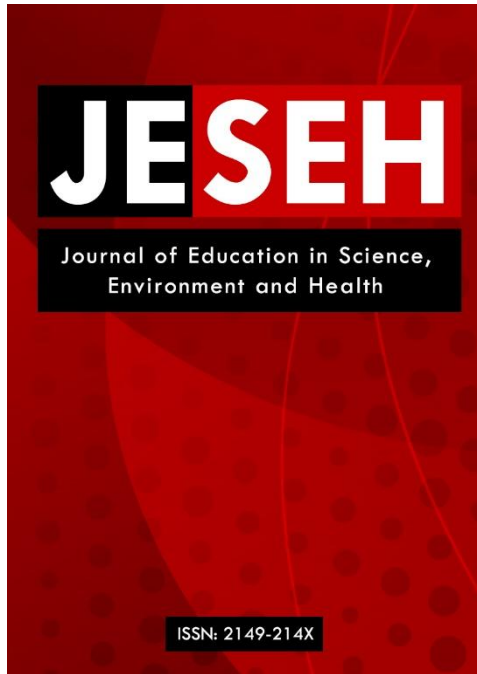




ISSN: 2149-214X

**Journal of Education in Science,
Environment and Health**

www.jeseh.net

AI-Powered Verbal Intelligence Games: Academics' Views on Open-Ended and Verifiable Inquiry, Problem-Solving, and Scientific Reasoning Skills

Bekir Yildirim
Mus Alparslan University

To cite this article:

Yildirim, B. (2026). AI-powered verbal intelligence games: Academics' views on open-ended and verifiable inquiry, problem-solving, and scientific reasoning skills. *Journal of Education in Science, Environment and Health (JESEH)*, 12(4), 362-370. <https://doi.org/10.55549/jeseh.926>

This article may be used for research, teaching, and private study purposes.

Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden.

Authors alone are responsible for the contents of their articles. The journal owns the copyright of the articles.

The publisher shall not be liable for any loss, actions, claims, proceedings, demand, or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of the research material.

AI-Powered Verbal Intelligence Games: Academics' Views on Open-Ended and Verifiable Inquiry, Problem-Solving, and Scientific Reasoning Skills

Bekir Yildirim

Article Info

Article History

Published:
01 October 2026

Received:
02 June 2026

Accepted:
06 September 2026

Keywords

Artificial intelligence
Verbal intelligence
Scientific reasoning skills

Abstract

Today, artificial intelligence is making its impact felt in education, as in all other fields. The use of artificial intelligence in education is becoming an increasing priority. The purpose of this study was to examine academics' views on the implications of artificial intelligence (AI)-supported verbal intelligence games for open and confirmatory inquiry, problem-solving, and scientific reasoning skills in education. The study group consisted of 13 academics. Convenience sampling was employed to select the participants. A phenomenological research design, one of the qualitative research methods, was adopted in this study. Qualitative data were collected through a semi-structured interview form. The collected qualitative data were analyzed using the inductive content analysis method. The findings revealed that the participants held positive views regarding AI-supported verbal intelligence games. Furthermore, the participants stated that AI-supported verbal intelligence games had positive implications for open and confirmatory inquiry, problem-solving, scientific reasoning, and reasoning skills in education. Based on these findings, recommendations were made for educators and policymakers.

Introduction

The process that began with Industry 1.0 reached an advanced stage with Society 6.0. Society 6.0 focuses on the coexistence of humans and artificial intelligence (Çobanoğlu, 2026). AI is defined as computer systems designed to imitate human behavior (Luckin et al., 2007). With the emergence of Society 6.0, artificial intelligence has influenced many aspects of human life, ranging from healthcare to the economy. One of the areas affected by AI is education. The increasing influence of AI on education has accelerated its integration into educational processes (Kölemen & Yıldırım, 2025). For example, many countries, including China and Canada, have initiated efforts to integrate artificial intelligence into their school curricula (Chiu & Chai, 2020). This technological transformation has contributed not only to the integration of educational technologies into learning environments but also to the development of instructional processes that support higher-order thinking skills.

