Teacher Candidates' Perceptions of AI Integration in Secondary Education: A Comparative Study of STEM and Non-STEM Majors

Jung Colen
Bellarmine University, United States

Teacher Candidates' Perceptions of AI Integration in Secondary Education: A Comparative Study of STEM and Non-STEM Majors

Jung Colen

Article Info	Abstract
	This study delves into teacher candidates' (TCs) perspectives, particularly in secondary mathematics and science education. Through qualitative analysis of survey data and essays from 17 TCs across two institutions, including 9 STEM education major TCs (math and science TCs), and 8 non-STEM TCs, diverse attitudes towards AI integration emerge. Our finding shows that more STEM TCs exhibit enthusiasm than non-STEM TCs. However, both groups emphasized the need for ethical AI use and students' critical thinking skills. Their exposure to AI-embedded classroom experiences also showed differences. This study underscores the importance of tailored mathematics teacher education programs for AI integration in preparing future secondary teacher educators. In summary, this study not only sheds light on the perspectives of secondary TCs on AI integration but also provides actionable recommendations for enhancing teacher education programs to better prepare future educators for AI-enhanced classrooms.

Introduction

The rapid advancement of Artificial Intelligence (AI) technologies has spurred significant interest in its potential applications within educational settings. Recent studies have highlighted the transformative capabilities of AI in enhancing teaching and learning experiences (Baidoo-Anu & Ansah, 2023; Crompton & Burke, 2023; Cukurova, 2024; Holstein et al., 2019; Martínez-Comesaña et al., 2023; USDE, 2023; Zhou, 2023). Martínez-Comesaña et al. (2023) noted a substantial increase in publications on AI in education, underscoring its growing significance. While the potential benefits of AI integration are widely recognized, including personalized learning, efficient administrative processes, and innovative instructional strategies, concerns regarding ethics, creativity, and critical thinking persist (Borenstein & Howard, 2021; Karran et al., 2024). Understanding the perspectives of various stakeholders, particularly preservice teachers (TCs), is crucial for effective AI integration in education. Previous research has explored the attitudes of in-service teachers, policymakers, and educators toward AI around the world (e.g., Ayanwale et al., 2022; Colen & Colen, in press; Fundi et al., 2024; Galindo-Domínguez, et al., 2024; Pak et al., 2024; Park et al., in press), but there remains a gap in understanding how TCs, especially those specializing

in secondary STEM education, perceive and envision the role of AI in their future classrooms. This study aims to fill this gap and extend the literature by examining TCs' views on AI integration in secondary education, including STEM and non-STEM education majors.

Literature Review

AI in Education

AI has rapidly emerged as an educational force and captured global attention for its potential. For some examples, the U.S. Department of Education (USDE, 2023) emphasizes that AI can support personalized learning by adapting to individual student needs and ultimately enhancing their learning outcomes; UNESCO reported Singapore and South Korea's integration of AI into their national curricula and teacher training programs to enhance students' learning outcomes (2023); and Finland has also developed AI literacy initiatives that focus on equipping both students and educators with essential AI competencies (The 74, 2023).

A growing body of research has contended the benefits of AI integration in education (Crompton & Burke, 2023; Egara & Mosimege, 2024; Shi et al., 2024). These benefits include AI's capacity to automate tasks such as grading, attendance tracking, and even lesson planning, potentially enabling teachers to focus more on instructional activities. AI can also empower adaptive assessments by providing real-time feedback and data-driven instructional decisions based on student progress. Despite these addressed benefits, significant challenges remain in AI integration. Notably, ethical issues surrounding AI use are an ongoing concern. Borenstein and Howard (2021), for example, argue that AI ethics education is essential to address challenges such as data privacy, algorithmic bias, and the potential to undermine critical thinking and creativity in students.

