

Artificial Intelligence and Block-Based Coding in Science Education: Graduate Student Insights

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Abstract: This qualitative case study explored graduate students' views ($n=6$) on AI-supported applications and an AI-enabled block-based coding tool (PictoBlox) in science education. Data were gathered over a 39-hour implementation via a semi-structured interview form and screen captures from the activities, and analyzed with content analysis. Participants perceived AI tools as time-saving and pedagogically enriching, while emphasizing ethics and data security. PictoBlox's AI add-ons (e.g., natural language processing, image processing, machine learning) were seen to support concretization, visualization, and interactive content creation. Reported challenges concerned activity design and block creation skills. We discuss implications for teacher education, including targeted training on AI-supported lesson planning and assessment design, and guidance on ethical/data-protection practices. Limitations (convenience sampling, small n , self-report) constrain generalizability. Future research should replicate with larger, diverse cohorts and triangulate with classroom observations.

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Introduction

SCIENCE education aims to equip individuals with foundational knowledge in physics, chemistry, and biology, while enabling them to relate this knowledge to daily life and comprehend natural phenomena (Sönmez & Hastürk, 2020). In addition to fostering scientific understanding, it plays a vital role in nurturing critical thinking and effective problem-solving skills (Bayır & Kahveci, 2022). With the rapid advancement of technology and the growing influence of digital tools in education, science education is evolving into a more dynamic and interactive process that enhances student engagement and strengthens scientific learning (Moraiti et al., 2022).

The integration of digital technologies into science education has not only enhanced students' knowledge acquisition but also contributed to the development of essential 21st-century skills, including higher-order thinking, problem-solving, collaboration, and digital literacy (Atmaca-Aksoy, 2024). Recent years have witnessed a growing emphasis on using Web 2.0 tools, educational games, virtual reality, coding platforms, and AI-supported applications in classrooms (Turvey & Pachler, 2020). These technologies increase motivation, support personalized learning, and enrich instructional diversity (Mikropoulos & Iatraki, 2023). AI-supported tools, in particular, are gaining traction due to their ability to simulate human intelligence using techniques like machine learning, big data analysis, and natural language processing (AlKanaan, 2022; Aktay et al., 2023). When used effectively, they offer student-centered, interactive, and personalized learning environments (Mikropoulos & Iatraki, 2023).

The effective use of AI-supported applications in science education depends largely on how they are guided and implemented. In this context, the concept of a “prompt” has become increasingly important. A prompt refers to the instructions or cues used to guide AI systems in generating desired outputs (White et al., 2023). Effective prompt usage enhances the functionality of AI tools by enabling them to generate more original, relevant, and purposeful responses. In educational settings, this capability allows AI to support differentiated instruction, personalize content, and assist in assessing academic progress (Darayseh, 2023). Prompts are also crucial in AI-integrated coding processes, where algorithms and outcomes can be directed effectively through well-structured commands.

Coding, far beyond being a subset of information technologies, plays a fundamental role in various disciplines including science, engineering, and education (Weng et al., 2023). Coding supports the systematic development of solutions, logical reasoning, creative thinking, and collaboration skills (Ezeamuzie & Ezeamuzie, 2024). A particular branch of coding, block-based programming, simplifies learning algorithmic thinking by removing syntactic complexity. Platforms such as Scratch, Blockly, mBlock, and MakeCode

provide drag-and-drop interfaces that foster creative educational projects (Koray & Bilgin, 2023). Integrating block-based coding into science lessons enables students to explore scientific processes, analyze data, and visualize results (Moraiti et al., 2022; Ezeamuzie & Ezeamuzie, 2024). These platforms also promote enjoyment and motivation while strengthening connections between science and fields such as mathematics, engineering, and design (Copp et al., 2021; Taşmış & Doğru, 2024).

Existing research has explored various dimensions of AI-supported and block-based coding applications in education. Yu et al. (2025) examined the Tangible-MakeCode (T-MC) system and found it to be an accessible and motivating platform that encourages collaboration among learners with varying coding experience. Choi and Choi (2024) reported that Code.org's block-based curriculum improved motivation and engagement in K–12 students. Vasconcelos and Kim (2022) found that preservice teachers needed additional support in integrating coding and scientific modeling through the CS-Model module. Zahira et al. (2023), using a Design-Based Research approach, showed that PictoBlox-supported gamified media positively impacted primary students' arithmetic skills. Gökçe et al. (2024) emphasized the benefits of Arduino-based coding in science classrooms, particularly for enhancing teacher motivation and student engagement. Similarly, Cruz et al. (2021) highlighted the positive effects of AI-integrated PictoBlox on primary students' computational thinking and problem-solving skills.

While prior work has addressed AI tools and block-based coding separately, limited research has examined how graduate students perceive AI-supported applications together with an AI-enabled block-based environment within science education. This gap constrains program design in teacher education: without integrated evidence on perceived pedagogical value, risks (ethics/data security), and practical challenges, curricula may over- or under-emphasize AI components. By foregrounding graduate students' views after a 39-hour implementation, this study contributes design-relevant insights for course developers (what to include), capacity-building (what skills and supports are needed), and policy (what safeguards should accompany adoption).

The literature review revealed that no study has been conducted that simultaneously examines master's students' views on both AI-supported applications and block-based coding tools in the context of science education. This study explores graduate students' perceptions of AI-supported applications in science education with a specific focus on PictoBlox as an AI-enabled, block-based coding tool.

Table 1. Demographic Information of the Participants.

Code names of the Participants	Gender	Age	Grade Level
K1	F	24	Master's Student
K2	F	32	Science Teacher
K3	M	26	Research Assistant
K4	F	25	Master's Student
K5	F	28	Science Teacher
K6	F	35	Science Teacher

Methods

Research Design

The qualitative research method was preferred as the research model, and the case study was used among qualitative research methods. A case study is important in terms of revealing the problem situation in line with a holistic approach without reaching a general conclusion and forming ideas for future studies (Creswell, 2007).

Research Group

The study was conducted with six graduate students enrolled in the thesis-based master's program in Science Education at the Institute of Educational Sciences of a public university located in the Central Anatolia Region of Turkey. The participants were selected using a convenience sampling method. This sampling technique is commonly preferred in educational research, as it enables the researcher to collect data in a relatively short time and with minimal cost, particularly in contexts where limitations related to time, accessibility, or resources are present (Cohen et al., 2007). Demographic information about the participants (age, gender, and professional status) is presented in the table (**Table 1**).

Based on a background item and course records, [3/6] participants reported prior use of AI-supported applications (e.g., ChatGPT, mBlock, MAXQDA), whereas [3/6] reported no prior use. During analysis, prior exposure was used as a sensitizing variable; we compared code frequencies inductively across exposed vs non-exposed participants and observed. Given the small n, this is interpreted cautiously and discussed as a limitation.