AI is integrated into school curricula in two different ways: learning about AI and learning with AI (Lim, 2024; Zhang & Aslan, 2021). The integration of artificial intelligence into educational processes in these two different ways has reshaped teaching and learning processes (Alwaqadani, 2024). This has enabled students to gain a unique learning experience through AI (Prentzas, 2013). The provision of a unique learning experience through AI in education has led countries to implement various projects (Ouyang & Jiao, 2021; Zhang & Aslan, 2021). The primary aim of these projects is to educate individuals who are literate in AI. However, countries need not only individuals who are specialized in a particular field but also individuals who are capable of interdisciplinary thinking and possess reasoning, scientific reasoning, problem-solving, and critical thinking skills. Therefore, countries have focused on various teaching and learning approaches, such as STEM, TRIZ, and gamification, that support the development of these skills. Furthermore, with the advancement of AI technology, increasing attention has also been given to artificial intelligence-supported digital games. This is because AI-supported games provide feedback based on students' performance, offer content tailored to their needs, and enable the personalization of the educational process (Çat & Huseynova, 2025). Therefore, one of the teaching and learning approaches that has received considerable attention is intelligence games. According to Dempsey et al. (2002), intelligence games are defined as tools used to help individuals achieve predetermined educational goals.

Intelligence games are entertaining, educational, and engaging games that support the development of individuals' cognitive, affective, and psychomotor skills (Çağır & Oruç, 2020). Games are also effective in promoting students' participation in the educational process, increasing their motivation, enhancing their interest in lessons, and encouraging them to learn (Bottino et al., 2013; Kacmaz & Dubé, 2025; Terzi & Altun, 2026). Due to these characteristics, the integration of games into classroom environments is important for educating students as individuals equipped with the competencies required by the age in which they live (Ayar et al., 2023). The

acquisition of problem-solving, scientific reasoning, and reasoning skills through games also facilitates the integration of these games into educational processes (Kurbal, 2015; Şahin & Tezci, 2023). Indeed, countries need individuals who possess algorithmic thinking skills, are capable of solving the problems they encounter, and have scientific reasoning skills. Individuals with these competencies are able to generate solutions to the problems they encounter in real life (Kocagül-Sağlam & Ünal-Çoban, 2020). On the other hand, scientific reasoning skills are important because they enhance individuals' research and inquiry skills (Han, 2013; Osborne, 2013).

Accordingly, it can be stated that the findings obtained in this study will make valuable contributions to future scientific studies on AI-supported and intelligence games. Furthermore, it is anticipated that this study will serve as a valuable reference for researchers conducting future studies on AI-supported intelligence games. Moreover, this study is considered important because it reveals academics' views on AI-supported intelligence games. To the best of our knowledge, no previous study has comprehensively examined the implications of AI-supported intelligence games for open and confirmatory inquiry, problem-solving, scientific reasoning, and reasoning skills in education based on academics' views. On the other hand, previous studies have emphasized that the use of artificial intelligence in educational processes improves students' academic achievement, problem-solving skills, attitudes toward lessons, interest, motivation, and learning outcomes (Ambarita & Nurrahmatullah, 2024; García-Martínez et al., 2023). In addition, there are studies reporting that intelligence games have positive effects on problem-solving, and scientific reasoning skills (Bayaga, 2025; Baki, 2022; Çetin & Özbuğutu, 2020; Karataş et al., 2022; Nkereuwem et al., 2023). All these considerations highlight the importance of examining the implications of artificial intelligence-supported games for higher-order thinking skills. Therefore, this study is expected to contribute to the literature by addressing this research gap. This situation makes it necessary to examine the contributions of AI-supported verbal intelligence games to higher-order thinking skills from different perspectives. By addressing this research gap, the present study aims to make both theoretical and practical contributions to the relevant literature.