Perspectives of TCs

Assessing TCs' perspectives is critical in designing teacher education programs that align with their beliefs and equip them with the necessary skills for AI-integrated instruction. Flores et al. (2014) suggest that understanding how TCs' views on their training is key to sustaining quality teacher education. Research indicates that teachers' attitudes toward technology significantly influence their classroom adoption and effective use of these tools (Ertmer & Ottenbreit-Leftwich, 2010; Ghimire & Edwards, 2024; Li, 2024; Rana, 2012). As AI becomes increasingly prevalent in educational settings, it is paramount to explore how TCs perceive AI as an instructional tool and its impact on their near future teaching. TCs' perceptions can provide valuable insights into the potential facilitators and barriers of AI integration in education.

Research indicates that STEM TCs often hold distinct perspectives compared to non-STEM TCs. For example, Looi et al. (2020) found that STEM TCs were more likely to view computational thinking as logical reasoning. Hartmann et al. (2022) reported diverging vacation interests between these two groups. These studies suggest that STEM TCs and non-STEM TCs may possess different attitudes and beliefs regarding educational issues. Thus, this study aims to explore if there are any differences in TCs' perceptions of AI and identify specific needs and concerns that should be addressed in teacher training programs.

AI and STEM Education

In STEM education, there has been a significant push for the integration of AI. This trend is evident in scholarly papers and special calls for contributions. For example, *Special Call for Connections Manuscripts: Artificial Intelligence in Mathematics Teacher Education* (AMTE, 2024) aimed to gather research on the effective integration of AI in mathematics teacher education (MTE). Additionally, new positions on AI's role in mathematics education are being published, such as the National Council of Teachers of Mathematics (NCTM, 2024)'s *Artificial Intelligence and Mathematics Teaching*. These efforts highlight the growing recognition of AI's potential to transform mathematics education by enhancing teaching methods, personalizing learning, and increasing student engagement. Furthermore, UNESCO states that AI has the potential "to address some of the biggest challenges in education today, innovate teaching and learning practices, and accelerate progress" to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (UNESCO, 2023).

STEM education presents unique opportunities and challenges for AI integration. AI tools can offer the benefits addressed above. Despite these advantages, the educational system has historically been slow to adopt new technologies, often due to concerns about efficacy, accessibility, and teacher training (Rogers, 2000). Resistance to rapid change and adoption of AI in classrooms may stem from institutional inertia and ethical considerations (Borenstein & Howard, 2021; Karran et al., 2024). Now, this sparked my curiosity about TCs' perspectives on AI in their near future instructions.

Moreover, I became interested in how STEM education TCs and non-STEM education TCs perceive AI differently. Thus, I focus on the perspectives of STEM TCs and compare them with those of non-STEM TCs to understand their attitudes toward AI integration in secondary education. By exploring these perspectives, I aim to provide insights that can inform the development of MTE programs and support the effective and ethical integration of AI in secondary STEM classrooms.

Methodology

This study employed qualitative methods to explore the perspectives of 17 TCs from two universities, one in the Southern and the other in the Eastern region of the USA. The participants are all secondary education majors, including sophomores, juniors, and Master of Arts in Teaching (MAT) students. Specifically, 9 participants specialized in STEM education (6 in mathematics and 3 in sciences), and 8 specialized in non-STEM subjects. Among the latter, 4 focused on English Language Arts and Reading, 3 on Social Studies/History, and 1 on various subjects, including Art, Physical Education, Dance, Music, Theatre, and Languages Other Than English (LOTE).

Table 1 presents the demographic information of the participants. To ensure confidentiality, I assigned each participant a unique identifier (e.g., P01, P02, etc.). The table details key attributes such as participants' major, academic year, gender, institutional affiliation (Institution A or B), and self-reported familiarity with AI on a scale of 1 to 5, where 1 represents minimal familiarity and 5 indicates extensive familiarity. I highlighted the STEM education major TCs (STEM TCs) in the table.

