reality simulations, or AI-assisted tutoring systems. These technologies can enhance student engagement, provide real-time feedback, and adapt teaching methods based on students' responses and learning styles.

After teaching sessions, educators reflect on the effectiveness of their methods and assess student performance. The slight integration of AI Tools can alter the role it plays in this phase of automating the assessment process, providing insights into student progress, and offering recommendations for future improvements with could affect the students' performance in mathematics. Data analytics tools powered by AI can assist teachers in making data-driven decisions to refine their teaching approaches.

The result of this study was supported by Prieto, Gamazo, Cruz-Benito, Therón, and García-Peñalvo (2020) where they highlighted the growing role of AI assessment tools in education, emphasizing their ability to support teaching, learning, and student evaluation by improving educators' understanding of student progress and needs.

Similarly, Owan, Abang, Idika, Etta, and Bassey (2023) underlined the transformative potential of AI-powered educational tools in enhancing accuracy, streamlining processes, and providing personalized feedback, which allow teachers to tailor instruction and better support student success.

Additionally, Karan and Angadi (2023) provided a meta-review emphasizing the importance of teacher training and the integration of AI-based curricula for shaping the future of education. Melo (2023) explored the revolutionary potential of AI in education but also stressed the necessity of technical expertise, resources, and ethical considerations for its effective implementation.

In the Philippine context, Melchor et al., (2023) highlighted the potential of AI in enhancing mathematics education for Generation Alpha in the Philippines through personalized learning and critical thinking development. Similarly, Manrique & Palomares (2024) emphasized that teachers perceive AI tools as valuable and easy to use, although their familiarity with AI remains moderate.

Meanwhile, the slight integration of AI Tools by teachers could be attributed to the findings of Estrellado & Miranda (2023) where they enumerated challenges, such as resource limitations, data privacy concerns, and disparities in teacher training, need to be addressed through collaboration among educators and policymakers.

Vidal (2023) highlighted that stakeholders must balance AI's benefits, like intelligent tutoring and real-time feedback, with ethical considerations Additionally, Arguson et al., (2023) articulated that senior high school teachers in Manila are receptive to generative AI, citing ease of use and confidence in its application. These studies emphasize integrating AI in mathematics education while addressing ethical, resource, and training issues.

Significant Difference in level of Familiarity and Integration of Artificial Intelligence Tools by Mathematics Teachers

Added on the purposes of this study were to explore the significant difference in the level of familiarity and integration of the different AI Tools by teachers in teaching mathematics. These AI Tools were categorized as *AI Writing and Language Tools, Assessment and Engagement Tools, Math Assistance Tools* and *Communication Tools*, while the integration of AI Tools were examined on the phases of teaching namely, *Pre-Active Phase, Inter-Active Phase,* and *Post-Active Phase*.

The results indicate that the respondents achieved a *p*-value of 0.056853, corresponding to the interpretation of *Not Significant* for ANOVA on level of familiarity with AI Tools. Similarly, the teachers recorded a *p*-value of **0.064476** (*Not Significant*) for ANOVA on extent of AI Tools integration in teaching.

Table 3.a ANOVA for level of Familiarity with the different AI Tools by teachers

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.24	3	0.08	3.84	**0.056853**	4.066181
Within Groups	0.166667	8	0.020833			
Total	0.406667	11				

Legend: p-value < 0.05– Significant
p-value > 0.05– Not Significant

Table 3.b ANOVA for level of AI Tools Integration by teachers

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1.075556	2	0.537778	4.481481	**0.064476**	5.143253
Within Groups	0.72	6	0.12			
Total	1.795556	8				

Legend: p-value < 0.05– Significant
p-value > 0.05– Not Significant

The results presented in Table 3.a indicate that the respondents achieved a *p*-value of 0.056853, corresponding to the interpretation of *Not Significant* for ANOVA on level of familiarity with AI Tools. Similarly, on Table 3.b, the teachers recorded a *p*-value of **0.064476** (*Not Significant*) for ANOVA on extent of AI Tools integration in teaching.

