Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #48242

Integrating AI Literacy into Early Childhood Education: Exploring Female Teachers' Perceptions and Challenges in Developing Nations

Miss Aysel Guliyeva, The Institute of Education of the Republic of Azerbaijan

Aysel Guliyeva is a specialist at the Institute of Education of the Republic of Azerbaijan. She is currently working on the integration of artificial intelligence literacy into early childhood education, with a focus on exploring female teachers' perceptions and the challenges they face in developing nations. Her work includes designing research-based tools and strategies to support teachers in incorporating AI concepts into early learning environments.

Dr. Ibrahim H. Yeter, Nanyang Technological University

Ibrahim H. Yeter, Ph.D., is an Assistant Professor at the National Institute of Education (NIE) at Nanyang Technological University (NTU) in Singapore. He is an affiliated faculty member of the NTU Centre for Research and Development in Learning (CRADLE) and the NTU Institute for Science and Technology for Humanity (NISTH). Dr. Yeter serves as the Director of the World MOON Project and holds editorial roles as Associate Editor of the IEEE Transactions on Education and Editorial Board Member for the Journal of Research and Practice in Technology Enhanced Learning. He is also the upcoming Program Chair-Elect of the PCEE Division at ASEE. His current research interests include STEM+C education, specifically artificial intelligence literacy, computational thinking, and engineering.

Integrating AI Literacy into Early Childhood Education: Exploring Female Teachers' Perceptions and Challenges in Developing Nations

Aysel Guliyeva, The Institute of Education of the Republic of Azerbaijan

Aysel Guliyeva is a specialist at the Institute of Education of the Republic of Azerbaijan. She is currently working on integrating artificial intelligence literacy into early childhood education, focusing on exploring female teachers' perceptions and the challenges they face in developing nations. Her work includes designing research-based tools and strategies to support teachers in incorporating AI concepts into early learning environments.

Dr. Ibrahim H. Yeter

Integrating AI Literacy into Early Childhood Education: Exploring Female Teachers' Perceptions and Challenges in Developing Nations

Abstract:

This study explores the evolving role of Artificial Intelligence (AI) in early childhood education, focusing on Azerbaijan, where its integration is still in its nascent stages. This study evaluates the current knowledge of AI among kindergarten teachers in Azerbaijan, identifies the obstacles they face, and their perceptions of AI's role in early learning environments. The study offers practical strategies for introducing basic AI concepts to young children. By addressing these gaps, the research hopes to provide valuable insights into how early education can better equip teachers and children for a future shaped by AI. As AI continues to influence the global educational landscape, fostering awareness and foundational skills from a young age is critical, ensuring children are prepared for the digital future. This research addresses two key questions: 1) What are early childhood teachers' perceptions regarding AI in Azerbaijan? 2) What are the kindergarten teachers' suggestions for incorporating AI tools more effectively in the K-school setting? A qualitative method approach was employed. A systematic sample of 16 teachers from different regions of Azerbaijan was selected for semi-structured interviews. The goal was to explore teachers' familiarity with AI concepts, their challenges in integrating AI into their classrooms, and their perspectives on how AI could enhance early learning environments. The findings demonstrated the stakeholders' and teachers' perspectives on the challenges and opportunities associated with introducing AI into Azerbaijani kindergartens, helping to develop a more comprehensive framework for AI integration. It allows for the creation of a comprehensive framework for integrating AI education into Azerbaijani kindergartens, which aligns with the country's early childhood education standards. Teachers have lacked a foundational understanding of AI, with the majority perceiving technology as the primary means of introducing AI concepts. However, limited access to tools and AI-related training posed significant challenges. Despite these barriers, there is a growing interest among younger teachers in learning and integrating AI into their teaching practices. The study proposes an appropriate framework that does not rely solely on advanced technology but emphasizes AI literacy through unplugged activities and simple tools. This framework meets existing early childhood education standards in Azerbaijan and is designed to be practical for implementation in under-resourced settings. Theoretically, this study contributes to the literature for early education teachers and provides a foundation for further studies in low-technological environments. The research offers a roadmap for educators and policymakers to enhance AI literacy among kindergarten teachers.

