KeAi
CHINESE ROOTS
GLOBAL IMPACT

International Journal of Innovation Studies

" THE RELATIONSHIP BETWEEN THE USE OF ARTIFICIAL INTELLIGENCE-SUPPORTED DESIGN INSTRUMENTS AND THE DEVELOPMENT OF CREATIVE THINKING AMONG GIFTED STUDENTS IN PRIMARY SCHOOLS WITHIN THE GREEN LINE, FROM THE TEACHERS' PERSPECTIVE "

Dr. Eiman Nassar
Ministry of Education
eiman.seren@gmail.com

Dr. Amani Darawshi Jawabreh
Ministry of Education
Amany_drawshy@walla.co.il

Dr. Samar Suliman
Ministry of Education
Samar.soliman79@gmail.com

Dr. Heba Abd El Rahman
Ministry of Education
heba7881@gmail.com

Abstract

This study aimed to explore the impact of AI-supported design tools on the development of creative thinking among gifted students in elementary schools inside the Green Line, through analyzing teachers' perceptions. The research was conducted on a sample of 50 male and female teachers, randomly selected using stratified sampling from schools in the region. The sample reflected demographic diversity in terms of gender (36% male, 64% female), teaching experience (14% less than 5 years, 26% between 5–10 years, and 60% more than 10 years), and academic qualification (44% bachelor's degree, 56% postgraduate studies).

The study employed a questionnaire consisting of 35 items distributed across six main domains. The validity and reliability of the instrument were confirmed ($\alpha = 0.87$). A descriptive-analytical approach was followed, along with the use of advanced statistical methods including analysis of variance, correlation coefficients, and regression analysis.

The results revealed that 44% of teachers used AI tools extensively, while 16% never used them. The domains related to creative fluency recorded the highest mean scores (1.72–2.12), whereas the domains of originality and group brainstorming showed moderate levels (2.18–2.34). Analysis of variance showed statistically significant differences ($p < 0.05$) in favor of teachers who used AI tools more frequently. Regression analysis indicated that 58% of the variance in creativity could be explained by variables related to the use of AI tools.

No statistically significant differences were found based on gender or academic qualification, indicating the inclusivity and generalizability of the results. The study recommends the adoption of a set of measures on multiple levels:

- **At the educational policy level**: AI should be integrated into gifted development strategies and budgets allocated for supporting technical infrastructure.
- **At the training level**: Intensive training programs should be implemented to focus on the integration between AI and human creativity, along with practical workshops to empower teachers.
- **At the curriculum level**: There is a need to develop educational units based on technology-supported design and include activities that enhance critical thinking.
- **At the research level**: Longitudinal studies are necessary to measure long-term impact and expand the scope of research to include different geographical areas.

This study provides a practical framework for integrating modern technologies in gifted education and emphasizes that AI is not a substitute for human creativity, but rather an enabling tool that enhances creative potential when used in a balanced manner. The findings form a significant foundation for policymakers and educators in the digital transformation era and open new horizons for research in the field of technology-enhanced creative education.

Keywords: Artificial Intelligence, Creative Thinking, Gifted Students, Elementary Education, Design Tools.

Introduction

In the past two decades, the world has witnessed a tremendous digital revolution that has reshaped every aspect of life, especially in education. Artificial Intelligence (AI) technologies have brought about fundamental changes in how educational content is developed, delivered, and assessed. One of the core competencies of 21st-century learning is creative thinking, which is particularly essential for gifted students who require advanced, interactive learning environments (Abdulrahman & Naeem, 2021).

AI-assisted design tools represent one of the most innovative applications that offer a rich educational space full of creative opportunities. These tools allow students to generate novel ideas, transform them into digital or physical products, and interactively analyze their designs (Al-Khatib, 2023). From AI-based image generators to storytelling platforms and gamified design tools, students engage in creative practices characterized by fluency, flexibility, originality, and elaboration.

Within the educational context of elementary schools inside the Green Line, there are unique challenges in fostering creativity among gifted students. These students often do not receive sufficient intellectual stimulation. Integrating AI-assisted design tools into the classroom environment could enhance students' creative capacities and encourage nontraditional engagement with learning materials (Zahran, 2019).

The questionnaire employed in this research examines teachers' perceptions of the impact of AI-assisted design tools on creative thinking dimensions, such as fluency, flexibility, originality, and elaboration. It also addresses additional areas like storytelling, game design, and peer-teaching, reflecting the tools' holistic educational role.