The results presented in Tables 3.a and 3.b show that the computed p-values for both tests exceeded the conventional alpha level of 0.05, with a p-value of 0.056853 for the level of familiarity with AI tools and 0.064476 for the extent of AI tools integration in teaching. Both results are interpreted as *Not Significant*, indicating that there are no statistically significant differences among the respondents in these areas. This suggests that the participants, regardless of groupings or categories, generally share similar experiences or exposure to AI tools. Such uniformity may point to a common institutional framework, equal access to professional development opportunities, or limitations in the availability of diverse AI technologies across the schools represented in the sample.

Furthermore, the findings imply a homogenous implementation of AI tools in teaching practices. This could mean that while AI tools are being integrated into instruction, the manner and extent of this integration remain consistent—possibly limited—across the respondents. This may reflect systemic factors such as centralized training programs, standardized teaching practices, or shared challenges in adopting AI technologies in classroom settings.

Interestingly, while the results are statistically not significant, the p-values are relatively close to the 0.05 threshold. This marginal difference suggests that there may be emerging variations or trends that were not fully captured in the current analysis but could become significant with a larger sample size or more sensitive research instruments. As such, these findings point to the need for further investigation into the factors affecting AI tools usage in teaching, including teacher readiness, technological infrastructure, and administrative support.

Overall, the lack of significant differences underscores the necessity for more targeted and differentiated interventions to promote meaningful AI integration in education. Stakeholders may consider revisiting their approaches to professional development and technology integration to ensure that teachers not only have access to AI tools but are also equipped to utilize them effectively based on their unique instructional contexts.

These findings are consistent with several related studies that similarly report non-significant differences in teachers' familiarity with and integration of AI tools. For instance, a study on the integration of AI among African science teachers found that demographic variables such as gender, age, and location had no statistically significant effect on their intention to adopt AI tools. The researchers reported a p-value of 0.057, slightly above the standard threshold of significance, suggesting a relatively uniform disposition toward AI usage among respondents (Omodan & Ige, 2021). This closely aligns with the current study's results, where a p-value of 0.056853 was observed for AI familiarity.

Similarly, research involving K–12 online teachers in the United States found no significant relationships between teachers' level of familiarity with AI tools and their perceptions of AI's impact on student learning. Specifically, ANOVA tests indicated p-values of 0.71 for familiarity and 0.14 for actual usage, both well above the 0.05 level of significance (Trust et al., 2022). This reinforces the interpretation that regardless of their experience or exposure, teachers tend to exhibit consistent patterns in how they view and integrate AI tools into their teaching practices.

Moreover, a study conducted by Gündoğan (2023) examined the role of demographic factors in shaping attitudes toward AI in education. The results showed that variables such as age, sex, and teaching experience had no significant influence on teachers' attitudes or behaviors regarding AI use. These findings support the interpretation that uniform training opportunities, shared policy directives, or standardized access to technology may contribute to the observed homogeneity in familiarity with and use of AI tools among teachers.

Taken together, these studies provide empirical support for the current findings, underscoring the absence of statistically significant group differences in AI familiarity and integration. They also highlight the need for educational institutions to focus on systemic and programmatic improvements rather than relying on demographic distinctions when designing professional development for AI integration.

Enhancement Program for Mathematics Teachers' Familiarity and Integration of AI Tools

One of the primary outcomes of this study is the development of a targeted enhancement program designed specifically to strengthen teachers' familiarity with mathematics with and integration of artificial intelligence (AI) tools in instruction. Rather than focusing broadly on AI adoption in basic education, this initiative centers on mathematics teachers as key agents of instructional innovation. The program serves as a structured framework to support teachers in developing technical competence, pedagogical confidence, and strategic integration skills necessary for embedding AI tools meaningfully within mathematics teaching.