Introduction

Education, one of the industries most significantly impacted by rapid advancements in artificial intelligence (AI), is on the brink of a revolution. Since the introduction of generative AI technologies in 2022, as demonstrated by ChatGPT and other platforms, the potential of these tools to revolutionize a range of educational processes has come to light more and more [1]. AI enables a revolutionary change in education by utilizing its powers in data analysis, pattern recognition, and personalized feedback. In addition to improving teaching strategies, this technology is changing how students learn, encouraging participation and comprehension [2, 3]. Teaching subjects like language and arithmetic in dynamic and engaging ways is now possible,

which helps students confidently grasp complex ideas. This potential of AI in education should inspire optimism about the future of learning, fostering a positive outlook among educators, policymakers, and researchers.

In early childhood education, female teachers play a crucial role that significantly influences the developmental paths of young learners. This trend is particularly evident in Azerbaijan, where most educators working with preschool children are women. According to Azerbaijan's State Statistical Committee, 99.9% of kindergarten teachers in the country are women, highlighting the dominant presence of female educators in shaping early childhood learning experiences [4]. Furthermore, in Azerbaijan, as in many regions globally, the integration of AI into early childhood education (ECE) is still in its early stages. Early identification of developmental milestones can significantly enhance lifelong learning outcomes. However, there is ongoing debate regarding the appropriateness of introducing AI to young learners [5]. Despite these concerns, research suggests that AI tools can provide valuable support in ECE settings. These tools can offer personalized instructional strategies that evolve with each child's developmental stage and individual learning style, deliver timely feedback and support, encourage active engagement and purposeful learning, and provide foundational skills in literacy and numeracy through adaptive learning tools. The potential of AI in education should inspire optimism about the future of learning [6,7,8,9,10,11]. AI has become an integral aspect of contemporary life, prompting governments to prioritize educational advancement on a global scale.

Research objectives

In December 2023, Azerbaijan's Ministry of Education announced plans to establish new educational standards by mid-2025, including integrating STEAM (Science, Technology, Engineering, Arts, and Mathematics) into the national curriculum [12]. This initiative reflects a strategic response to advancements in information and communication technology (ICT), particularly emphasizing incorporating 3D robotics within technology courses for grade 6 and beyond. By aligning national priorities with global technological trends, Azerbaijan aims to enhance the quality of education and promote technological literacy among students.

Additionally, Azerbaijan has made significant progress toward achieving the United Nations Sustainable Development Goals (SDGs), particularly Goal 4 (inclusive and equitable quality education) and Goal 9 (resilient infrastructure and innovation). The 'Azerbaijan 2030: National Priorities for Socio-Economic Development' strategy underscores the importance of fostering a competitive economy, ensuring social equity, and supporting sustainable growth [13]. The urgency and importance of this research are highlighted by the need to address these challenges and bridge the gap in technological education, particularly in resource-limited settings where educators may lack the training and resources to integrate technology into their teaching practices effectively:

- Identify the perceptions of early childhood educators regarding AI in Azerbaijan.
- Investigate kindergarten teachers' challenges and opportunities in implementing AI tools in educational settings.

- Develop a comprehensive framework to support the integration of AI and technology within early childhood education, focusing on infrastructure improvements, educator training, and resource accessibility.

Methodology

This research used a qualitative case study methodology involving a comprehensive investigation and portrayal of a specific system or phenomenon [14]. The qualitative case study methodology is beneficial in research because it provides rich, in-depth insights into complex phenomena within their natural contexts [15]. This method enables researchers to uncover detailed, contextually rich data that may not be accessible through quantitative approaches alone, thus contributing to a deeper understanding of the researched phenomenon [16].