Implementation Process

Table 2. Implementation Process of the Research.

Application Period	Activities	Description
3 Hours	Introduction to Google Classroom and Access Procedures What is AI? – Definitions and Key Concepts	Introduction to the Google Classroom application, creation of a virtual classroom, and provision of access to the virtual classroom for participants Introduction to basic concepts and areas of application related to AI
3 Hours	Fundamentals of AI	Addressing fundamental issues related to the ethical, legal, and moral dimensions of AI
3 Hours	The Role of AI in Educational Contexts	In line with the 2023 Education Vision, examining sample applications that integrate AI techniques and technologies that can be used in education
3 Hours	Understanding the Concept of Prompts in AI	The concept of “prompt” has been introduced; evaluations have been made on the function and importance of this concept in the context of AI
3 Hours	Introduction to AI-Supported Applications	Introduction to MagicSchool AI, Diffit for Teachers, ChatGPT, and Gemini applications; sample lesson plan and question preparation exercise with participants using each application Introduction to the Diffit for Teachers application and question preparation exercise with participants
3 Hours	Review of Participant Studies	Review of participants' work with MagicSchool AI, Diffit for Teachers, Chat GPT, and Gemini applications
3 Hours	Introduction to AI-Supported Presentation Applications	Introduction to Gamma.app, Canva AI, and Copilot applications; example presentation and poster preparation work with participants using each application
3 Hours	Review of Participant Studies	Review of participants' work using Gamma.app, Canva AI, and Copilot applications
3 Hours	Introduction to Algorithms, Coding, Block-Based Coding, and the PictoBlox Application	Providing participants with information about the place of algorithms, coding, and block-based coding in an educational context Introduction to the block-based PictoBlox application with AI-enhanced.
3 Hours	Text-to-Speech Module with PictoBlox Application	Participants were introduced to the AI plugins available on the PictoBlox platform; using block-based coding via the text-to-speech module, they carried out an activity related to current environmental issues and a speech bubble activity related to eutrophication
3 Hours	Natural Language Processing Module with PictoBlox Application	Participants were introduced to AI plugins available on the PictoBlox platform; the “Ecology Assistant” activity was carried out using block-based coding through the natural language processing module
3 Hours	Image Processing Module with PictoBlox Application	Participants were introduced to AI plugins available on the PictoBlox platform. Using block-based coding via the image processing module, they performed classification activities such as gender detection from fingerprints, cell classification from microscopic cell images, and separation of living groups such as animals, plants, fungi, and bacteria
3 Hours	Review of Participant Studies	Review of participants' work in the PictoBlox application

The 39-hour application, planned for students enrolled in the thesis-based master’s program in science education, was conducted in sessions of three hours each. In the application process, a virtual classroom was first created via Google Classroom, and in the first week, the participants in the study were given access to the virtual classroom. For the purpose of monitoring the process, the work carried out in the virtual classroom each week was collected by the researchers. The application schedule for the study is presented in the table (**Table 2**). In addition, as a final project for the

Table 3. Distribution of Participants' Use of AI Extensions and Subject Areas in Post-Implementation Projects Using PictoBlox.

Type of AI Extension Used	Subject Area	Participant Code
Natural Language Processing (NLP)	Interaction of Light with Matter	K2
	Solar and Lunar Eclipses	K3
	Food Chain and Energy Flow	K4
	Heat and Temperature	K5
Text-to-Speech (TTS)	Biodiversity	K2
	Solar and Lunar Eclipses	K3
	Matter Cycles and Environmental Issues	K4
	Heat and Temperature	K5
	Human-Environment Interaction	K6
Machine Learning (Image Processing Module)	The Cell	K1
	Genetics / Heredity	K1
	Solar and Lunar Eclipses	K3
	The Solar System	K5
	Reproduction, Growth, and Development in Plants and Animals	K6

application process, each participant was asked to select at least one topic from the Science Course Curriculum and create a block-based coding project using the PictoBlox application with AI-enhanced. The distribution of the AI add-ons used by the participants and the topics they selected is shown in the table (**Table 3**).

Data Collecting Instruments

The data in this study were collected using a semi-structured written interview form developed by the researchers, entitled "Interview Form for Identifying Views on the Use of AI-supported Applications and the Block-Based Coding Tool PictoBlox in Science Education.". In the study, a semi-structured written interview form was preferred. This form allows participants to express their individual opinions and experiences on the subject in detail without limiting the level of structuring of the responses (Punch, 2005). The interview form consisted of 21 open-ended questions designed to elicit participants' perspectives on both AI-supported applications and the AI-enhanced block-based coding platform PictoBlox, as well as their opinions regarding the use of these technologies within the context of science education. During the development phase, expert reviews were obtained from three subject-matter specialists and one language expert. Based on their

feedback, the necessary revisions were made, and the form was finalized accordingly.

Data Collection and Analysis

The data for this study were obtained following the 39-hour implementation process through two sources: (1) the semi-structured written interview form, and (2) outputs produced by participants during the learning process (activity products) within the intervention applications. The collected data were analyzed using content analysis. The analysis was conducted based on the categories and codes developed by the researchers. Content analysis is a systematic technique that involves categorizing and coding qualitative data, enabling the identification of recurring patterns and supporting the emergence of comparable thematic structures across studies (Silverman, 2001). During the analysis process of the study, each participant was first assigned a unique participant code. Subsequently, similar responses provided by the participants were grouped together under common themes and heading codes to form meaningful wholes. The codes, which were examined by the researchers based on their similarities and differences, were presented in tabular form.

Two researchers independently open-coded 30% of the dataset and then reached consensus through discussion to stabilize a shared codebook. On the double-coded subset, most discrepancies involved minor boundary/label refinements rather than substantive code disagreements; therefore, following recommendations for small-sample qualitative work, we prioritized negotiated agreement over a coefficient and documented decisions in an audit trail (Campbell et al., 2013; Miles, Huberman, & Saldaña, 2014; O'Connor & Joffe, 2020). The remaining materials were coded with the agreed codebook; peer debriefing, spot-checks, and memoing supported trustworthiness.

Results

For readability, findings are organized into four subthemes: 1) Views on AI (concept, uses, ethics, data security, perceived effectiveness); 2) PictoBlox-specific perceptions (usefulness, effective AI add-ons, intended use); 3) Challenges (activity design, block creation, interface); 4) Prior exposure and differential perceptions. Each subtheme is presented with a consolidated table (f/6) and 2–3 representative quotes. Participant-generated artifacts from the learning activities were used to corroborate interview-based claims, strengthening the credibility of interpretations.

Table 4. Distributions According to AI Recognition.