Table 1. Demographics of Participants

Participant ID	Major	Year of School	Gender	Institution	Familiarity to AI
P01	English Language Arts and Reading	Sophomore	F	A	4
P02	English Language Arts and Reading	Sophomore	F	A	5
P03	English Language Arts and Reading	Sophomore	F	A	4
P04	Social Studies/History	Sophomore	M	A	4
P05	Mathematics	Sophomore	F	A	1
P06	English Language Arts and Reading	Sophomore	F	A	4
P07	Social Studies/History	Sophomore	M	A	5
P08	Mathematics	Sophomore	F	A	1
P09	Mathematics	Sophomore	F	A	3
P10	Mathematics	Senior	M	B	3
P11	Social Studies/History	MAT	F	B	5
P12	Art, Physical Education, Dance, Music, Theatre, and LOTE	MAT	M	B	3
P13	Mathematics	MAT	M	A	3
P14	Mathematics	MAT	M	A	3
P15	Science	Junior	M	A	3
P16	Science	Sophomore	F	B	4
P17	Science	Sophomore	F	B	5

The main data collection method was online surveys. The survey items (see Appendix) asked question items regarding TCs' perspectives on AI's role in lesson planning and delivery, their views on the teacher-AI relationship, the impact of AI on instructional strategies, and their perceptions of the benefits and challenges of integrating AI in education. As an additional data resource, I collected the TCs' reflective essays in which the participants shared their thoughts on AI's potential future role in their classrooms. To investigate potential

differences, I compared responses between Math TCs and non-Math TCs around the emerging themes by employing a thematic analysis approach.

First, I reviewed this data set and identified initial patterns from the survey items. Next, I categorized participants into two groups: STEM TCs and non-STEM TCs to compare their responses. Then, I reviewed their essay statements that support the corresponding TC's responses in the survey. Through this analysis, I refined the emerging patterns into three themes: (1) the potential benefits of AI integration on teaching, (2) AI's perceived impact on student learning, and (3) the potential applications of AI in teaching practices. In the Findings section, I will compare the survey responses and essay statements from STEM TCs and non-STEM TCs within each identified theme. This comparative analysis uncovered nuanced differences in attitudes and beliefs regarding AI integration in secondary education.

Findings

The participating TCs expressed a mix of optimism and skepticism about AI integration in education. In general, STEM TCs exhibited a pragmatic approach toward AI, focusing on its ability to assist their teaching and classroom management. In contrast, most non-STEM TCs were more cautious about utilizing AI in their teaching. In this section, I present what I have found from the collected data within three themes: potential benefits of AI integration, AI's impact on student learning, and the possible use of AI for teaching.

Potential Benefits of AI on Teaching

I found different perspectives between STEM and non-STEM TCs regarding the benefits of AI integration in their teaching as shown in Table 2. Most STEM TCs expressed optimism about AI's role in enhancing their teaching practices. In particular, they highlighted AI's potential to save time in lesson planning and implementation which allows them to focus more on effective lesson delivery ("cut down on time used to prepare lessons"; "Efficient and saves me time to work on other things like executing the lesson"). Many STEM TCs also recognized AI's capacity to generate ideas and resources that can enrich classroom activities. Notably, some STEM TCs emphasized AI's ability to offer diverse teaching strategies ("giving good ideas to use"; "many ways to solve a math problem or input on how to structure a topic"; "useful in finding more teaching resources."), support the development of varied problem sets ("question formatting and assignment formatting"; "help create examples that would focus on certain things in problems"), and introduce new teaching techniques ("...various techniques…in my classroom"; "new…techniques or teaching methods").

On the other hand, non-STEM TCs displayed more mixed perspectives about AI's direct benefits to student learning outcomes. While some acknowledged AI's potential to generate new teaching ideas or serve as a supplementary resource ("an additional resource to students to enhance their learning and understanding"; "AI can help me plan, and build new ways to teach lessons"; "giving teachers and students more ideas on how you do things"; "can be helpful for my lesson planning as it can give me some ideas of what activities I can do"), many expressed doubts about its overall value in their classrooms. The non-STEM TCs explicitly stated they did not

see AI as a significant benefit or intend to use it in their lesson planning, indicating a perceived lack of value in AI integration ("Not so sure…but i cannot think of any specific benefits yet. "; "I don't think there will be any"; "I don't see AI as a huge benefit to my classroom": "I don't think it will bring any").