Within this framework, the purpose of this study was to reveal academics' views on the implications of artificial intelligence-supported intelligence games for open and confirmatory inquiry, problem-solving, and scientific reasoning skills. In line with this purpose, the main research problem was formulated as follows: "What are academics' views on the implications of AI-supported verbal intelligence games for open and confirmatory inquiry, problem-solving, and scientific reasoning skills?" Based on this main research problem, answers were sought to the following four research questions:

1. What are the general views on AI-supported verbal intelligence games?
2. What are academics' views on the implications of AI-supported verbal intelligence games for open and confirmatory inquiry in education?
3. What are academics' views on the implications of AI-supported verbal intelligence games for problem-solving?
4. What are academics' views on the implications of AI-supported verbal intelligence games for scientific reasoning skills (reasoning skills)?

Method

Research Model

To comprehensively reveal all dimensions of the study, the research was conducted from a post-positivist perspective by establishing a connection between the experimental and interpretive paradigms from ontological and epistemological perspectives (Twining et al., 2017). Accordingly, the study was designed in accordance with the phenomenological research design, one of the qualitative research methods, in order to comprehensively and thoroughly reveal academics' views on the implications of AI-supported intelligence games for open and confirmatory inquiry, problem-solving, and scientific reasoning skills.

Participants

The study group was selected using criterion sampling, one of the purposive sampling methods. In this sampling method, the researcher selects individuals who meet specific criteria. This method provides the researcher with speed and practicality (Yıldırım & Şimşek, 2016). On the other hand, in the process of selecting the participants, not only accessibility but also several additional criteria were considered. The study group was formed by reaching individuals who met these criteria. In this context, the following criteria were taken into consideration: (1) being

academics with studies in the field of science education, (2) having knowledge of intelligence games, (3) having knowledge of artificial intelligence, and (4) voluntarily participating in the study. The purpose of establishing these criteria was to fully reveal the academics' views and experiences regarding intelligence games in conjunction with artificial intelligence. Accordingly, the study group consisted of 13 academics. The participants consisted of academics working in the field of science education. The participants' professional experience ranged from 4 to 21 years. The participants had previous experience with artificial intelligence and intelligence games. Of the participants, 4 were male and 9 were female. The academics included in the study group were assigned code names.

Qualitative Data Collection Instrument

Interview Form

Within the scope of the study, a semi-structured interview form was used to elicit academics' views on the implications of AI-supported intelligence games for open and confirmatory inquiry, problem-solving, and scientific reasoning skills. Before the semi-structured interview form was developed, a review of the relevant literature was conducted, and a pool of interview questions was prepared based on this review. Following the development of the question pool, the interview form was finalized. The interview form was then submitted to two experts who had completed their doctoral education. Necessary revisions were made to the interview form in accordance with the experts' feedback. Following these revisions, the interview form was finalized.

Data Analysis

Analysis of the Qualitative Data

Before conducting the interviews, the academics were informed about the interview protocol and the purpose of the study. The qualitative data were collected from the participants online. Following the detailed briefing, the collected qualitative data were analyzed. The data were collected between June 1 and June 30, 2026, and each data collection session lasted between 10 and 19 minutes. The data were collected based on the participants' voluntary participation. The collected data were transcribed and converted into textual form for analysis. The inductive content analysis method was employed to analyze the qualitative data (Patton, 2014). The qualitative data analysis consisted of four stages: (1) preparing the transcripts, (2) analyzing the transcripts, (3) developing themes and codes, and (4) constructing and interpreting the tables (Yıldırım & Şimşek, 2016). The developed themes and codes were submitted to two independent experts. Based on the feedback received from the experts, the themes and codes were finalized, after which they were tabulated and interpreted.

Findings

Findings Related to the First Research Question

In the first research question, academics' general views on AI-supported verbal intelligence games were examined.