The findings of the study indicate that mathematics teachers demonstrate varying levels of familiarity with different categories of AI tools, as well as differing degrees of instructional integration. While there is evident interest in utilizing AI to enhance mathematics instruction, the results suggest that familiarity does not always translate into consistent pedagogical application. In particular, teachers showed stronger awareness of general AI applications but more limited exposure to AI tools specifically designed for formative assessment, adaptive practice, and data-driven instructional planning. Statistical analyses further revealed significant differences in familiarity and integration levels, underscoring the need for structured professional development interventions tailored to mathematics educators.

In response, the proposed enhancement initiative—**"Strengthening AI Integration in Mathematics Instruction"**—is designed as a focused professional development program exclusively for mathematics teachers. The program aims to: (1) deepen conceptual understanding of AI and its pedagogical affordances in mathematics education; (2) expand teachers' familiarity with AI tools relevant to problem-solving, assessment, and differentiated instruction; and (3) enhance their capacity to integrate AI systematically across the pre-active, inter-active, and post-active phases of teaching.

The program is structured into three core components. First, a foundational module introduces mathematics teachers to AI-driven platforms that support adaptive learning, automated feedback, item generation, and learning analytics. Emphasis is placed on evaluating tools based on mathematical accuracy, alignment with curriculum standards, and appropriateness for diverse learners. Second, a pedagogical integration workshop guides teachers in embedding AI tools into lesson planning, classroom facilitation, and assessment design. Participants engage in collaborative lesson redesign, microteaching demonstrations, and reflective discussions focused on maintaining conceptual rigor while leveraging AI support. Third, an implementation and mentoring phase provides ongoing guidance as teachers apply AI-integrated strategies in their mathematics classrooms, document best practices, and reflect on instructional impact.

A critical dimension of the program involves responsible and ethical AI integration. Mathematics teachers are guided in establishing clear boundaries for AI use, ensuring that technology enhances rather than replaces mathematical reasoning. Discussions include academic integrity, data privacy, and strategies for preventing overreliance on automated solutions. By foregrounding pedagogy over technology, the initiative reinforces the teacher's central role in cultivating higher-order thinking and problem-solving skills.

This enhancement program directly addresses the gaps identified in the study by transforming familiarity into purposeful instructional integration. By equipping mathematics teachers with structured training, practical experience, and reflective support, the initiative promotes sustainable AI integration aligned with curricular goals and learner needs. Ultimately, strengthening teachers' familiarity and integration competencies contributes to more responsive, data-informed, and engaging mathematics instruction in an increasingly technology-driven educational landscape.

Based on findings, Mathematics teachers were slightly familiar with the different AI Tools. They slightly integrate AI Tools in teaching mathematics. There is no significant difference in the level of familiarity and of AI Tools by teachers in teaching mathematics. An enhancement activity for the use of AI in basic education can be formulated. This enhancement activity can be used as a blueprint for educators in incorporating AI in the teaching and learning process to maximize student's learning

Given that mathematics teachers were found to be only slightly familiar with, and to only slightly integrate, AI tools in their teaching practice, it is recommended that comprehensive professional development programs be implemented. These programs should provide structured and sustained training opportunities, including workshops, seminars, and collaborative learning activities aimed at deepening teachers' understanding of AI tools and their pedagogical applications. Furthermore, teachers should be provided with access to relevant AI resources and exemplars of effective integration in mathematics instruction. Enhancing teachers' familiarity and capacity to incorporate AI tools is essential to fostering more innovative and effective teaching practices in mathematics.

CONCLUSIONS

1. The teachers were slightly familiar with the different AI Tools in teaching mathematics.
2. Teachers slightly integrate AI Tools in teaching lessons in mathematics.
3. There is no significant difference on the teacher's level of familiarity and integration of AI Tools in teaching Mathematics content.
4. An enhancement program to enhance the level of familiarity and integration of AI Tools by mathematics teachers can be developed.

ACKNOWLEDGEMENTS
The researcher would like to express his earnest gratitude to his supportive wife-Jocelyn N. Orogo, to all Department of Education (DepEd), to the research staff Ms. Ara Jill E. Umali and to all of the respondents for making this study a reality and to Almighty for the strength and all unspeakable gifts.