Table 2. TCs' Perspectives on Potential Benefits of AI Integration

STEM Ed Major TCs' Responses	Non-STEM Ed Major TCs' Responses
- I think AI could potentially cut down on time used to prepare lessons for me as a teacher. I do not think AI will necessarily benefit student learning outcomes in a math classroom. - Learning about potential AI tools may be a good way to incorporate new and various techniques or teaching methods in my classroom. - Efficient and saves me time to work on other things like executing the lesson. - By giving good ideas for how to execute a lesson and by giving good ideas to use. - I would use AI to help students learn about the many ways to solve a math problem or input on how to structure a topic. - I would imagine that AI would help create examples that would focus on certain things in problems that some students could utilize. - AI can be incorporated for question formatting and assignment formatting, but AI will most likely not be incorporated into the classroom in extreme ways. - I think it helps me to plan and deliver the lessons better because AI can be useful in finding more teaching resources.	- I think it could be beneficial as an additional resource to students to enhance their learning and understanding. - AI can help me plan, and build new ways to teach lessons. - Not so sure. ai might help with giving teachers and students more ideas on how you do things, but i cannot think of any specific benefits yet. - I don't think there will be any. - I don't see AI as a huge benefit to my classroom. Only to allow students to do tasks when assigned. - I don't think it will bring any. - I think AI-powered tools like ChatGPT can be helpful for my lesson planning as it can give me some ideas of what activities I can do for some holidays, but for delivery I think it is all on me.

Impact on Student Learning

STEM and non-STEM TCs held distinct perceptions of AI's potential impact on student learning outcomes (Table 3). While their responses were often general, more STEM TCs expressed optimism, noting AI's potential to enhance creativity ("Students can be more creative"), motivation ("more motivation, or more interest in the

subject"), and differentiation ("If the differentiation is possible because of using of AI tools, students' learning outcomes will improve"; "AI can allow differentiation and will diagnose and provide a path for individual students"). While three STEM TCs expressed uncertainty about AI's benefits for student learning, none voiced negative opinions about AI integration.

In the meantime, non-STEM TCs generally have a hesitant or skeptical view of AI's benefits for student learning. Several of their responses indicate uncertainty or a lack of clarity about AI's benefit for their students. For example, some stated that they are unsure if AI could offer any real benefit for their students ("I am not sure about benefits for my students"). Several non-STEM TCs displayed negative views regarding AI's potential benefits ("I don't see any benefit"; "There is no benefit for students"; "I don't see AI as a huge benefit to my classroom"). Only one non-STEM TCs acknowledged AI's potential as "an additional resource to students to enhance their learning and understanding," indicating a more positive, albeit supplementary, view. Another TC mentioned that "AI might help with giving students more ideas on how to do things," suggesting a limited but positive view of AI's role in stimulating student thinking.

Both groups share a degree of uncertainty, but the overall tone from STEM TCs was more favorable toward the idea that AI could play a positive role in education, particularly in terms of differentiation and supporting individual students' needs. Non-STEM TCs, in contrast, appear to need more information or experience before they can assess AI's effectiveness in the classroom.

Table 3. TCs' Perspectives on AI's Benefit on Student Learning

STEM Ed Major TCs' Responses	Non-STEM Ed Major TCs' Responses
● I do not think AI will necessarily benefit student learning outcomes in a math classroom.	● I am not sure about benefits for my students.
● Students can be more creative as the AI takes the manual work away.	● i think ai might help with giving students more ideas on how to do things
● I think more motivation, or more interest in the subject knowing they have something to fall back on so they are not as lost.	● I don't see any benefit.
● If the differentiation is possible because of using of AI tools, students' learning outcomes will improve.	● I don't see AI as a huge benefit to my classroom. Only to allow students to do tasks when assigned.
● AI can allow differentiation and will diagnose and provide a path for individual students.	● There is no benefit for students.
● I am not sure.	● I think it could be beneficial as an additional resource to students to enhance their learning and understanding.
● I don't know.	● I'm not sure.