Category	Code	Participant Code	f	%
What is AI?	Time-saving functionality	K1, K2	2	28.6
	Machine learning	K1, K4	2	28.6
	Human-like characteristics	K3, K5, K6	3	42.8

Table 5. Distribution of AI by Area of Use.

Category	Code	Participant Code	f	%
Distribution of AI by Area of Use	Healthcare	K1, K2, K3, K4	4	17.4
	Education	K1, K2, K3, K4, K5	5	21.7
	Law	K1, K2	2	8.7
	Information Technology	K1, K2, K5, K6	4	17.4
	Advertising and Design	K1	1	4.35
	Transportation	K2	1	4.35
	Military	K3, K4	2	8.7
	Engineering	K3, K4, K5, K6	4	17.4

Participants in the study were asked the question, “What do you think AI is?” Similar answers from participants in the study regarding what AI is were collected under the same heading and examined (**Table 4**).

An examination of **Table 4** reveals that participants’ responses regarding AI were categorized under three primary codes. The majority of participants conceptualized AI under the code "human-like characteristics" (3 participants, 42.8%). In addition, several participants defined AI in terms of time-saving functionality and machine learning. Some of the participants’ opinions obtained in the study are given below:

“A tool that saves time.” (K2)

“In my opinion, AI is the ability of computers and machines to perform everything that humans can do using their intelligence, through specific algorithms. It is about a machine’s capacity to learn and think.” (K4)

“It is the simulation of human intelligence by computers (technology). It is a digital tool that can learn, demonstrate will in a situation, recognize sound and images, solve problems, and simplify complex structures.” (K6)

Participants in the study were asked the question, “What are the areas of application for AI?” Similar answers from participants regarding the areas of application for AI were compiled under the same heading and analyzed (**Table 5**).

Table 6. Distribution of AI-Supported Applications According to Their Purpose of Use.

Category	Code	Participant Code	f	%
AI-Supported Applications According to Their Purpose of Use	Time-saving functionality	Education	K1, K2, K3, K4, K5, K6	6
	Machine learning	Entertainment	K4, K5, K6	3
	Human-like characteristics	Work-Related	K3, K6	2

Note. Multiple responses were allowed; therefore, percentages may exceed 100%. Frequencies are out of N = 6 and percentages are computed as (f/6)×100. Minor discrepancies may occur due to rounding.

An examination of **Table 5** reveals that the responses provided by the participants regarding the areas of AI application were generally categorized under eight main themes. It was determined that the majority of the participants identified “Education” as the primary area of AI application (5 participants, 21.8%). In addition, the participants indicated other areas where AI is utilized, including healthcare, law, information technologies, advertising and design, transportation, the military, and engineering. Some of the participants’ opinions obtained in the study are given below:

“Areas such as health, education, law, information technology, and design.” (K1)

“It is used in almost every field today. Health, education, transportation, etc.” (K2)

“There are many areas of application. The main ones are health, engineering, and the military. In addition to these, we also use AI in education.” (K3)

Participants in the study were asked the question, “For what purposes do you use AI-supported applications?” Similar responses from participants regarding their purposes for using AI-supported applications were grouped under the same heading and analyzed (**Table 6**).

An examination of **Table 6** reveals that the participants’ responses regarding the purposes of using AI applications were generally categorized under three main themes. It was found that the majority of participants identified “education” as the primary purpose of use (6 participants, 54.5%), while other stated purposes included entertainment and professional (work-related) applications.

Participants in the study were asked the question, “Do you consider the use of AI tools in education to be ethical? Please explain.” Similar responses from participants regarding the ethicality of using AI tools in education were grouped under the same heading and analyzed (**Table 7**).

Table 7. Distributions of Ethical Views on the Use of AI Tools in Education.

Category	Code	Participant Code	f	%
Ethical Views on the Use of AI Applications in Education	Perceived as Ethical	K3, K5	2	33.3
	Perceived as Conditionally Ethical	K1, K2, K4	3	50
	Perceived as Unethical	K6	1	16.7

Table 8. Distributions According to the Impact of AI on Data Security.

Category	Code	Participant Code	f	%
The Impact of AI on Data Security	Threat	K1, K2, K3, K4, K5, K6	5	100
	Secure	K6	0	0

An examination of **Table 7** reveals that the participants' responses regarding the ethicality of using AI tools in education were analyzed. It was observed that the majority of participants considered the use of AI tools in educational settings to be ethically acceptable only under certain conditions (3 participants, 50%). Some of the participants' opinions obtained in the study are given below:

“AI tools should be used as instruments in education, not as ends in themselves. Any lesson plan or activity generated with the help of AI must be reviewed and approved by a teacher. If there are any errors, they should be corrected before use. Otherwise, I do not consider it ethically appropriate.” (K1)

“I believe that there will be no problem as long as AI tools are used in accordance with ethical principles. In cases where we utilize such tools, it is essential to clearly state that the product was created with the help of an AI tool.” (K3)

“The ethical implications of AI depend on how it is used. I do not consider the information directly obtained from AI tools—without questioning or verifying—to be ethical or reliable.” (K6)

Participants in the study were asked the question, “Do you think the use of AI technologies poses a threat to data security?”. Similar responses from participants in the study regarding whether the use of AI technologies poses a threat to data security were compiled under the same heading and analyzed (**Table 8**).

An examination of **Table 8** reveals that the participants' responses regarding whether the use of AI technologies poses a threat to data security

Table 9. Distributions Regarding the Utilization Status of AI in Education.

Category	Code	Participant Code	f	%
Utilization Status of AI in Education	Opportunity	K1, K2, K3, K4	4	66.7
	Threat		0	0
	Both Opportunity and Threat	K5, K6	2	33.3

were analyzed. It was determined that all participants considered the use of AI technologies to be a threat to data security (5 participants, 100%). Some of the participants' opinions obtained in the study are given below:

"I believe it may pose a threat in terms of data security. The inappropriate disclosure of personal data can create a significant security concern. The involuntary recording of everything in our daily lives (such as through social media accounts) may also constitute a data security risk." (K3)

"Yes, I think so. Every time we use AI tools, we generate data, and through this data, AI technologies can improve themselves. However, we do not have the option to consent to whether this data is used or not. This situation poses a threat in terms of data security." (K4)

"Yes, it does. Any information we input while using such applications is collected and may be shared with others, resulting in a risk of data sharing without our knowledge." (K5)

Participants in the study were asked the question, "Do you see AI as an opportunity or a threat in education? Please explain your reasons." Similar responses from participants in the study regarding whether the use of AI in education is an opportunity or a threat were collected under the same heading and analyzed (**Table 9**).