This study adopts a qualitative empirical research design to explore the perceptions of female kindergarten teachers regarding the integration and use of artificial intelligence in early childhood education. A qualitative approach is chosen to capture the depth and richness of participants' lived experiences, perspectives, and insights, essential for understanding the nuances of their attitudes toward AI [17].

The study is grounded in an interpretive paradigm, emphasizing the subjective meanings and contextual factors influencing teachers' perceptions. By focusing on a qualitative design, the research aims to uncover patterns, themes, and interpretations that may not emerge through quantitative methods [18]. Sample Questions:

Teacher's Experience with Technology in the Classroom:

What is your overall experience with using technology in your teaching? Can you provide examples?

How do you feel about integrating new technologies, such as AI, into your daily teaching practices?

Have you encountered any challenges while using technology in the classroom? How did you address them?

Teacher's Perception of AI Integration in ECE:

What comes to mind when you hear the term "AI"? How would you define it?

What potential do you see in using AI tools to enhance children's preschool learning experiences?

Can you identify any challenges or barriers to implementing AI effectively in early childhood education?

How do you think AI literacy could influence young children's developmental outcomes?

Teacher's Feedback on AI Tools Trial Period:

Did you find the AI tools easy to use in your teaching activities? Why or why not?

Were AI tools effective in engaging children during classroom activities? Please share examples.

Did you notice any changes in children's learning behaviors or outcomes after introducing AI tools? If so, what were they?

Teacher's Recommendations for AI Integration in ECE:

What strategies or approaches would you suggest for introducing AI literacy in early childhood education?

How can teachers be better supported in learning to use AI tools effectively?
What recommendations would you make for policymakers to facilitate AI integration in preschool education?

Data Analysis

We undertook a thematic analysis, drawing upon an existing framework to code the data and organize it into themes that captured both commonalities and differences experienced by participants [19]. A first level of coding was established by closely reading the transcripts to extract key statements and phrases relevant to the study objectives [20]. The codes were then clustered into more overarching themes, including teachers' understanding of AI, limited resources and training challenges, and proposed strategies to promote AI literacy in the classroom [21]. The names of the interviewees wouldn't be revealed to keep them confidential. Those who participated in the interviews (teachers) were identified as "T1, T2, T3, … T16." Transcription of speech, observation description, field note creation, message interpretation, performance judgment, television presentation categorization—all of these are ways of recording or coding transient, unstructured, or fuzzy but perfectly meaningful phenomena into the terminology of a data language that can be analyzed through the application of appropriate techniques [22,23]. Through this analysis process, we could interrogate patterns in the data and identify both commonalities and distinctions in teachers' perspectives [24].

Findings and discussion

Our study reveals that misconceptions about AI and its role in education are prevalent among early childhood educators in Azerbaijan. The teachers' thoughts on this topic are as follows:

"In our kindergarten, I am increasingly concerned that the push for AI might eventually lead to the replacement of teachers—especially since we lack proper facilities and even reliable internet connectivity (T5)."
"Our kindergarten is housed in an old building, far from a modern tech environment, which makes me worry that, without the necessary infrastructure, there is a risk of substituting human educators with AI systems (T11)."
"Due to our limited resources and the absence of innovative teaching activities, we rely on what little we have. This scarcity raises fears that AI could be seen as a cost-effective alternative to the personalized support provided by teachers (T16)."

This result supports and expands on earlier studies by Bali [24] and Luckin et al. [25], who contend that instructors are valuable because of their indispensable roles as crucial learning facilitators, creative mentors, and givers of socioemotional support. Even though these studies stress that AI should only be used to help teachers with routine tasks so they can concentrate on higher-order educational functions, our empirical data shows that many Azerbaijani educators still have false beliefs about the potential and constraints of AI.