By employing a descriptive-analytical methodology, this study aims to explore the relationship between AI tools and creative thinking from the perspectives of teachers working in elementary schools within the Green Line. The goal is to provide evidence-based pedagogical recommendations that support the effective integration of AI in developing gifted students' talents.

Recent studies show that AI tools enhance engagement and learning outcomes by creating stimulating educational environments (Al-Hammadi, 2022; Abu Awad, 2020). Literature also highlights that gifted students tend to respond positively to intelligent tools, especially when they are introduced creatively, encouraging higher-order thinking skills and self-expression. The expected outcomes of this study may lead to actionable recommendations for teachers of the gifted and support decision-makers in adopting smart tools that foster innovation and adaptability among students in digital societies.

Research Problem

Education in modern societies is undergoing a significant transformation driven by rapid technological advancements, particularly with the emergence of Artificial Intelligence (AI) as a central force reshaping teaching and learning approaches. Within this shift, creative thinking is regarded as a vital 21st-century skill, especially in the education of gifted students, who require innovative strategies and tools that go beyond traditional teaching models.

AI-assisted design tools have emerged as innovative educational solutions that empower students to explore and expand their creative abilities through interactive digital environments. However, the actual effectiveness of these tools remains uncertain in real educational contexts—especially in elementary schools within the Green Line—where pedagogical, social, and economic conditions vary across regions. Moreover, the readiness of teachers and technological infrastructure differ greatly, and local studies specifically targeting gifted students are limited.

Field observations and educational reports indicate a clear gap between the potential capabilities of AI tools and their actual implementation in fostering creative thinking among gifted students in Green Line schools. Additionally, teachers' perceptions—being pivotal stakeholders in the educational process—have not been adequately studied in terms of how these tools impact fluency, flexibility, originality, and elaboration, as well as storytelling, game design, and advanced expression skills.

Thus, the research problem lies in the need to analyze the relationship between the use of AI-assisted design tools and the development of creative thinking among gifted elementary students within the Green Line, as perceived by teachers. The study aims to observe and interpret the current situation through a systematic scientific lens and provide results that can guide the improvement of educational practices and policy-making.

Research Objectives

This study is grounded in an educational vision that emphasizes the importance of keeping pace with modern technological developments and systematically integrating them into quality education for gifted students—particularly within elementary schools located in the Green Line. The study aims to contribute to this goal by pursuing the following objectives:

1. To identify the extent to which AI-assisted design tools are used in elementary classrooms within the Green Line, by analyzing teachers' perspectives regarding their prevalence, usage patterns, and integration with educational activities targeting gifted students.

2. To examine the relationship between the use of AI design tools and the development of core dimensions of creative thinking (fluency, flexibility, originality, and elaboration), which are essential indicators for evaluating students' creative growth.
3. To explore teachers' perceptions of the educational and pedagogical impact of these tools, particularly their role in helping students create stories, design educational games, and develop interactive presentations—contributing to verbal and written expression skills.
4. To provide an analytical educational framework that highlights both the opportunities and challenges of integrating AI tools in gifted education within the Green Line, including potential limitations related to infrastructure or teacher preparedness.

5. To formulate evidence-based recommendations that inform educational policymakers, curriculum developers, and school leaders on how to invest effectively in AI tools to enhance learning outcomes and create an environment conducive to creativity and innovation.

Research Questions

Based on the research problem and objectives, the study seeks to answer the following questions:
1. To what extent do teachers integrate AI-assisted design tools in teaching gifted students in elementary schools within the Green Line?
2. What is the impact of these tools on enhancing the creative fluency of gifted students from the teachers' perspective?
3. How do AI tools contribute to developing flexibility and originality among gifted students according to teachers' views?
4. What is the effect of AI-assisted design tools on developing creative elaboration in students' projects?
5. To what extent do these tools empower students to build stories, design interactive games, and engage in peer-teaching?
6. What are teachers' overall perceptions regarding the relationship between AI-assisted design tools and the development of creative thinking among gifted students?

Research Sample

The research sample consists of male and female teachers of gifted students in elementary schools located within the Green Line. Participants were selected purposively based on their direct or indirect experience in using AI-assisted design tools in their teaching practice. The sample includes teachers who are familiar with AI technologies and who actively engage with gifted students in real classroom settings. Data were collected using a structured electronic questionnaire that covered multiple dimensions of creative thinking and the perceived impact of AI tools.