An examination of **Table 9** reveals that participants' responses concerning whether the use of AI in education represents an opportunity or a threat were generally categorized under three main themes. The findings indicate that the majority of participants perceived the integration of AI into education as an "opportunity" (4 participants, 66.7%). Moreover, some participants described it as both a threat and an opportunity. Some of the participants' opinions obtained in the study are given below:

"I see it as an opportunity. If used as a tool, it can help save time and space and enable easy access to information." (K1)

Table 10. Distributions of Beliefs Regarding the Use of AI in Professional Practice.

Category	Code	Participant Code	f	%
Beliefs Regarding the Use of AI in the Profession	I believe	K1, K2, K3, K4, K5, K6	6	100
	I do not believe		0	0

“Students should be taught how to use it properly. I do not see it as a threat to teachers; rather, I consider it an opportunity that may reduce the paperwork burden in the future.” (K2)

“AI is both a threat and an opportunity. This depends on how it is used by the individual. If we view and use AI (the digital world) as an end in itself without questioning, it becomes a threat; however, if we use it as a tool, it becomes an opportunity.” (K6)

Participants in the study were asked the question, "Do you believe that AI can be helpful to you in your profession?". The participants' responses to this question were grouped under similar headings and analyzed accordingly in the table (**Table 10**).

An examination of **Table 10** reveals that participants' views on whether AI would be beneficial in their professional lives were categorized under two main headings. It was found that all participants expressed their belief that AI would support them in their professional careers, coded as "I believe" (6 participants, 100%). Some of the participants' opinions obtained in the study are given below:

“Yes, as a teacher, I believe these applications can be helpful in lesson planning and preparing exams.” (K1)

“Since I consider myself a conscious user, I believe it will assist me in my profession. By using it at specific times, I think I can save time. For instance, during the process of preparing a poster or presentation, it will offer a wide range of visual materials, allowing me to create my own design using my own discretion.” (K3)

“It can be useful when explaining certain topics. In this way, we are able to attract and maintain students' attention and interest.” (K5)

Participants in the study were asked the question, “Have you used any AI-supported applications in the courses you previously took? If yes, which applications did you use?” The responses provided by the participants regarding whether they had used AI-supported applications in previous

Table 11. Distributions of AI-Supported Applications Used Prior to the Implementation Process.

Category	Theme	Code	Participant Code	f	%
AI-Supported Applications Used Prior to the Implementation Process	Used	Chat GPT	K1, K6	2	28.6
		mBlock	K5	1	14.3
		MAXQDA	K6	1	14.3
	Not Used	Not used	K2, K3, K4	3	42.8

Table 12. Distributions Based on the Purposes of Using AI in Education.

Category	Theme	Code	Participant Code	f	%
Purposes of Using AI in Education	Instructional Content	Lesson Planning	K1, K3, K4, K6	4	23.5
		Question Preparation	K1, K6	2	11.9
		Presentation Design	K2, K3, K6	3	17.6
		Activity Development	K1, K2, K4	3	17.6
		Poster Creation	K6	1	5.9
		Assessment Tool Development	K1, K4, K6	3	17.6
		Translation	K2	1	5.9

courses, the specific course, and the name of the application were analyzed by grouping similar responses under the same headings (**Table 11**).

An examination of **Table 11** reveals the participants' responses regarding whether they had previously used AI-supported applications in their coursework and, if so, which specific applications they had utilized. It was found that half of the participants had previously incorporated AI-supported applications into their courses. Among those who had used such applications, "Chat GPT," "mBlock," and "MAXQDA" were identified as the tools employed during instruction. Some of the participants' opinions obtained in the study are given below:

"No, I didn't." (K4)

"Yes, I used Mblock." (K5)

"Yes, I used MAXQDA in the computer-assisted qualitative data analysis course and Chat GPT in the scientific research methods and ethics course." (K6)

The study participants were asked, "For what purposes is AI used in education?" The responses provided by the participants were analyzed using a thematic approach, and similar statements were grouped under standard headings. Accordingly, the table systematically categorized and presented

Table 13. Distribution of AI-Supported Applications Used in Education.

Category	Code	Participant Code	f	%
AI-Supported Applications Used in Education	ChatGPT	K1, K2, K3, K4, K6	5	12.3
	MagicSchool AI	K1, K2, K4, K5	4	9.7
	Gamma.app	K1, K2, K3, K4, K5	5	12.3
	Prezzi	K1	1	2.4
	Microsoft Copilot	K1, K2, K3, K4, K6	5	12.3
	Popai	K2	1	2.4
	Diffit for Teachers	K3, K4, K5	3	7.3
	PictoBlox	K1, K3, K5	3	7.3
	Gemini	K2, K3, K4	3	7.3
	Sider	K2	1	2.4
	Canva	K2, K3, K4, K5, K6	5	12.3
	Scratch	K5	1	2.4
	Google Translate	K5	1	2.4
	Turnitin	K5	1	2.4
	Udacity	K5	1	2.4
	Robonova	K5	1	2.4

participants' views on the purposes of using AI technologies in educational contexts.

An examination of **Table 12** reveals that the participants' responses regarding the purposes of using AI in education were generally categorized under seven main headings. However, the response provided by the participant coded as "K5" did not align with the coding scheme and was therefore excluded from the analysis. It was found that most participants primarily used AI for "Lesson Planning" purposes in educational settings (4 participants, 23.5%). In addition, it was observed that participants also utilized AI for purposes such as question preparation, presentation design, activity development, poster creation, assessment tool development, and translation. Some of the participants' opinions obtained in the study are given below:

"It can be used for preparing lesson plans, activities, and questions. It may also be utilized in developing assessment tools for student evaluation." (K1)

"It is used for language translation, preparing presentations, and designing instructional activities." (K2)

"In education, AI technology is used during the lesson planning process, in the evaluation of lessons, for generating various instructional visuals, and for incorporating diverse activities and tasks into lessons." (K4)

Table 1. Distribution of the Advantages and Disadvantages of AI-Supported Applications in Science Education.

Category	Theme	Code	Participant Code	f	%
Advantages and Disadvantage Opinions	Advantages	Attention-Grabbing	K1, K2, K3, K5	4	30.8
		Interactive Learning	K1, K2, K3	3	23.0
		Concretization	K3, K6	2	15.4
	Disadvantages	Enriched Teaching	K3, K4, K5, K6	4	30,8
		Gamification	K1, K3, K4	3	30
		Ethical Issues	K2	2	20
		Dogmatic Thinking	K1, K3, K5, K6	4	40
		Mislearning	K6	1	10

Participants in the study were asked the question, “What are the AI-supported applications used in education? Please list their names.”. The responses provided by the participants regarding of AI-supported applications used in educational contexts were grouped and analyzed under common headings based on similarity (**Table 13**).