Table 1. General views on AI-supported intelligence games

Theme	Code
General Views	Personalized learning (n = 4)
	Cognitive skill development (n = 3)
	Suitability for students' proficiency levels (n = 2)
	Improving the quality of education (n = 2)
	Providing feedback (n = 2)
	Increasing academic achievement (n = 2)
	Promoting socialization (n = 1)
	Interdisciplinary integration (n = 1)
	Education aligned with the demands of the contemporary era (n = 1)
	Active participation (n = 1)
	Enjoyable learning (n = 1)
	Increasing interest in technology (n = 1)

*Participants provided more than one response.

As shown in the table, the academics stated that AI-supported verbal intelligence games have various positive features, such as promoting personalized learning, enhancing cognitive skills, and improving the quality of instruction. Sample responses from the academics are presented below:

P4: "When properly planned, they increase students' participation in lessons, support learning, and contribute to the development of their cognitive skills."

P9: "I believe that their use in education will be beneficial because they transform the learning experience into a personalized one."

P10: "I am optimistic about AI-supported games. AI tools can understand students' behaviors and provide more accurate feedback."

Table 2. Benefits of using AI-supported verbal intelligence games for students

Theme	Coda
Benefits	Developing problem-solving skills (n = 2)
	Providing immediate feedback (n = 3)
	Developing reasoning skills (n = 2)
	Developing cognitive thinking skills (n = 3)
	Keeping pace with the contemporary era (n = 1)
	Increasing interest in lessons (n = 1)
	Increasing student achievement (n = 1)
	Enhancing self-efficacy (n = 1)
	Increasing motivation (n = 1)
	Personalized learning (n = 1)
	Promoting positive attitudes toward school (n = 1)
	Facilitating concept learning (n = 1)
	Promoting long-term learning (n = 1)
	Promoting strategic thinking (n = 1)
	Promoting time management (n = 1)
	Supporting group work (n = 1)
	Developing problem-solving skills (n = 2)

*Participants provided more than one response.

As shown in the table, the academics stated that the use of AI-supported verbal intelligence games in education offers various benefits, such as improving problem-solving, reasoning, immediate feedback, and cognitive thinking skills. Sample responses from the academics are presented below:

P1: "I believe that the use of AI-supported games in education will contribute to students' academic achievement and their attitudes toward school."

P6: "They can promote more strategic thinking, time management, teamwork, and communication skills."

P10: "AI can recognize students, analyze their development, and provide accurate feedback."

Findings Related to the Second Research Question

Table 3. Implications of AI-supported verbal intelligence games for open and confirmatory inquiry

Theme	Coda
Open and Confirmatory Inquiry	Discovering one's learning style (n = 4)
	Developing alternative solution strategies (n = 4)
	Identifying the most appropriate solution (n = 2)
	Developing self-regulation skills (n = 2)
	Increasing motivation (n = 1)
	Promoting systematic planning (n = 1)
	Developing prediction skills (n = 1)
	Learning from mistakes (n = 1)
	Improving decision-making skills (n = 1)

*Participants provided more than one response.

The second research question examined academics' views on the implications of AI-supported verbal intelligence games for open and confirmatory inquiry in education. As shown in the table, the academics stated that the use of AI-supported verbal intelligence games in education contributes to individuals' open and confirmatory inquiry by enabling them to discover their learning styles, develop alternative solution strategies, identify the most appropriate solution, and acquire self-regulation skills. Sample responses from the academics are presented below:

P7: "They try to produce more systematic solutions, and their prediction skills improve. Their ability to use artificial intelligence also improves."

P12: "I think it improves thinking skills and self-regulation skills."

P13: "Rather than offering the same pathway to every student, artificial intelligence can generate different recommendations based on each student's performance. In this way, students can discover their own learning strategies and recognize which methods help them achieve better results. I also believe that this will support their self-regulation skills."

Findings Related to the Third Research Question

The third research question examined academics' views on the implications of AI-supported verbal intelligence games for problem-solving in education.