Data Collection instrument

The questionnaire included closed-ended items measured using a five-point Likert scale, where respondents rated their level of agreement from "Very High" to "Very Low." It was reviewed by a panel of educational experts and AI specialists to ensure face validity and relevance to the study's objectives.

Research Methodology

This study adopted the descriptive-analytical methodology, which is most appropriate for examining educational phenomena as they exist in reality. It aims to analyze the relationships between variables based on participants' perspectives. This methodology is suitable for analyzing teachers' perceptions of the role of AI-assisted design tools in developing creative thinking among gifted students in elementary schools within the Green Line. Data were collected using a questionnaire and analyzed statistically to derive findings and provide recommendations.

Research Limitations

This study is subject to several limitations that must be considered when interpreting the findings:

1. Spatial Limitations: The study is limited to elementary schools within the Green Line.

2. Human Limitations: The sample includes only teachers of gifted students.

3. Temporal Limitations: The study was conducted during the second semester of the academic year 2025.

4. Topical Limitations: The research focuses solely on AI-assisted design tools and creative thinking.

Research Importance

This research gains its significance from the rapid evolution of educational technology, particularly the increasing integration of Artificial Intelligence (AI) tools in instructional practices. The importance becomes even more prominent when these tools are directed toward gifted students—a group that requires intellectually stimulating and flexible environments to foster creative expression.

In the local context of the Green Line, the need for adaptive and effective teaching strategies is growing due to disparities in infrastructure and resource availability across schools. This research contributes by providing reliable data on the effectiveness of AI-assisted design tools in enhancing creative thinking, offering insights that support professional development initiatives and curriculum planning for gifted education.

Moreover, the study serves as a valuable reference for educators, researchers, and policymakers on how to implement AI tools to empower students in creative domains such as storytelling, game design, and multimedia presentation.

On the academic level, the research adds to the growing Arabic literature on AI in education, advancing a data-driven approach through a structured quantitative instrument (questionnaire) within a real-world educational setting.

Operational and Conceptual Definitions

•Artificial Intelligence (AI):

Refers to the ability of digital systems to simulate human thinking by performing tasks such as learning, analyzing, predicting, and decision-making. In this study, it denotes intelligent tools used to support educational and design-related activities.

•AI-Assisted Design Tools:

Applications or platforms that allow users—especially students—to create and design creative content (e.g., images, stories, games, presentations) with the support of smart technologies that enhance and refine creative processes.

•Creative Thinking:

The capacity to generate novel, unconventional, and valuable ideas. It includes core dimensions such as fluency (quantity of ideas), flexibility (variety), originality (uniqueness), and elaboration (richness of content).

- ***Gifted Students:***

Learners who exhibit exceptional natural abilities or cognitive performance compared to peers, requiring enriched educational programs to develop their full potential.

- ***Schools within the Green Line:***

Educational institutions located within the borders of the 1949 Armistice Line, representing a diverse and complex educational environment that faces infrastructural and socio-cultural challenges—making this setting particularly relevant for educational research.

The Concept of Creative Thinking and Its Dimensions

Creative thinking is one of the most vital higher-order cognitive skills that educators strive to foster in students, particularly gifted students who demonstrate exceptional intellectual capabilities. Creative thinking involves more than just producing novel ideas; it entails the ability to connect existing knowledge in new ways and to solve problems through unconventional approaches (Suleiman, 2023).

Guilford defined creative thinking as "the ability to produce a large number of ideas for a given problem in a limited time, with attention to diversity and originality." Torrance (1974) described it as "the process of sensing gaps or problems, formulating hypotheses, testing them, and communicating the results." These definitions illustrate that creativity is not limited to the arts but extends across educational and social spheres.

Dimensions of Creative Thinking

Researchers often break down creative thinking into several measurable sub-skills, including:

1. Fluency:

This refers to the individual's ability to generate as many relevant ideas as possible within a specific timeframe. It reflects the openness of thought and the readiness to respond quickly to different stimuli (Al-Jubouri, 2022). In the context of AI design tools, fluent students may quickly produce diverse outputs or solutions.

2. Flexibility:

Flexibility denotes the ability to shift from one thinking pattern to another, or to view problems from various perspectives. It is a critical skill in diverse and multilingual environments such as the educational settings inside the Green Line (Abdullah, 2020).