An examination of **Table 13** reveals that participants’ responses regarding AI-supported applications used in education were categorized under 16 distinct codes. It was found that the most commonly mentioned AI tools were ChatGPT, Gamma.app, Microsoft Copilot, and Canva. In addition, participants identified several other AI-supported applications used in educational contexts, including MagicSchool AI, Prezi, Diffit for Teachers, PictoBlox, Gemini, Sider, Scratch, Google Translate, Turnitin, Udacity, and Robonova. Some of the participants’ opinions obtained in the study are given below:

“Gemini, Copilot, Chatgpt, Sider, Canva, Magic School, Gammapp, Popai.” (K2)

“Pictoblox, Scratch, Google Translate, Turnitin, Udacity, Robonova, Diffit for Teachers, Canva, Magicschool AI, Gammaapp.” (K5)

“Many Web 2.0 tools used today have been integrated into education with AI add-ons. Some AI-supported applications include: ChatGPT, Microsoft Copilot, Canva.” (K6)

Participants in the study were asked, “What are the advantages and disadvantages of using AI-supported applications in science education from the perspective of teachers and students? Please explain.” The participants’ responses to this question were grouped under thematic headings, taking into account similar opinions, and analyzed accordingly. (**Table 14**)

Table 2. Distribution Based on the Perceived Impact of AI-Supported Applications in Science Education.

Category	Code	Participant Code	f	%
The Impact of AI-Supported Applications in Science Education	Effective	K1, K2, K3, K4, K6	5	83.3
	Ineffective	K5	1	16.7

An examination of **Table 14** reveals that participants' responses regarding their advantage and disadvantage views on using AI-supported applications in science education were categorized under four themes in each category. The advantage opinions were grouped under the codes "Attention-Grabbing", "Interactive Learning", "Concretization" and "Enriched Teaching" whereas the disadvantage opinions were classified under the codes "Gamification", "Ethical Issues", "Dogmatic Thinking" and "Mislearning". Some of the participants' advantage/disadvantage opinions obtained in the study are provided below:

"I believe that AI tools can make abstract concepts in science education more concrete and understandable. Teachers can achieve this by using appropriate simulations or animations. This will have a positive impact on students' interest and curiosity." (K3, Advantage)

"From the teachers' perspective, it is an advantageous learning environment for students to be able to learn better and more effectively through enriched teaching, thanks to environments that enable more effective learning through different methods and techniques, alternative learning tools, and the ability to address students with different learning styles through writing, as it is a tool that aids education." (K4, Advantage)

"Disadvantages such as data privacy and security, ethical issues, and dependence on technology." (K2, Disadvantage)

"The direct acquisition of information may lead to misconceptions; the uncontrolled use of ready-made templates may result in presentations, questions, or posters containing inaccurate, incomplete, or outdated content. Instead of engaging in critical thinking or inquiry, students and teachers may increasingly rely on AI, potentially weakening their cognitive skills. Moreover, the uncontrolled use of such tools may lead to avoidance of homework and responsibilities, which could negatively impact the overall learning process." (K6, Disadvantage)

The study participants were asked, "Do you think using AI-supported applications in science education is effective? Please explain your reasons." The similar responses of the participants in the study regarding the effectiveness of using AI-supported applications in science education were examined under the same heading in the table (**Table 15**).

Table 3. Distribution Based on the Perceived Impact of the PictoBlox Application in Science Education.

Category	Code	Participant Code	f	%
The Effect of PictoBlox Application in Science Education	I think	K1, K2, K3, K4, K5	5	83.3
	I don't think	K6	1	16.7

An examination of **Table 15** reveals that opinions regarding the effectiveness of AI-supported applications in science education are grouped under two headings. It was determined that most participants expressed that AI-supported applications provide effective teaching with the code “Effective” (5 participants, 83.3%). Some of the opinions of the participants obtained in the study are given below:

“It is effective. If we want to keep up with the times and support our students’ development in various fields, it would be beneficial to use such applications.” (K1)

“I don’t think we can completely distance ourselves from AI tools in today’s world. Therefore, we must learn how to use these tools effectively and efficiently. Once we develop this awareness, we can utilize AI-supported applications in science education to minimize students’ misconceptions. Moreover, with the help of AI tools, we can repeatedly simulate many experiments that would not normally be conducted in a classroom or laboratory setting. For this reason, I consider the use of AI-supported applications in science courses to be essential.” (K3)

“I do not think it is particularly effective. While it may influence students’ attitudes toward the course, I believe delivering information through more traditional instructional methods is more effective for student learning.” (K5)

The study participants were asked, “Do you think using the PictoBlox application in science education will provide effective teaching? Please explain your reasons.” Similar responses from participants in the study regarding the effectiveness of using the PictoBlox application in science education were collected under the same heading and analyzed (**Table 16**).

An examination of **Table 16** reveals that opinions regarding the effectiveness of the PictoBlox application in science lessons are grouped under two headings. It was determined that most participants expressed their belief that the PictoBlox application provides effective teaching using the code “I think” (5 participants, 83.3%). Some of the participants’ opinions obtained in the study are given below:

Table 4. Distribution of Challenges Encountered While Using the PictoBlox Application.

Category	Code	Participant Code	f	%
Challenges Encountered in the PictoBlox Application	Creating a block	K1, K6	2	40
	Preparing an activity	K2, K4	2	40
	Using the interface	K3	1	20

“I believe it would be effective, as it contributes to problem-solving and critical thinking skills and supports STEM education.” (K2)

“Yes, I do. Because students can learn basic coding and develop their algorithmic thinking skills through PictoBlox, while also engaging in integrated learning with AI. This may enhance their motivation as well as positively impact their academic performance.” (K4)

“In order for this application to be used effectively, the teacher must have coding knowledge, be capable of diversifying activities, and keep up with the updates in the application’s content. While it may be effective for teachers who are proficient in coding, there are currently many ready-to-use educational games available. Therefore, if the teacher is not sufficiently competent in using the application, alternative tools or platforms offering up-to-date simulations and games aligned with the curriculum outcomes may be preferred.” (K6)

Participants in the study were asked the question, “What parts of using the PictoBlox application did you find difficult in this course?” Similar responses from participants in the study regarding the difficulties they experienced while using the PictoBlox application were collected under the same heading and analyzed (**Table 17**).

An examination of Table 17 reveals that, the difficulties encountered by participants while using the PictoBlox application can generally be grouped under three headings. However, it was determined that the response of the individual with participant code “K5” did not fit this coding, and therefore the relevant question was excluded from the evaluation. Among the challenges experienced by the majority of participants, “Preparing activities” (2 participants, 40%) stands out. Additionally, participants indicated that they experienced difficulties in creating blocks and using the interface in the PictoBlox application. Some of the participants’ views obtained in the study are provided below:

“Creating blocks was a bit difficult for me.” (K1)

Table 5. Distribution of Participants Based on Their Willingness to Use the PictoBlox Application in Their Professional Lives and the AI Extensions They Found Effective.