This knowledge gap highlights the necessity of thorough AI competency training for teachers and points to a more significant issue with the use of technology in the classroom. Professional development programs must be created to highlight AI's ability to automate administrative duties

while underscoring the essential human elements of education that technology cannot replace to close this gap. Educational stakeholders can better assist teachers in utilizing AI by addressing these misconceptions head-on. This will ensure that the technology complements, rather than diminishes, educators' vital and intricate role in creating a vibrant, encouraging, and dynamic learning environment. According to the literature, AI should support teachers and improve instruction by freeing them to focus more on inspiring, creative, and sympathetic endeavors. Therefore, training teachers is essential. Teachers must learn new skills, like how AI may help children learn, conduct research and analyze data, and successfully manage human and AI resources. Furthermore, developing children's capacity to recognize AI's potential and its drawbacks requires a critical viewpoint on the impact of digital technology.

Proposed AI Integration Framework

Framework for AI Literacy in Early Childhood Education:

Focus on Unplugged AI Activities: Emphasizing unplugged methods for teaching AI concepts without reliance on advanced technology.
Use of Simple Tools and Resources: Recommend low-cost, accessible tools suitable for Azerbaijani kindergartens.
Professional Development for Female Teachers: Developing AI literacy training programs tailored to the needs of female teachers in ECE settings.
Alignment with Early Childhood Education Standards: The proposed AI integration framework must align with Azerbaijan's early childhood education standards and curriculum.

This study recommends several opportunities for untangling the challenges in integrating AI in Azerbaijani kindergartens, built on methodologies that can be easily leveraged in under-resourced environments. One effective strategy is to focus on unplugged AI activities. These activities help educators learn foundational concepts about AI without needing advanced technology [26]. This section introduces five unplugged activities—exercises or problems that do not require computing—demonstrating key principles to understand AI concepts such as patterns, classifications, and problem-solving. They are instrumental in resource-limited settings where few resources are available while also providing children with the ability to connect with the ideas of AI in context [27]. Another main recommendation includes using uncomplicated instruments and materials that are low-cost and accessible for Azerbaijani kindergartens. Several teachers suggested inexpensive classroom supplies like cards, boards, and games to mimic AI-related tasks.

Conclusion

This study provides insights into female kindergarten teachers' perceptions of AI in Azerbaijan, including their challenges and potential for AI in early childhood education. These women teachers' awareness of and comfort with AI is influenced by their access to resources and training and the culture of teacher professional development in their country [24]. The AI integration framework discussed in the study helps to overcome these barriers by providing practical approaches that could facilitate the use of AI in resource-constrained classrooms.

Furthermore, it emphasizes the necessity of professional development programs tailored to the unique needs of female teachers, enabling them to build the skills and confidence required to integrate AI into their teaching [27]. The framework strives to cultivate a supportive ecosystem for female educators to develop their technology skills, navigate challenges common among their gender, and capitalize on AI usage in education through a focus on mentorship and community support networks. By fostering collaboration and resource sharing among teachers, this approach aims to empower female educators and enhance the quality of early childhood education in Azerbaijan.

References

[1] Bengesi, T., et al. (2024). Advancements in generative AI: A comprehensive review of GANs, GPT, autoencoders, diffusion model, and transformers. IEEE Access. http://dx.doi.org/10.1109/ACCESS.2024.3397775

[2] Silva, A., & Janes, D. (2020). Exploring the role of artificial intelligence in education: A comprehensive perspective. Review of Artificial Intelligence in Education. https://doi.org/10.37497/rev.artif.intell.education.v1i00.5

[3] Bozkurt, A., Karadeniz, A., Baneres, D., Guerrero-Roldán, A. E., & Rodríguez, M. E. (2021). Artificial intelligence and reflections from the educational landscape: A review of AI studies in half a century. Sustainability. https://doi.org/10.3390/su13020800

[4] The State Statistical Committee of the Republic of Azerbaijan. (n.d.). Gender. Retrieved February 14, 2025, from https://www.stat.gov.az/source/gender/?lang=en

[5] Su, J., & Zhong, Y. (2022). Artificial intelligence (AI) in early childhood education: Curriculum design and future directions. Computers and Education: Artificial Intelligence. https://doi.org/10.1016/j.caeai.2022.100072