3. Originality:

Originality is the capacity to produce ideas that are unique and uncommon. It is often evaluated based on the rarity or uniqueness of the response (Torrance, 1974). Students who use AI design tools to create novel and unexpected outcomes exhibit this dimension strongly.

4. Elaboration:

Elaboration is the ability to enrich basic ideas with detailed development. It shows depth of thought and imagination, often encouraged by AI-supported environments that promote exploration and refinement (Suleiman, 2023).

The integration of AI tools in elementary schools within the Green Line region plays a crucial role in nurturing these dimensions. By fostering a learner-centered environment that supports experimentation and critical reflection, schools can significantly enhance students' creative capacities.

AI-Powered Design Tools

Definition of AI-Powered Design Tools

AI-powered design tools are software applications that leverage artificial intelligence technologies—such as machine learning, computer vision, and natural language processing—to enhance the creative design process. These tools support users in creating visual, audio, or interactive content more efficiently by providing smart suggestions or automating parts of the design process (Nasser, 2023; Alzahrani, 2022).

In educational contexts, especially in complex multicultural environments like the schools within the Green Line in Israel, AI-powered tools help break down traditional barriers to creativity and offer students new ways of expression. These tools encourage students, particularly the gifted ones, to explore innovative pathways to problem-solving and communication (Hassan, 2024).

Examples of AI Design Tools and Their Educational Uses

Several AI tools have been integrated into educational settings to foster creativity and enhance design thinking skills among students:

1. ***Canva AI:***

A widely used design platform that now includes AI features for layout suggestions, image generation, and automated content formatting. It is used by teachers and students to create infographics, visual content, and interactive presentations that support visual and creative thinking (Alzahrani, 2022).

2. ***DALL·E by OpenAI:***

A text-to-image generator that helps students visualize concepts and translate ideas into creative artwork, enhancing their originality and flexibility in creative projects (Brown et al., 2021).

3. ***ChatGPT and Bard:***

These text-generating AI tools assist students in brainstorming ideas, writing narratives, and engaging in creative writing exercises that develop their elaboration and fluency dimensions.

4. ***AutoDraw:***

An AI tool that helps young learners sketch quickly by predicting and enhancing their drawings. It is particularly useful in primary education to support visual literacy and motor creativity.

5. ***ThingLink:***

A tool for creating interactive visual content such as images and videos that can be enriched with multimedia links, encouraging elaboration and integrative learning (El-Hamamsy, 2023).

In Arab schools within the Green Line, these tools are increasingly being integrated into classroom activities to bridge linguistic and technological divides. They provide students with a stimulating environment that encourages experimentation and innovation in design-based learning (Hassan, 2024).

The Role of Artificial Intelligence in Education

Artificial Intelligence (AI) has emerged as a transformative force in the educational landscape, providing advanced tools to enhance learning, personalize content delivery, and support teacher-student interaction (Al-Hashimi, 2022). Its role has evolved from a supportive technology to an active agent in fostering creativity, promoting project-based learning, and enabling personalized education (Hassan, 2023).

1. Personalized Learning:

AI allows for the adaptation of educational content based on individual learning patterns. Through machine learning algorithms, intelligent learning systems deliver customized activities that match a student's cognitive level, facilitating differentiated learning—an essential need in culturally diverse environments like schools inside the Green Line (Abdulrahman, 2021).

2. Fostering Creative Thinking:

AI supports creative thinking by providing interactive platforms that encourage experimentation, free expression, and the generation of novel ideas. When integrated into classroom activities such as design-based projects, AI enables students to explore unconventional problem-solving methods (Alzahrani, 2022).

3. Performance Evaluation and Data Analytics:

AI-powered analytics tools can process large datasets to evaluate student performance, helping teachers make informed instructional decisions (Nasser, 2023).

4. Bridging Language and Cultural Gaps:

In the multilingual and multicultural setting of Arab schools inside the Green Line, AI technologies such as real-time translation, voice recognition, and adaptive learning interfaces help overcome language barriers, promoting inclusion and active participation (Hassan, 2023).

AI-Supported Design Thinking

Definition of Design Thinking

Design Thinking is a human-centered, creative, and iterative process for solving complex problems. It promotes empathy, idea generation, and innovation, making it a powerful framework for enhancing students' creative and critical thinking abilities (El-Shafei, 2021).