Table 4. Implications of AI-supported verbal intelligence games for problem-solving

Theme	Coda
Problem-Solving	Generating alternative solutions (n = 3)
	Personalization (n = 3)
	Creative problem-solving (n = 2)
	Decision-making (n = 2)
	Developing strategies (n = 1)
	Suitability for students' proficiency levels (n = 1)
	Redesigning solutions (n = 1)
	Promoting reasoning (n = 1)
	Receiving feedback (n = 1)

*Participants provided more than one response.

As shown in the table, the participants expressed various views regarding the implications of using AI-supported verbal intelligence games for problem-solving in education, including generating alternative solutions, personalization, creative problem-solving, and decision-making. Sample responses from the academics are presented below:

P10: "The student realizes that there is not only one correct solution but that different strategies can be used to reach the same outcome, and, in doing so, discovers his or her own learning style."

P12: "Real-time learning analytics that reveal students' responses while solving problems, their decision-making time, and their error patterns..."

P13: "Students can discover their own learning strategies and recognize which methods enable them to achieve better results."

Findings Related to the Fourth Research Question

The fourth research question examined academics' views on the implications of AI-supported verbal intelligence games for scientific reasoning skills. As shown in the table, the academics expressed different views regarding the implications of AI-supported verbal and intelligence games for scientific reasoning skills. The participants stated that AI-supported verbal intelligence games positively enhance scientific reasoning skills by fostering critical thinking, analytical thinking, problem-solving, and the ability to identify alternative solutions. Sample responses from the academics are presented below:

Table 5. Implications of AI-supported verbal intelligence games for scientific reasoning skills

Theme	Code
Scientific Reasoning Skills	Critical thinking (n = 4)
	Analytical thinking (n = 4)
	Logical thinking (n = 4)
	Problem-solving (n = 4)
	Considering alternative solutions (n = 2)
	Personalized learning (n = 2)
	Relational thinking (n = 1)
	Developing self-discipline (n = 1)
	Decision-making (n = 1)
	Algorithmic thinking (n = 1)
	Interdisciplinary thinking (n = 1)
	Drawing inferences (n = 1)

*Participants provided more than one response.

P4: "Thanks to its personalization feature, it can be used particularly in special education as well as in educational, healthcare, and research applications..."

P8: "It can improve problem-solving skills, enhance attention skills to facilitate reasoning, and increase motivation. I think it can also support the establishment of cause-and-effect relationships."

P9: "It may also be effective in supporting coding and analytical thinking skills."

P10: "Because artificial intelligence can analyze the player's strategy and develop alternative strategies in response, students are compelled to think multidimensional, anticipate the next step, and view situations from different perspectives."

P13: "I believe that it can also make significant contributions to the development of applications tailored to individual needs."

Discussion and Conclusion

The first research question examined academics' general views on the use of artificial intelligence-supported verbal intelligence games in education. The findings revealed that the participants stated that the use of artificial intelligence-supported intelligence games in education improves problem-solving, reasoning, immediate feedback, and cognitive thinking skills. The participants also emphasized that artificial intelligence-supported intelligence games provide various benefits, including personalized learning, cognitive skill development, and improved instructional quality. A review of the literature indicates that several studies have examined views on the use of artificial intelligence-supported intelligence games in education (e.g., Karataş et al., 2022; Nkereuwem et al., 2023). Gündüzalp (2021) found that digital games positively improved participants' self-efficacy and motivation but had no positive effect on self-regulation skills. Alaswad and Nadolny (2015) emphasized that the intentional and systematic implementation of game-based learning enhances its impact on student achievement and motivation. Sulaiman and Amin (2026) reported that artificial intelligence-supported games improved participants' performance. Mansur (2025) stated that artificial intelligence-supported gamification increased students' participation in educational processes and their motivation through personalization, adaptive support, and real-time feedback. Accordingly, it can be concluded that the findings of the present study are consistent with those reported in the existing literature.