Category	Theme	Code	Participant Code	f	%
Use of PictoBlox in the Profession and Effective AI	Would Use	Image Processing	K1	1	16.7
		Natural Language Processing	K2, K4	2	33.3
		Machine Learning	K3, K5	2	33.3
	Would Not Use	Would Not Use	K6	1	16.7

“I had difficulties in coming up with original activities, particularly in the creative aspect and thinking through each step in detail—in general, it was challenging for me.” (K2)

“The interface of the application is quite complex. This may lead to students encountering problems while using the application.” (K3)

Participants in the study were asked the question, “Do you use the PictoBlox application in your professional life? If so, what is the most effective AI add-on in the application? Please explain.” The responses from participants in the study regarding whether they would use the PictoBlox application in their professional lives and, if so, which AI feature they found most effective were analyzed under the same heading in the table (**Table 18**).

An examination of **Table 18** reveals that, the responses given by the participants in the study regarding whether they would use the PictoBlox application again in their professional lives and, if so, which AI add-on would be more effective, were examined under three headings for “I would use it” and one heading for “I would not use it.” Most of the participants in the study indicated that they would use the PictoBlox application in their professional lives (5 participants, 83.3%). Additionally, participants who expressed an intention to use the PictoBlox application stated that they found the “image processing,” “natural language processing,” and “machine learning” add-ons to be effective. Some of the participants’ opinions obtained in the study are provided below:

“I would use it. The image processing add-on was both enjoyable to work with and offered a wide range of activity design options.” (K1)

“Yes, I would use it. The natural language processing plugin. Because the assistant application created with this plugin can be integrated into many science subjects.” (K4)

Participants in the study were asked the question, “If you were to design an activity using the PictoBlox app, what topic would you choose?”

Table 6. Distribution of Activity Designs in the PictoBlox Application.

Category	Theme	Code	Participant Code	f	%
Activity Design in the PictoBlox Application	Science Education	Force and Motion	K1	1	14.3
		Genetics / Heredity	K4	1	14.3
		The Plant Kingdom	K5	1	14.3
		Heat and Temperature	K4	1	14.3
		The Sun, Earth, and Moon	K3	1	14.3
	Everyday Life Contexts	Real-Life Problem Scenarios	K2, K6	2	28.5

Similar responses from participants in the study regarding what topics they would choose to design activities with the PictoBlox app were collected under the same heading and analyzed (**Table 19**).

An examination of **Table 19** reveals that participants' responses regarding the activities they planned to design using the PictoBlox application were grouped under five codes related to science education themes and one code associated with real-life contexts. The science-related codes included "Force and Motion", "Genetics / Heredity", "The Plant Kingdom", "Heat and Temperature", and "The Sun, Earth, and Moon". Under the real-life theme, the responses were categorized under the code "Real-Life Problem Scenarios". Some of the participants' views obtained in the study are provided below:

"It can be adapted for physics class. We can use it for motion." (K1)

"I would use the Internet of Things (IoT). When people go on vacation, they often have to leave their keys with their neighbors. For people who cannot leave their keys, I would like to send an SMS to notify them that the plants have been watered." (K2)

"If I were to use the PictoBlox application, I would use the Machine Learning Environment AI add-on to classify the topic of solar and lunar eclipses, which is often confused and has many misconceptions in science education. This way, students will be able to easily understand the difference between solar and lunar eclipses with quick feedback." (K3)

Discussion

The purpose of this study is to determine the opinions of master's students in science education regarding AI-supported applications and the use of the AI-enhanced block-based coding application PictoBlox in science education. In line with the purpose of the study, the views of graduate students in science education regarding AI-supported applications and the AI-enhanced block-

based coding tool PictoBlox were examined. The responses provided by the participants in the study were analyzed under similar headings. The participants' opinions on AI-supported applications and the AI-enhanced block-based coding application PictoBlox were examined under 16 categories. In the participants' definitions of AI, elements such as time saving, machine learning, and human-like features were frequently highlighted. It is thought that the definition of AI with human-like features coincides with the basic definition of this concept in the literature. The emphasis on various sectors such as health, law, information technology, design, transportation, military, and engineering as areas of application for AI in the study is consistent with the findings obtained by Benzer and Benzer (2022). Similarly, research conducted by Çam et al. (2021) revealed that science and computer and instructional technology teacher candidates' awareness of AI technologies coincides with the findings obtained in this study. These results may be interpreted in relation to the increasing prevalence of AI technologies across various sectors, the rapid advancement of technological integration processes, and the growing societal prominence of AI.

In addition, when examining the participants' purposes for using AI-supported applications, the AI applications they had previously used, their purposes for using AI in education, and their responses regarding AI applications used in education, it was observed that AI was primarily used by participants in education for purposes such as preparing lesson plans, activities, and presentations. Allam et al. (2023) investigated the role of AI in education, particularly the performance of ChatGPT in instructional settings. Their findings indicated that while ChatGPT could support students in writing, language learning, and conducting research, it may also produce inaccurate or unreliable content (Allam et al., 2023). It is observed that the integration of AI technologies into educational environments is increasing and that the use of these technologies as various teaching materials is becoming widespread. However, in order for these technologies to be used effectively and reliably, the accuracy of the content produced by AI must be evaluated from a pedagogical and scientific perspective. The fact that some of the participants frequently use AI-supported applications in their daily lives is an indication that this technology is also widely integrated in areas outside of education. The diversity of the participants' use of AI, in addition to its use for entertainment and work purposes, highlights the practicality and functionality that this technological development provides in the education process. It has been determined that the most preferred AI-supported applications in education are Chat GPT, Canva, Microsoft Copilot, and Gamma.app. These findings emphasize that there are various applications that can use AI technologies in the education process and that it is important to enrich teaching processes with digital tools.