Possible Use of AI for Teaching

The third category is about how participating secondary TCs anticipated their use of AI in their future teaching. STEM TCs generally perceived AI as a valuable teaching tool to integrate into their instruction (Table 4). Recognizing the potential of AI to streamline various aspects of teaching, the STEM TCs highlighted AIs ability to create assignments and lesson plans, specifically in generating practice problems, answer sheets, and worksheets ("to help me make assignments and activities"; "create resources to use within the classroom. It can help me outline lesson plans and make corresponding worksheets"; "helpful in lesson planning in the forms of creating worksheets and creating problem sets for the students"; "AI gives more ideas to incorporate real-world word problems for the tests"). Additionally, they noted that AI could improve mathematics instruction by providing accurate problem sets with verified solutions ("without any error"; "it almost guarantees a problem with an associated correct answer").

In contrast, the responses from non-STEM TCs present a more cautious approach in using AI in their teaching (Table 4). While some express interest in AI as a resource for lesson planning and generating ideas, others remain pessimistic about its broader use in teaching. One TC suggests using AI exclusively for brainstorming and organizing content rather than for actual student assignments or writing tasks. There is a notable reluctance to embrace AI as a tool that could fundamentally alter the traditional methods of teaching and learning, with one TC explicitly stating that AI conflicts with the core values of education.

Table 4. TCs' Perspectives on the Use of AI for Teaching

STEM Ed Major TCs' Responses	Non-STEM Ed Major TCs' Responses
● I can use AI in the classroom to help me make assignments and activities. For example, if I am teaching the class about one-step equations, I can have the computer generate practice problems for the students to complete. Because it can create step-by-step answer for the questions, I can easily provide my students answer sheet without any error. ● AI can help me create resources to use within the classroom. It can help me outline lesson plan and make corresponding worksheets. ● AI-powered tools can be helpful in lesson planning in the forms of creating worksheets and creating problem sets for the students. With the use of AI in this way, it almost	● I have not thought too deeply into using AI to help with these aspects of teaching but I could do so by asking AI for recommendations for resources to assist in a lesson. ● no clue. ● I want my students to know that I want them to use the benefits of AI to get ideas or help them better understand an object. I also want to use it to help build my lesson plans. ● I don't. I think it anathema to the act of teaching and learning. ● I may allow the use for ideas for brainstorm only. Not for their writing. ● I would say I would use it to help organize things and put it in a sturdy format.

STEM Ed Major TCs' Responses	Non-STEM Ed Major TCs' Responses
guarantees a problem with an associated correct answer rather than myself having to think of new problems in every lesson. • I think using AI gives more ideas to incorporate real-world word problems for the tests.	

However, when asked about specific AI tools or applications they envision using to enhance student learning, many STEM TCs expressed limited prior knowledge or experience with AI (Table 5). Although some STEM TCs mentioned specific AI tools such as ChatGPT, Gemini, and Canva, their exposure to these tools were limited ("I have never personally used AI before"; "I am not aware with the AI tools or applications"; "I do not have prior knowledge of AI tools or other applications").

The non-STEM TCs in this study did not explicitly mention their prior experience with AI tools. However, their responses revealed a significant level of uncertainty and a cautious, limited view of AI's role in teaching. Many did not envision using AI at all, indicating a lack of planning and consideration of specific tools ("I am unsure right now what tools and applications I would like to use in my classroom"; "i don't plan on using ai"; "I don't envision using any"; "Not sure"). While the majority were hesitant, two TCs with English Language Arts and Reading emphasis suggested using AI (specifically ChatGPT) to generate resources or ideas, such as aiding with essay writing and definitions ("I would probably only use things such as generative AI; "The use of CHATGPT could give students a better understanding or a start to writing a paper").

Table 5. TCs' Responses on Specific AI Tools and Applications in Teaching

STEM Ed Major TCs' Responses	Non-STEM Ed Major TCs' Responses
• I have never personally used AI before so I am unsure of what AI tools and applications are available to students that would enhance their learning experience. • I am not aware with the AI tools or applications so I have not looked into using them to enhance student learning experiences yet. • I do not have prior knowledge of AI tools or other applications in the classroom, so I am not aware of how these can apply to student learning	• I would probably only use things such as generative AI to help with resources and ideas for lessons but would get my content based off of those recommendations from an additional source. • I am unsure right now what tools and applications I would like to use in my classroom. • i don't plan on using ai, unless it makes something that could grade a paper instantly then ill [sic] use that. • I don't envision using any.