The second research question examined academics' views on the implications of using artificial intelligence-supported verbal intelligence games in education for open and confirmatory inquiry. The participants stated that the use of artificial intelligence-supported verbal intelligence games in education contributes to individuals' open and confirmatory inquiry by enabling them to discover their learning styles, develop alternative solution strategies, identify the most appropriate solution, and acquire self-regulation skills. A review of the literature revealed that no studies have directly examined the implications of using artificial intelligence-supported intelligence games in education for open and confirmatory inquiry. Therefore, this study is expected to contribute to the literature in this respect.

The second research question examined academics' views on the implications of artificial intelligence-supported verbal intelligence games for open and confirmatory inquiry in education. The participants stated that the use of artificial intelligence-supported verbal intelligence games in education contributes to individuals' open and confirmatory inquiry by enabling them to discover their learning styles, develop alternative solution strategies, identify the most appropriate solution, and acquire self-regulation skills. A review of the literature revealed that no studies have directly examined the implications of artificial intelligence-supported intelligence games for open and confirmatory inquiry in education. Therefore, this study is expected to contribute to the literature in this respect.

The fourth research question examined academics' views on the implications of using artificial intelligence-supported verbal intelligence games in education for scientific reasoning skills. The participants stated that artificial intelligence-supported verbal intelligence games positively enhance scientific reasoning skills by fostering critical thinking, analytical thinking, problem-solving, and the ability to identify alternative solution strategies. A review of the literature indicates that there are studies demonstrating the positive implications of using artificial intelligence-supported intelligence games in education for scientific reasoning skills (e.g., Baki, 2022; Bottino et al., 2009; Reiter et al., 2014). Kurbal (2015) emphasized that intelligence games positively improved participants' reasoning skills. Bertizlioğlu (2025) emphasized that virtual intelligence games are effective in improving reasoning skills. In the same study, the views of the participants were also examined, and they stated that virtual intelligence games positively improved reasoning skills. Çetin and Özbuğutu (2020) concluded that artificial intelligence games have a positive effect on the development of reasoning skills. Sulaiman and Amin (2026) reported that artificial intelligence-based games are particularly effective in improving memory, reasoning, and coordination skills. Accordingly, it can be concluded that the findings of the present study are consistent with those reported in the existing literature.

Limitations and Recommendations

This study has several limitations. First, the study was limited to academics' views on AI-supported intelligence games. Therefore, the findings should be evaluated in relation to the academics' knowledge and experiences regarding intelligence games and artificial intelligence. For this reason, no experimental study was directly conducted with academics in the present study. This constitutes the first limitation of the study. Future studies may investigate the effects of AI-supported intelligence games by employing quantitative research methods to examine these variables.

The second limitation is related to the dependent and independent variables examined in the study. Specifically, the study investigated academics' views on the implications of AI-supported intelligence games for open and confirmatory inquiry, problem-solving, and scientific reasoning skills. This constitutes the second limitation of the study. Future research may also examine the effects of AI-supported intelligence games on different variables. In addition, the present study provides a theoretical framework regarding the effects of AI-supported intelligence games on higher-order thinking skills. Therefore, the findings obtained in this study are expected to provide guidance for the development of AI-supported intelligence game applications.

The third limitation of the study concerns the study group. The study was conducted based on the views of academics. Therefore, future studies may examine the views of different groups, such as teachers and preservice teachers, because the views of these groups were not examined in the present study. Therefore, future research may be carried out with different participant groups to obtain a broader perspective.

Scientific Ethics Declaration

* The author declares that the scientific ethical and legal responsibility of this article published in JESEH journal belongs to the author.

* The data for this study were collected voluntarily from academics. I am grateful to all the academics who participated in this process. Before collecting opinions as part of this study, the interview protocol was read, and opinions were gathered from academics who voluntarily agreed to participate in the interview.

Conflict of Interest

* The author has no conflict of interest to declare regarding the content of this article.

Funding

* No Fund

Data availability

* The datasets created and analyzed during this study are available from the corresponding author upon reasonable request.