[6] Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. IEEE Access. https://doi.org/10.1109/ACCESS.2020.2988510

[7] Yue, M., Jong, M. S.-Y., & Dai, Y. (2022). Pedagogical design of K-12 artificial intelligence education: A systematic review. Sustainability. https://doi.org/10.3390/su142315620

[8] Williams, R., Park, H. W., Oh, L., & Breazeal, C. (2019). PopBots: Designing an artificial intelligence curriculum for early childhood education. Proceedings of the AAAI Conference on Artificial Intelligence. https://doi.org/10.1609/aaai.v33i01.33019729

[9] Yi, H., Liu, T., & Lan, G. (2024). The key artificial intelligence technologies in early childhood education: A review. Artificial Intelligence Review. https://doi.org/10.1007/s10462-023-10637-7

[10] Castro-Schez, J., Morcillo, C., Albusac, J., & Vallejo, D. (2020). An intelligent tutoring system for supporting active learning: A case study on predictive parsing learning. Information Sciences. https://doi.org/10.1016/j.ins.2020.08.079

[11] Su, J., Ng, D. T. K., & Chu, S. (2023). Artificial intelligence (AI) literacy in early childhood education: The challenges and opportunities. Computers and Education Artificial Intelligence. https://doi.org/10.1016/j.caeai.2023.100124

[12] Ministry of Science and Education of Azerbaijan. (2023, December). New educational standards to integrate STEAM education into the national curriculum by 2025. Retrieved from https://edu.gov.az/en/news-and-updates/20651-1

[13] United Nations. (n.d.). Sustainable Development Goals: Goal 4—Quality education and Goal 9—Industry, innovation, and infrastructure. Retrieved from https://sdgs.un.org/goals

[14] Ng, E., & Tan, B. (2018). Achieving state-of-the-art ICT connectivity in developing countries: The Azerbaijan model of technology leapfrogging. E J Info Sys Dev Countries. https://doi.org/10.1002/isd2.12027

[15] Merriam, S. B. (2009). Qualitative research: A guide to design and implementation. Jossey-Bass.

[16] Yin, R. K. (2014). Case study research: Design and methods (5th ed.). Sage Publications.

[17] Creswell, J. W. (2013). Qualitative inquiry and research design: Choosing among five approaches (3rd ed.). Sage Publications.

[18] Poth, C. (2018). Innovation in the research process: A guide to integrating new approaches in qualitative research (1st ed.). Sage Publications.

[19] Merriam, S. B., & Tisdell, E. J. (2015). Qualitative research: A guide to design and implementation (4th ed.). Jossey-Bass.

[20] Vaismoradi, M., Turunen, H., & Bondas, T. (2016). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. Nursing & Health Sciences. https://doi.org/10.1111/nhs.12303

[21] Saldana, J. (2016). The coding manual for qualitative researchers (3rd ed.). Sage Publications.

[22] Flick, U. (2018). An introduction to qualitative research (6th ed.). Sage Publications.

[23] Krippendorff, K. (2018). Content analysis: An introduction to its methodology (4th ed.). Sage Publications.

[24] Bali, M. (2017). 'Against the 3A's of EdTech: AI, Analytics, and Adaptive Technologies in Education'. The Chronicle of Higher Education. Available at: https://www.chronicle.com/blogs/profhacker/against-the-3as-of-edtechai-analytics-and-adaptive-technologies-ineducation/64604

[25] Luckin, R., & Holmes, W. (2016). Intelligence unleashed: An argument for AI in education. UCL Knowledge Lab. https://www.pearson.com/

[26] Brennan, K., & Resnick, M. (2012). Using artifact-based interviews to study the development of computational thinking in interactive media design. Paper presented at the Annual America Educational Research Association meeting, Vancouver, BC, Canada.

[27] Kafai, Y. B., & Burke, Q. (2015). Constructionist gaming: Understanding the benefits of making games for learning. Educational Psychologist. https://doi.org/10.1080/00461520.2015.1124022