STEM Ed Major TCs' Responses	Non-STEM Ed Major TCs' Responses
experiences. ● Chat gpt ● Gemini and chat BTC [sic]. ● To find questions tailored to students' interests. ● I do not invision [sic] using AI in the classroom in many ways, although it may be helpful to create concept maps or form questions. ● I do not envision using them. I am aware of a tool called Magic School AI. ● I am familiar with ChatGPT and Canva. But I will see if there are more tools. I heard that the students' textbooks incorporate AI Digital functions so that differentiation will be more available for them and I want to learn more about that.	● The use of CHATGPT could give students a better understanding or a start to writing a paper. I note that the beginning of an essay can be difficult to start, so this tool could be beneficial to get the students on track. ● I would say it should only be used for definitions and prompting. ● I think I can use ChatGPT to ask for activities that students can do to enhance their learning in the classroom. ● Not sure

Conclusion

This study aimed to understand how STEM and non-STEM TCs perceive and envision the integration of AI into their teaching. The findings suggest these two groups pose different attitudes and envision AI integration. STEM TCs generally showed a more pragmatic and optimistic view of AI as a valuable tool for planning lessons, generating various problem sets, ensuring accurate assessments, and enhancing teaching strategies. They generally expressed greater enthusiasm for utilizing AI to support their students' understanding of subject matter concepts and improve efficiency in differentiated learning. Non-STEM TCs, on the other hand, displayed less enthusiasm and more caution towards AI integration compared to the STEM TCs.

Despite the limitation in small participant numbers, this study's findings suggest several implications for STEM teacher education programs. First, STEM TCs' interest and enthusiasm toward integrating AI in their future teaching suggest their readiness to embrace innovative teaching tools like AI. STEM teacher education programs should develop specialized training tailored specifically to the TCs' needs to provide more comprehensive education for TCs to explore these tools. Second, STEM TC's positive attitudes toward AI to enhance teaching methods and resources calls for pedagogical innovation of STEM teacher education programs. It is therefore essential that STEM TCs are provided with opportunities to practice using these relatively new teaching tools before they commence their teaching careers. These opportunities should focus on practical applications, specifically aimed at enhancing student learning outcomes. Third, all participating TCs have shown unanimous concern about the ethical considerations in AI integration as well as the necessity of preserving students' critical

thinking skills. It would be necessary that STEM teacher education programs incorporate discussions and activities focused specifically on ethical AI use, alongside the development of strategies to foster critical thinking.

In summary, this study not only sheds light on the perspectives of secondary TCs on AI integration but also provides actionable recommendations for enhancing teacher education programs to better prepare future educators for AI-enhanced classrooms.

References

Association of Mathematics Teacher Educators. (2024, Spring). *Special Call for Manuscripts: Artificial Intelligence in Mathematics Teacher Education.* Connections. https://amte.net/connections/2024/02/special-call-connections-manuscripts-artificial-intelligence-mathematics-teacher

Ayanwale, M. A., Sanusi, I. T., Adelana, O. P., Aruleba, K. D., & Oyelere, S. S. (2022). Teachers' readiness and intention to teach artificial intelligence in schools. *Computers and Education: Artificial Intelligence*, *3*, 100099. https://doi.org/10.1016/j.caeai.2022.100099

Baidoo-Anu, D., & Ansah, L. O. (2023). Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning. *Journal of AI*, *7*(1), 52-62. https://doi.org/10.61969/jai.1337500

Borenstein, J., & Howard, A. (2021). Emerging challenges in AI and the need for AI ethics education. *AI and Ethics*, *1*, 61-65.

Colen, J. & Colen, Y. (in press). Teacher Candidates' Perspectives on Ai: A Stem vs. Non-Stem Analysis. *Proceedings of the Annual Convention of the School Science and Mathematics Association*.

Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: the state of the field. *International Journal of Educational Technology in Higher Education*, *20*(1), 22. https://doi.org/10.1186/s41239-023-00392-8

Cukurova, M. (2024). The interplay of learning, analytics and artificial intelligence in education: A vision for hybrid intelligence. *British Journal of Educational Technology*. https://doi.org/10.48550/arXiv.2403.16081

Egara, F. O., & Mosimege, M. (2024). Exploring the integration of artificial intelligence-based ChatGPT into mathematics instruction: Perceptions, challenges, and implications for educators. *Education Sciences*, *14*(7), 742. https://doi.org/10.3390/educsci14070742

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education*, *42*(3), 255-284. 10.1080/15391523.2010.10782551

Flores, M. A., Santos, P., Fernandes, S., & Pereira, D. (2014). Pre-service teachers' views of their training: Key issues to sustain quality teacher education. *Journal of Teacher Education for Sustainability*, *16*(2), 39-53. 10.2478/jtes-2014-0010

Fundi, M., Sanusi, I. T., Oyelere, S. S., & Ayere, M. (2024). Advancing AI education: Assessing Kenyan in-service teachers' preparedness for integrating artificial intelligence in competence-based curriculum.

Computers in Human Behavior Reports, *14*, 100412. https://doi.org/10.1016/j.chbr.2024.100412

Galindo-Domínguez, H., Delgado, N., Losada, D., & Etxabe, J. M. (2024). An analysis of the use of artificial intelligence in education in Spain: The in-service teacher's perspective. *Journal of Digital Learning in Teacher Education*, *40*(1), 41-56. 10.1080/21532974.2023.2284726

Ghimire, A., & Edwards, J. (2024). Generative AI Adoption in Classroom in Context of Technology Acceptance Model (TAM) and the Innovation Diffusion Theory (IDT). *https://doi.org/10.48550/arXiv.2406.15360*

Hartmann, F. G., Mouton, D., & Ertl, B. (2022). The Big Six interests of STEM and non-STEM students inside and outside of teacher education. *Teaching and Teacher Education*, *112*, 103622. https://doi.org/10.1016/j.tate.2021.103622

Holstein, K., McLaren, B. M., & Aleven, V. (2019). Designing for complementarity: Teacher and student needs for orchestration support in AI-enhanced classrooms. In *Artificial Intelligence in Education: 20th International Conference, AIED 2019, Chicago, IL, USA, June 25-29, 2019, Proceedings, Part I 20* (pp. 157-171). Springer International Publishing.

Karran, A. J., Charland, P., Martineau, J. T., de Guinea, A. O., Lesage, A. M., Senecal, S., & Leger, P. M. (2024). Multi-stakeholder Perspective on Responsible Artificial Intelligence and Acceptability in Education. https://doi.org/10.48550/arXiv.2402.15027

Looi, C.-K., Chan, S. W., Huang, W., Seow, P., & Wu, L. (2020). Preservice teachers' views of computational thinking: STEM teachers vs non-STEM teachers. In S. C. Kong, H. U." Hoppe, T. C. Hsu, R. H. Huang, B. C. Kuo, K. Y. Li, C. K. Looi, M. Milrad, J. L. Shih, K. F. Sin, K. S. Song, M. Specht, F. Sullivan, & J. Vahrenhold (Eds.), *Proceedings of International Conference on Computational Thinking Education 2020* (pp. 73-76). The Education University of Hong Kong.

Martínez-Comesaña, M., Rigueira-Díaz, X., Larranaga-Janeiro, A., Martínez-Torres, J., Ocarranza-Prado, I., & Kreibel, D. (2023). Impact of artificial intelligence on assessment methods in primary and secondary education: Systematic literature review. *Revista de Psicodidáctica (English ed.)*. https://doi.org/10.1016/j.psicoe.2023.06.002

National Council of Teachers of Mathematics. (2024, February). *Artificial Intelligence and Mathematics Teaching*. NCTM. https://www.nctm.org/standards-and-positions/Position-Statements/Artificial-Intelligence-and-Mathematics-Teaching/

Pak, B., Colen, J., Kwon, N., Yeo, S., Park, J., & Kim, J. (2024). Teacher perspectives on harnessing AI in mathematics classrooms [Special Issue: Artificial Intelligence in Mathematics Teacher Education]. *Connections*. https://www.amte.net/connections/2024/08/connections-thematic-articles-artificial-intelligence-mathematics-teacher

Park, J., Cho, H., Colen, J., Kwon, N., Yeo, S., Kim, J., & Pak, B. (in press).Teachers' Perceptions of AI-Empowered Digital Textbooks in Mathematics. *The Mathematical Education*.