References

- Alaswad, Z., & Nadolny, L. (2015). Designing for game-based learning: The effective integration of technology to support learning. *Journal of Educational Technology Systems*, 43(4), 389-402. Retrieved from <https://www.learntechlib.org/p/175201/>
- Alwaqadani, M. (2024). Investigating teachers' perceptions of artificial intelligence tools in education: Potential and difficulties. *Education and Information Technologies*, 30(3), 2737–2755.
- Ambarita, N., & Nurrahmatullah, M. F. (2024). Impacts of artificial intelligence on student learning: A systematic literature review. *Jurnal Varidika*, 36(1), 13-30.
- Ayar, A., Tüysüz, H., Alp, G., & Cavas, P. (2023). A systematic analysis of the studies in the field of mind and intelligence games. *Mehmet Akif Ersoy University Journal of Education Faculty*, 66, 51-83.
- Baki, Ü. (2022). *Reflection of game-based mathematics teaching on 6th grade students' reasoning skills* [Unpublished Master's thesis, Ondokuz Mayıs University]. YOK.
- Bayaga, A. (2025). Enhancing problem-solving skills in AI game-based learning environment through structural equation modelling and artificial neural network. *International Journal of Technology in Education*, 8(2), 574-589.
- Bertizlioğlu, I. (2025). *The Effect of science activities supported by verbal intelligence games on preservice teachers' problem-solving skills, scientific reasoning skills, motivation, and self-regulation, and their views*. (Master's Thesis). Retrieved from <https://tez.yok.gov.tr>
- Bottino, R. M., Ott, M., & Benigno, V. (2009). Digital mind games: experience-based reflections on design and interface features supporting the development of reasoning skills. In Proc. *3rd European Conference on Game Based Learning*.
- Chiu, T. K. F., & Chai, C. S. (2020). Sustainable curriculum planning for artificial intelligence education: A self-determination theory perspective. *Sustainability*, 12(14), 5568.
- Çağır, S., & Oruç, Ş. (2020). Intelligence and mind games in concept teaching in social studies. *Participatory Educational Research*, 7(3), 139-160.
- Çat, A. K., & Huseynova, Z. (2025). Artificial intelligence and gamification in education: determination of artificial intelligence awareness levels of secondary school students. *Asya Studies*, 9(32), 133-150.
- Çetin, A., & Özbuğutu, E. (2020). The opinions of pre-service science teachers about mental-intelligence games. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi*, (37), 93-99.
- Çobanoğlu, S. (2026). The transmission of traditional ecological knowledge in the proverbs of turkish tribes in the context of the ecological revolution of society 6.0. *Türk Dünyası Araştırmaları* 138(274), 1-34.
- Dempsey, J. V., Haynes, L. L., Lucassen, B. A., & Casey, M. S. (2002). forty simple computer games and what they could mean to educators. *Simulation and Gaming*, 33(2), 157-168.
- Epçaçan, U., & Bahçeci, F. (2023). The effect of mind games course on problem solving and creative thinking skills. *Anatolian Journal of Educational Leadership and Instruction*, 11(2), 342- 361.
- García-Martínez, I., Fernández-Batanero, J. M., Fernández-Cerero, J., & León, S. P. (2023). Analysing the impact of artificial intelligence and computational sciences on student performance: Systematic review and meta-analysis. *Journal of New Approaches in Educational Research*, 12(1), 171-197.
- Gündüzalp, C. (2021). The effect of digital game-based activities on students' self-regulation, self-sufficiency and motivation in online lessons. *Kocaeli Üniversitesi Eğitim Dergisi*, 4(2), 355-376.
- Güngör, K. & Tuğrul, B.. (2020). The effect of mind games that preschool children play on their problem solving abilities. *International Social Sciences Studies Journal*, 6(75), 5550-5561.
- Han, J. (2013). *Scientific reasoning: research, development, and assessment*. Unpublished Doctor of dissertation]. The Ohio State University.