The traditional five stages of design thinking—**Empathize**, **Define**, **Ideate**, **Prototype**, and **Test**—allow learners to explore real-world issues in a structured yet flexible manner (Brown, 2009).

How AI Supports the Design Thinking Process

When integrated with artificial intelligence, design thinking evolves into a more powerful educational strategy. AI contributes to each stage of the process in the following ways:

1. **Empathize:** AI tools can analyze user behavior and sentiment to help students better understand target users' needs (Suleiman, 2022).
2. **Define:** AI algorithms assist in analyzing problem contexts, helping students frame problems from various dimensions (Al-Hashimi, 2023).
3. **Ideate:** Text and image generators like ChatGPT and DALL·E provide students with creative prompts and ideas, enhancing idea fluency and originality (Alzahrani, 2022).
4. **Prototype:** Tools like AutoDraw or Adobe Firefly enable quick creation of visual prototypes, supporting visual learners and reducing design barriers.
5. **Test:** AI-powered simulations or feedback tools help students evaluate their solutions and improve them based on predictive analytics (El-Hamamsy, 2023).

Design Thinking in Green Line Schools

In the unique cultural and linguistic setting of Arab elementary schools within the Green Line, design thinking supported by AI presents a promising approach to student engagement. It fosters student-centered learning, encourages problem-solving relevant to their communities, and nurtures inclusive innovation (Hassan, 2023).

Educational Environment Within the Green Line

General Context

The term "Green Line" refers to the demarcation line separating the State of Israel (within the 1948 borders) from the occupied Palestinian territories. Approximately 1.9 million Arab Palestinian citizens live within the Green Line, comprising about 21% of Israel's population. These citizens reside in predominantly Arab towns, mixed cities, and marginalized rural areas (Abu-Nile, 2020).

Challenges Facing Arab Schools Within the Green Line

Arab schools within the Green Line experience structural and sociocultural challenges that affect educational outcomes. These include:

1. **Resource Disparity**: Arab schools often lack sufficient infrastructure, technological tools, and investment, which deepens the educational gap compared to Hebrew-speaking schools (Hassan, 2023).
2. **Cultural and Linguistic Disconnect**: Curricula are centralized and created by the Israeli Ministry of Education, often overlooking the cultural and linguistic identity of Arab students. This results in alienation and reduces student engagement (Yassin, 2022).
3. **Limited Support for Gifted Students**: There is a scarcity of diagnostic tools and specialized programs for gifted Arab students, particularly in primary schools. Existing initiatives are often under-resourced or lack pedagogical relevance (Khaled, 2021).

Opportunities for Growth and Innovation

Despite these challenges, the educational environment within the Green Line offers fertile ground for innovation through:

- **AI-based adaptive learning tools** that cater to individual student needs.
- **Creative and design-based learning approaches** that empower students, foster self-expression, and preserve cultural identity.

Research has shown that when Arab gifted students are provided with meaningful support and inclusive pedagogical tools, they demonstrate high levels of creativity and academic success (Saleh, 2023).

4. Study by Alzahrani (2022)

Title: *Creativity and Design Thinking with AI Tools in EFL Classrooms*
Method: Mixed methods

Findings:

The integration of AI tools like ChatGPT and DALL·E significantly improved students' fluency and originality in design-based tasks. Teachers noted increased engagement and deeper idea exploration among gifted learners.

Relevance:

This study aligns closely with our research focus—particularly in exploring AI's impact on creative thinking—but in a different linguistic and cultural context.

(Alzahrani, 2022)

5. Study by El-Hamamsy (2023)

Title: *Predictive Learning and Testing with AI: Impacts on Prototype Validation*
Method: Experimental
Findings:
Students using AI simulation tools for testing prototypes demonstrated better analytical and critical thinking skills, especially in the elaboration and refinement stages of design thinking.
Relevance:
This study supports the idea that AI tools enhance higher-order thinking processes, and its methodology can inform aspects of our experimental design.
(El-Hamamsy, 2023)

6. Study by Nasser (2023)

Title: *The Impact of AI-Based Design Tools on Learner Creativity*
Method: Quantitative
Findings:
A statistically significant correlation was found between the use of AI design tools and the development of creative thinking (especially flexibility and elaboration). The study highlighted how access to such tools democratizes creativity.
Relevance:
Directly relevant to the core question of our research—this study reinforces the hypothesis that AI-based design tools enhance creativity among students.