Rana, N. (2012). A study to assess teacher educators' attitudes towards technology integration in classrooms. *MIER Journal of Educational Studies, Trends & Practices, 2*(2), 190-205. Doi: 10.52634/mier/2012/v2/i2/1569

Rogers, P. L. (2000). Barriers to adopting emerging technologies in education. *Journal of Educational Computing Research*, *22*(4), 455-472. 10.2190/4UJE-B6VW-A30N-MCE5

Shi, L., Ding, A. C., & Choi, I. (2024). Investigating teachers' use of an AI-Enabled system and their perceptions

of AI integration in science classrooms: a case study. *Education Sciences*, *14*(11), 1187. 10.3390/educsci14111187

The 74. (2023, August 7). *Shockwaves & innovations: How nations worldwide are dealing with AI in education*. https://www.the74million.org/article/shockwaves-innovations-how-nations-worldwide-are-dealing-with-ai-in-education/

UNESCO. (2023). *How generative AI is reshaping education in Asia-Pacific*. https://www.unesco.org/en/articles/how-generative-ai-reshaping-education-asia-pacific

U.S. Department of Education (USDE) (2023). Office of Educational Technology, Artificial Intelligence and Future of Teaching and Learning: Insights and Recommendations, Washington, DC, 2023.

Zhou, C. (2023). Integration of modern technologies in higher education on the example of artificial intelligence use. *Education and Information Technologies*, *28*(4), 3893-3910. 10.1007/s10639-022-11309-9

Author Information

Jung Colen

https://orcid.org/0000-0002-0628-1451

Associate Professor of Mathematics Education

Bellarmine University

Annsley Frazier Thornton School of Education

United States

Contact e-mail: *jcolen@bellarmine.edu*

Appendix. STEM vs Non-STEM TCs' Perspective Survey

1. What is your subject area? *

☐ English Language Arts and Reading

☐ Mathematics

☐ Science

☐ Social Studies/History

☐ Art, Physical Education, Dance, Music, Theatre, and Languages Other Than English (LOTE)

☐ Prefer not to respond

2. What is your current level of education? *

○ Undergraduate Freshman

○ Undergraduate Sophomore

○ Undergraduate Junior

○ Undergraduate Senior

○ Master of Arts in Teaching (MAT)

○ Master of Arts in Education (MAEd)

○ Prefer not to respond

3. On a scale of 1 to 5, where 1 indicates minimal familiarity and 5 signifies extensive familiarity, how familiar are you with the concept of artificial intelligence (AI) in education?

1	2	3	4	5

4. How do you ENVISION incorporating AI-powered tools or platforms in LESSON PLANNING and DELIVERY within your subject area?

5. Describe the ideal ROLE of AI in facilitating teaching and learning in your classroom context.

6. Describe the ideal ROLE of TEACHER in facilitating teaching and learning in your classroom context.

7. What specific AI TOOLS or APPLICATIONS do you envision using to enhance student LEARNING EXPERIENCES?

8. How do you foresee AI impacting your INSTRUCTIONAL STRATEGIES and TEACHING METHODOLOGIES?

9. What potential BENEFITS do you expect AI integration to bring to your teaching practice and student learning outcomes?

10. What CHALLENGES do you foresee in implementing AI technologies in your subject-matter classroom?

11. In what ways do you think AI could support DIFFERENTIATED instruction and PERSONALIZED learning experiences?

12. What ETHICAL CONSIDERATIONS do you think are important when integrating AI in education?

13. Do you feel adequately PREPARED to incorporate AI in your future teaching practice?

14. What additional TRAINING or RESOURCES do you think you would need to effectively use AI in the classroom?