Another noteworthy finding of the study is the participants' views on the use of AI technologies in education. According to the data obtained, it was determined that a large proportion of participants viewed the integration of AI technologies in education as an opportunity. Participants expressed the belief that the affordances provided by these technologies, particularly in instructional and assessment processes, would contribute positively to their professional practice. While most participants evaluated the educational use of AI-supported applications positively, some also acknowledged potential threats posed by these technologies, particularly in terms of ethical concerns and data security. In particular, the issue of data security was highlighted as a common area of concern by all participants. Nonetheless, some participants believe that AI-supported applications are ethically acceptable. This situation shows that, although AI offers significant opportunities for teaching and learning, it simultaneously introduces various risks that must be carefully considered. Participants emphasized that AI technologies could support their professional roles and that the integration of such tools into educational processes would provide meaningful contributions. Thanks to the opportunities it provides in the teaching and assessment stages, AI-supported applications are seen as an innovative tool by many participants. Similar findings were reported by Saputra et al. (2023), whose study addressed the integration of AI into education from the perspectives of opportunities, challenges, threats, and barriers. Their research highlighted the benefits of AI technologies in the presentation of learning materials, assessment procedures, and learning management systems. However, issues related to data security and ethical concerns were also identified as prominent threats in the use of AI technologies (Saputra et al., 2023). These findings reveal that AI technologies offer opportunities in education but also carry various risks in terms of ethics and data security. Therefore, it is seen that certain restrictions should be imposed on the use of these technologies in educational environments and that users should be made aware of data security issues by taking ethical principles into consideration. Users acting consciously can play an important role in reducing concerns about AI technology.

Another topic examined in the study is the use of the PictoBlox application with AI in science education and the participants' opinions about this application. In this regard, responses to questions regarding the use of the PictoBlox application in science classes were examined; it was determined that the vast majority of participants (83.3%) believed that the application could provide an effective learning environment for science education. However, participants reported experiencing difficulties particularly in areas such as designing activities and creating blocks during the implementation process. A review of the literature reveals findings that are consistent with these observations. For instance, Zahira et al. (2023) developed an innovative gamified learning medium based on PictoBlox to teach addition and

subtraction to first-grade students. According to the research findings, this learning media was effective in helping students learn addition and subtraction; it was also determined that it increased students' attention, raised their motivation, and positively influenced their participation in learning activities during the teaching process (Zahira et al., 2023). Similarly, in another study conducted by Cruz et al. (2021), a teaching method was developed using the PictoBlox application to develop problem-solving skills, one of the 21st-century skills, and to teach AI applications. Research findings indicate that students actively participated in AI-based problem-solving processes through PictoBlox and were positively influenced by this process. However, it was also reported that some students experienced difficulties during the application process due to their lack of sufficient knowledge about AI use at the beginning (Cruz et al., 2021). When these findings are considered alongside the present study, it becomes evident that participants had limited prior experience with the use of block-based coding in the teaching of science content. When these findings are evaluated in conjunction with the existing literature, it is understood that participants had limited prior experience with the use of block-based coding in science education and that the insufficient integration of such applications into educational processes may lead to various difficulties in use. The participants' views indicate that the PictoBlox application is considered a useful teaching tool in the context of science education; however, difficulties were encountered during the application process, particularly in areas such as technical knowledge and content creation.

These findings highlight that the PictoBlox application has the potential to provide an effective learning environment in different disciplines, but it also points to the need for users to receive adequate training in order to use these technologies effectively in teaching processes. Additionally, participants identified image processing, natural language processing, and machine learning as the most effective AI features within the PictoBlox platform and expressed interest in utilizing these components in future instructional activities. They also indicated plans to design educational tasks through PictoBlox that address science curriculum topics and real-life problem scenarios. Finally, it was determined that participants found technologies such as image processing, natural language processing, and machine learning, especially AI plugins in the PictoBlox application, to be effective and planned to use them in the future. Participants indicated that they plan to use PictoBlox to design activities focused on science topics such as "Force and Motion", "Genetics/Hereditiy", "The Plant Kingdom", "Heat and Temperature" and "The Sun, Earth, and Moon," as well as everyday life problems.

Based on the findings obtained, it is suggested that AI-supported applications and block-based coding tools should be incorporated into teacher education programs. The fact that participants found these tools effective in the instructional process—particularly emphasizing the functionality of

PictoBlox in generating instructional materials through features such as natural language processing and image recognition—demonstrates the pedagogical applicability of such technologies. These findings align with existing literature emphasizing that teacher education should focus not only on content knowledge, but also on the development of digital pedagogical competencies (Voogt et al., 2015). In line with this, Weng et al. (2023) argued that coding applications are effective in fostering interdisciplinary thinking skills and advocated for their systematic integration into teacher training programs.

The study is limited by its small, convenience sample (n=6), single-institution context, and reliance on self-reported perceptions. Social-desirability bias cannot be ruled out, and the consolidated themes reflect a specific 39-hour implementation. Transferability is supported through thick description, yet replication with larger and more diverse cohorts and classroom observations is needed.

Conclusions and Recommendations

In this study, the opinions of master's students in science education regarding AI-supported applications and PictoBlox, a block-based coding application with AI add-ons, were examined. The findings show that participants found AI to be functional in education, particularly for purposes such as planning, preparing activities, and developing assessment tools. Participants noted that AI-supported applications enrich the teaching process, save time, and cater to different learning styles. However, concerns about data security and ethical issues drew attention to the limitations of the technology. A large portion of participants stated that AI offers opportunities in education but can pose a threat if not used consciously and pedagogically. When evaluating opinions on the PictoBlox application, it was understood that participants found the application effective in science education, particularly in integrating natural language processing, image processing, and machine learning plugins into the teaching process. However, the difficulties encountered in the block creation and original activity design processes revealed the need for users to develop their technical skills.

Based on the research findings, it is recommended that in-service training programs be expanded to enable teacher candidates to use AI-supported applications effectively. Additionally, it is important to develop guidelines for the ethical use of such tools in educational settings and to raise awareness regarding data security and content accuracy. In conclusion, conducting similar studies in different disciplines and with larger samples will contribute significantly to the literature on the integration of AI and coding technologies into teaching processes. An interdisciplinary approach must be adopted in order to use these technologies effectively in educational environments. Conducting these processes in collaboration with experts in educa-

tional technologies and Computer and Instructional Technology Education (CITE) will enhance the quality of the applications to be developed. Additionally, establishing the appropriate infrastructure to instill AI and coding skills from an early age will support students in acquiring basic knowledge and skills in these areas from a young age.