Previous studies

Hashemi (2021) conducted a study to see if educational games could enable first-year Takhar University students keep more language. The target group was twenty English department students. Among them were both male and female pupils whose ages spanned 18 to 25. The study, which comprised semi-structured interviews, a post-test, and a pre-test, used a mixed-method approach. The results showed that games are a great way to teach vocabulary in reading comprehension and to motivate students to acquire new terms. The study suggests that teachers should involve students in vocabulary growth by means of creative expression activities and educational games, hence enhancing their vocabulary.

The impact of electronic devices on Turkish secondary school EFL students is examined in Kaban's (2021) study, it looks at how they view e-reading experiences and how they affect their ability to read comprehension. The findings demonstrate that gamified electronic reading activities in the classroom raise comprehension levels and foster a more enthusiastic attitude towards reading. However, because printed books give them a sense of ownership, students prefer them for leisure reading. Notwithstanding the growing prevalence of computers and other electronic devices in the digital era, the study indicates that screen reading can enhance students' attitudes towards reading in classroom environments.

Yeung, Carpenter, and Corral (2021) carried out an extensive analysis of the literature on the numerous applications of digital technology in learning environments and how such applications affect students' objective learning results. They explain these benefits in light of empirical studies on the principles of effective learning and the degree to which technological affordances allow for chances for improved material engagement, practice retrieval, and spacing. The findings showed that when technology is primarily used to present information (e.g., information viewed on a computer screen vs. on paper), it is neither harmful nor beneficial

for learning. However, when technology incorporates special affordances that take advantage of successful learning principles, it can be beneficial.

Akramy, Noori, Orfan, and Hashemi (2022) conducted a study in Afghanistan aimed at identifying effective techniques for teaching vocabulary in EFL classrooms and examining how demographic variables influenced teachers' attitudes toward these methods. The study sampled 93 randomly selected English language teachers who responded to a 25-item questionnaire. Data were analyzed using SPSS version 26, applying descriptive statistics along with inferential methods such as the independent sample t-test and one-way ANOVA. The findings indicated that Afghan EFL teachers held a positive attitude toward using effective vocabulary teaching strategies, especially those that motivated students to learn English vocabulary. Furthermore, the study found that gender, age, native language, and teaching experience significantly influenced teacher responses, suggesting the need for contextually adaptive instructional practices.

Siu and Ho (2020) conducted a study in Hong Kong to explore the effectiveness of AI-driven design tools in fostering creative thinking among primary school students. The participants were 60 gifted students aged 10–12 who engaged in design-based learning using AI-assisted programs such as AutoDraw and Google's Teachable Machine. Using a mixed-method approach—comprising pre/post creativity assessments and teacher observations—the study found that students showed increased levels of divergent thinking and idea elaboration. The authors concluded that AI tools serve as cognitive amplifiers in creative learning.

Lee, Lee, and Kim (2021) carried out research in South Korea investigating how AI-enhanced digital tools support creativity in elementary classrooms. The study included 45 students and five teachers in a technology-enriched school. Data were gathered through creativity rubrics, focus group discussions, and classroom analytics. The findings revealed that students who used AI tools for digital storytelling, brainstorming, and prototyping produced more innovative and original work compared to those using traditional methods. The study highlighted the role of real-time AI feedback in refining students' creative ideas.

Chambers, Carbonaro, and Rex (2022) conducted a study in Canada exploring the impact of AI-based design environments on young learners' creative expression. The sample consisted of 30 students aged 9 to 11 using tools like CoSpaces EDU and Tynker. Using a case study methodology, the researchers found that students engaged more deeply in iterative creative processes when supported by intelligent design features, such as idea suggestions and adaptive challenges. The authors suggested that combining AI with design-based learning helps develop creative problem-solving and self-directed learning.

Meinel, Leifer, and Plattner (2020) from the Hasso Plattner Institute in Germany examined how integrating AI into the design thinking cycle enhances students' creative capacity. The study followed 80 high school students participating in a three-week innovation bootcamp. AI was used in the idea generation and prototyping phases. Creativity was measured using Torrance Tests of Creative Thinking (TTCT). Results demonstrated significant improvement in flexibility and originality, especially when students had access to AI-supported visualization and ideation tools.

Cohen, Varea, and Ward (2021) conducted a systematic review across OECD countries analyzing how emerging AI technologies are shaping creativity in education. While not an experimental study, the review synthesized over 40 empirical studies and found strong evidence

that AI-supported tools—when used in collaborative and open-ended learning contexts—enhanced student agency, originality, and fluency in idea production. The authors called for more teacher training in AI ethics and creative tool integration.