REFERENCES

1. Ahmad, S., Rahmat, M., Mubarik, M., Alam, M., & Hyder, S. (2021). Artificial intelligence and its role in education. *Sustainability.* https://doi.org/10.3390/su132212902
2. Cardona, M. A., Rodríguez, R. J., & Ishmael, K. (2023, May). *Artificial intelligence and the future of teaching and learning.* U.S. Department of Education. https://www2.ed.gov/documents/ai-report/ai-report.pdf
3. Casal-Otero, L., Catala, A., Fernández-Morante, C., & others. (2023). AI literacy in K-12: A systematic literature review. *International Journal of STEM Education, 10*(29). https://stemeducationjournal.springeropen.com/articles/10.1186/s40594-023-00418-7
4. Chai, C., Lin, P., Jong, M., Dai, Y., Chiu, T., & Huang, B. (2020). Factors influencing students' behavioral intention to continue artificial intelligence learning. *2020 International Symposium on Educational Technology (ISET),* 147–150. https://doi.org/10.1109/ISET49818.2020.00040
5. Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access, 8,* 75264–75278. https://doi.org/10.1109/ACCESS.2020.2988510
6. Ifenthaler, D., & Schumacher, C. (2023). Reciprocal issues of artificial and human intelligence in education. *Journal of Research on Technology in Education, 55,* 1–6. https://doi.org/10.1080/15391523.2022.2154511
7. Karan, B., & Angadi, G. R. (2023). Artificial intelligence integration into school education: A review of Indian and foreign perspectives. *Millennial Asia, 0*(0). https://doi.org/10.1177/09763996231158229
8. Kuleto, V., Ilić, M., Dumangiu, M., Ranković, M., Martins, O., Păun, D., & Mihoreanu, L. (2021). Exploring opportunities and challenges of artificial intelligence and machine learning in higher education institutions. *Sustainability.* https://doi.org/10.3390/su131810424
9. Kumar, V., & Raman, R. (2022). Student perceptions on artificial intelligence (AI) in higher education. *2022 IEEE Integrated STEM Education Conference (ISEC),* 450–454. https://doi.org/10.1109/ISEC54952.2022.10025165
10. Melo, N. (2023, February 16). *Incorporating artificial intelligence into the classroom: An examination of benefits, challenges, and best practices.* eLearning Industry. https://elearningindustry.com/incorporating-artificial-intelligence-into-classroom-examination-benefits-challenges-and-best-practices
11. Mohaghegh, M. (2020). The role of artificial intelligence in the future of education. *Iranian Journal of Virtual Learning and Medical Sciences, 11,* 65–67. https://doi.org/10.30476/IJVLMS.2020.85472.1021
12. Nadi, A., Hossain, S., Safin, M., Sofin, M., & Akhter, R. (2022). Discovering the role of artificial intelligence in K12. In *Designing effective distance and blended learning environments in K-12.* https://doi.org/10.4018/978-1-7998-6829-3.ch018
13. Park, J., Teo, T. W., Teo, A., & others. (2023). Integrating artificial intelligence into science lessons: Teachers' experiences and views. *International Journal of STEM Education, 10,* 61.

https://doi.org/10.1186/s40594-023-00454-3

14. Prothero, A. (2023, June 15). *How teachers are integrating AI into their daily tasks.* Education Week. https://www.edweek.org/technology/how-teachers-are-integrating-ai-into-their-daily-tasks/2023/06
15. Tsai, D., Huang, A., Lu, O., & Yang, S. (2021). Automatic question generation for repeated testing to improve student learning outcome. *2021 International Conference on Advanced Learning Technologies (ICALT),* 339–341. https://doi.org/10.1109/ICALT52272.2021.00108
16. Younis, H. A., Ruhaiyem, N. I. R., Ghaban, W., Gazem, N. A., & Nasser, M. (2023). A systematic literature review on the applications of robots and natural language processing in education. *Electronics, 12*(13), 2864. https://www.mdpi.com/2079-9292/12/13/2864