- Kacmaz, G., & Dubé, A. K. (2025). Measuring teacher scaffolding in game-based learning: Emotional and responsibility scaffolds lead while resources and previous game experience shape practices. *Computers & Education*, 237, 1-12.
- Karataş, D., Bakır, A., Doğru, E., Akkuş, M. A., & Fidan, G. (2022). Designing games for secondary school seventh students under the unit “cells and divisions. *Journal of World of Turks/Zeitschrift für die Welt der Türken*, 14(2), 61-85.
- Kocagül Sağlam, M., & Ünal Çoban, G. (2020). Identifying the needs of science teachers regarding the development of students’ scientific reasoning skills. *Journal of the Faculty of Education, Pamukkale University*, 50, 399-425.
- Kölemen, E. B., & Yıldırım, B. (2025). A new era in early childhood education (ECE): Teachers’ opinions on the application of artificial intelligence. *Education and Information Technologies*, 30(12), 17405-17446.
- Kurbal, M. S. (2015). *An investigation of sixth grade students' problem solving strategies and underlying reasoning in the context of a course on general puzzles and games* [Master’s thesis, Orta Doğu Technical University]. YOK
- Lim, E.M. (2024). Metaphor analysis on pre-service early childhood teachers’ conception of AI (Artificial Intelligence) education for young children. *Thinking Skills and Creativity*, 51.
- Luckin, R., George, K., & Cukurova, M. (2022). *AI for school teachers*. CRC Press.
- Mansur, S. (2025). Ai-Powered Gamification and its Impact on Student. *TIJER Technix International Journal*, 12(9), 128-139.
- Nkereuwem, I. V., Obi, N. C., & Oyovwikoghene, S. (2023). Relationship between chatbots and ai-powered gamification on chemistry students’ motivation. *African Journal of Science, Technology and Mathematics Education (AJSTME)*, 9(5), 317-322.
- Osborne, J. (2013). The 21st century challenge for science education: Assessing scientific reasoning. *Thinking Skills and Creativity*, 10, 265-279.
- Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers and Education: Artificial Intelligence*, 2.
- Patton, M. Q. (2014). *Qualitative research and evaluation methods* (Translated by M. Bütün and S. Beşirdemir). Pegem.
- Twining, P., Heller, R. S., Nussbaum, M., & Tsai, C. C. (2017). Some guidance on conducting and reporting qualitative studies. *Computers & Education*, 106, 1-9.
- Prentzas, J. (2013). Artificial intelligence methods in early childhood education. In X.- S. Yang (Ed.), *Artificial intelligence, evolutionary computing and metaheuristics* (pp. 169-199). Springer.
- Reiter, H. B., Thornton, J., & Vennebush, G. P. (2014). Using kenken to build reasoning skills. *Mathematics Teacher*, 107(5), 341-347.
- Sulaiman, N., & Amin, H. (2026). Impact of ai-powered game simulation on adults' cognitive functions: efficacy of “cognifit”. In *AI-Powered Educational Games and Simulations* (pp. 307-340). IGI.
- Şahin, E., & Tezci, E. (2023). The effect of intelligence games on primary school 4th grade students' problem solving skills. *Balıkesir Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 26(50), 601-616.
- Terzi, A., & Altun, T. (2026). An examination of parents' attitudes toward teaching methods based on mind and intelligence games. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi*, (49), 50-72.
- Yıldırım, A. & Şimşek, H. (2016). *Qualitative research methods in social sciences* [Sosyal bilimlerde nitel araştırma yöntemleri]. Seçkin.
- Zhang, K., & Aslan, A. B. (2021). AI technologies for education: Recent research & future directions. *Computers and Education: Artificial Intelligence*, 2, 1-11.

Author(s) Information

Bekir Yıldırım

PhD, Professor,
Mus Alparslan University, Faculty of Education,
Department of Mathematics and Science Education, 49250,
Muş Türkiye
Contact e-mail: bekir58bekir@gmail.com
ORCID iD: <https://orcid.org/0000-0002-5374-4025>