Reference

- Aksoy, A. C. A., & Irmak, Ş. (2024). Investigating the Research Trends of Articles on Science Education and Artificial Intelligence. *International Journal of Academic Studies in Technology and Education*, 2(2), 101-128.
- Aktay, S., Gök, S., & Uzunoğlu, D. (2023). ChatGPT in education. *Turkish Academic Publications Journal (TAY Journal)*, 7(2), 378-406.
- AlKanaan, H. M. (2022). Awareness regarding the implication of artificial intelligence in science education among pre-service science teachers. *International Journal of Instruction*, 15(3), 895-912.
- Allam, H., Dempere, J., Akre, V., Parakash, D., Mazher, N., & Ahamed, J. (2023). Artificial intelligence in education: An argument of Chat-GPT use in education. 9th International Conference on Information Technology Trends (ITT) (pp. 151-156). DOI: <https://doi.org/10.1109/ITT59889.2023.10184267>
- Bayır, E., & Kahveci, S. (2022). Examination of middle school science textbooks in terms of scientific process skills. *Cumhuriyet International Journal of Education*, 11(1), 253-262.
- Benzer, S., & Benzer, R. (2022). The Opinions of Informatics Graduate Students on Artificial Intelligence [in Turkish]. *Electronic Journal of Social Sciences*, 10, 53-83. DOI: <https://doi.org/10.29228/sbe.62139>
- Çam, M. B., Çelik, N. C., Turan Güntepe, E., & Durukan, Ü. G. (2021). Determination of pre-service teachers' awareness of artificial intelligence technologies. *Mustafa Kemal University Journal of Social Sciences Institute*, 18(48), 263-285.
- Campbell, J. L., Quincy, C., Osserman, J., & Pedersen, O. K. (2013). Coding in-depth semistructured interviews: Problems of unitization and inter-coder reliability. *Sociological Methods & Research*, 42(3), 294-320.
- Choi, W., & Choi, I. (2024). Exploring the Impact of Code.org's Block-Based Coding Curriculum on Student Motivation in K-12 Education. In 2024 12th International Conference on Information and Education Technology (ICIET), (s. 93-97). DOI: <https://doi.org/10.1109/ICIET60671.2024.10542810>
- Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education*. New York: Routledge.
- Copp, D. A., Isaacs, J. T., & Hespanha, J. P. (2021). Programming, robotics, and control for high school students. *Advances in Engineering Education*, 9(4), 1-27.
- Creswell, J. W. (2007). *Qualitative inquiry & research design: Choosing among five* (2.Baskı b.). USA: SAGE Publications.
- Cruz, S., Bento, M., & Lencastre, J. (2021). Computational Thinking Training using PICTOBLOX. *Proceedings of International Conferences Internet Technologies & Society 2021*, (s. 53-60).
- Darayseh, A. (2023). Acceptance of artificial intelligence in teaching science: Science teachers' perspective. *Computers and Education: Artificial Intelligence*(4), 100132.
- Ezeamuzie, N. O., & Ezeamuzie, M. N. (2024). Multidimensional Framing of Environments Beyond Blocks and Texts in K-12 Programming. *Review of Educational Research*, 20(10), 1-31. DOI: <https://doi.org/10.3102/00346543231216958>

- Gökçe, H., Bektas, O., & Şahin, A. (2024). Science teacher candidates' experiences with robotic coding. *Cappadocia Journal of Education*, 5(1), 1–21.
- Koray, A., & Bilgin, E. (2023). The Effect of Block Coding (Scratch) Activities Integrated into the 5E Learning Model in Science Teaching on Students' Computational Thinking Skills and Programming Self-Efficacy. *Science Insights Education Frontiers*, 18(1), 2825-2845.
- Mikropoulos, T., & Iatraki, G. (2023). Digital Technology Supports Science Education For Students With Disabilities: A Systematic Review. *Education and Information Technologies*, 28(4), 3911-3935. DOI: <https://doi.org/10.1007/s10639-022-11317-9>
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis* (3rd ed.). SAGE.
- Moraiti, I., Fotoglou, A., & Driga, A. (2022). Coding with Block Programming Languages in Educational Robotics and Mobiles, Improve Problem Solving, Creativity & Critical Thinking Skills. *International Journal of Interactive Mobile Technologies*, 16(20), 59-78. DOI: <https://doi.org/10.3991/ijim.v16i20.34247>
- O'Connor, C., & Joffe, H. (2020). Intercoder reliability in qualitative research: Debates and practical guidelines. *International Journal of Social Research Methodology*, 23(2), 261–276.
- Punch, K. F. (2005). *Introduction to social research* (D. Bayrak, H. B. Arslan, & Z. Akyüz, Trans.). Ankara: Siyasal Kitabevi.
- Saputra, I., Astuti, M., Sayuti, M., & Kusumastuti, D. (2023). Integration of Artificial Intelligence in Education: Opportunities, Challenges, Threats and Obstacles. *A Literature Review. Indonesian Journal of Computer Science*, 12(4).
- Silverman, D. (2001). *Interpreting Qualitative Data, Methods for Analyzing Talk, Text and Interaction* (2nd Ed. b.). London: Sage Publication Inc.
- Sönmez, D., & Hastürk, H. (2020). A bibliographic analysis of doctoral theses in the field of science education in Turkey. *Journal of Humanities and Social Science Research*, 94, 3174–3194.
- Taşmış, S., & Doğru, M. (2024). The effect of robotic coding applications in the unit of electric circuit elements on 5th grade students' academic achievement, science anxiety and motivation. *Journal of Science, Mathematics, Entrepreneurship and Technology Education*, 7(1), 76–90.
- Turvey, K., & Pachler, N. (2020). Design principles for fostering pedagogical provenance through research in technology supported learning. *Computers & Education*, 146, 103736. DOI: <https://doi.org/10.1016/j.compedu.2019.103736>
- Vasconcelos, L., & Kim, C. (2022). Preservice science teachers coding science simulations: epistemological understanding, coding skills, and lesson design. *Educational Technology Research and Development*, 70(4), 1517-1549. DOI: <https://doi.org/10.1007/s11423-022-10119-7>
- Voogt, J., Fisser, P., Good, J., Mishra, P., & Yadav, A. (2015). Computational thinking in compulsory education: Towards an agenda for research and practice. *Education and Information Technologies*, 20, 715-728. DOI: <https://doi.org/10.1007/s10639-015-9412-6>
- Weng, X., Ng, O.-L., Cui, Z., & Leung, S. (2023). Creativity Development With Problem-Based Digital Making and Block-Based Programming for Science, Technology, Engineering, Arts, and Mathematics Learning in Middle School Contexts. *Journal of Educational Computing Research*, 6(2), 304–328.
- White, J., Fu, Q., Hays, S., Sandborn, M., Olea, C., Gilbert, H., . . . Schmidt, D. (2023). A Prompt Pattern Catalog to Enhance Prompt Engineering with ChatGPT. *ArXiv Preprint, arXiv:2302.11382*.
- Yu, J., Garg, P., Synn, D., & Oh, H. (2025, April). Tangible-MakeCode: Bridging Physical Coding Blocks with a Web-Based Programming Interface for Collaborative and Extensible Learning. In *Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems* (pp. 1-15).
- Zahira, M., Mardiana, A., Mutmainah, R., Apriliya, S., & Saputra, E. (2023). Learning Media for Counting Operations Based on Pictoblox Gamification: Development Research in Class 1 Elementary School. *Al-Aulad: Journal of Islamic Primary Education*, 6(2), 144-154.

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