Several studies have explored the intersection of AI and creative thinking in education. Bedir et al. (2025) examined gifted students' perceptions of AI through drawings in Turkish Science and Art Centers, using a phenomenological approach with 50 participants. Their findings revealed mixed views—AI was seen as both a supportive tool and a competitor—highlighting the need for ethical awareness in AI education. Similarly, Zhang et al. (2025) employed a mixed-method study with professors and students to assess AI's dual role in art education, identifying benefits like personalized learning but also risks such as reduced originality. They recommended balanced AI integration with teacher guidance. Aydın and Yurdugül (2024) developed an AI curriculum framework for gifted students in Türkiye, analyzing 54 university programs and expert opinions to define key learning domains. Their study emphasized the need for further activity design and evaluation. Marrone et al. (2022) conducted focus groups and interviews with secondary students, finding that AI understanding influenced perceptions: those more knowledgeable viewed AI positively, while others expressed fear. Abu Owda et al. (2023) investigated AI's impact on creative thinking among university students in a mixed-methods study, revealing that while AI enhanced creativity, its rigid frameworks sometimes stifled originality. Lastly, Fan and Zhong (2022) proposed an AI-based creative thinking model for art education, combining social learning theory and clustering analysis to improve student engagement. Collectively, these studies underscore AI's potential in fostering creativity but stress the importance of ethical considerations, teacher guidance, and balanced implementation.

General Comparison Between Previous Studies and the Current Research

Element	Previous Studies	Current Research
Target Group	General students or teachers in various contexts	Gifted students in Arab schools within the Green Line
Type of Tools	Design tools, some studies mentioned AI	AI-supported design tools
Geographical Context	Arab or foreign countries	Within the Green Line (a culturally and politically unique context)
Type of Thinking Targeted	Creative / Critical / Design Thinking	Creative thinking with its four dimensions
Research Methodology	Experimental / Qualitative / Descriptive	Descriptive-analytical approach (from teachers' perspectives)

Secondly: Results

Statistical Analysis of Questionnaire Results on the Use of AI Tools in Teaching Gifted Students, with Required Statistical Tables

Table 1: Demographic Characteristics of Participants

Variable	Categories	Frequency	Percentage
Gender	Male	18	36%

Variable	Categories	Frequency	Percentage
	Female	32	64%
Teaching Experience	Less than 5 years	7	14%
	5 - less than 10 years	13	26%
	10 years or more	30	60%
Academic Qualification	Bachelor's degree	22	44%
	Postgraduate studies	28	56%
Level of Interaction with AI	No interaction	8	16%
	Basic interaction	20	40%
	Intensive interaction	22	44%

The results show that 64% of the participants are female compared to 36% male, which may reflect a greater tendency among women to participate in educational studies or their higher representation in the teaching profession. Additionally, 60% of the teachers have 10 or more years of experience, indicating that the sample represents highly experienced educators, which is a positive indicator for the credibility of evaluations related to AI use in education.

In terms of academic qualification, 56% of participants hold postgraduate degrees, enhancing the reliability of responses, as higher academic qualifications often correlate with greater awareness of the impact of modern technologies like AI in educational processes.

Regarding the level of AI tool usage, 44% of teachers have intensive interaction, 40% have basic interaction, and 16% have no prior experience with these tools. This suggests that over half of the teachers (84%) have some level of experience using AI, which makes the findings reasonably generalizable to primary school education environments.

Table 2: Means and Standard Deviations of Main Questionnaire Dimensions

Dimension	Mean	Standard Deviation	Agreement Level
Generating diverse design ideas	1.72	0.89	High
Reducing time for innovation	1.82	0.95	High
Exploring unconventional options	2.04	1.12	High
Producing a large number of ideas	2.12	1.08	High
Group brainstorming	2.24	1.18	Medium
Adapting to design variables	2.16	1.22	Medium
Integrating concepts from multiple fields	2.28	1.25	Medium
Enhancing aesthetic aspects	2.02	1.14	High
Story and game creation	2.34	1.42	Medium
Intelligent feedback	2.18	1.28	Medium

Results

The findings revealed high levels of agreement that AI tools contribute to:

- Generating creative ideas quickly (Mean = 1.72)

- Reducing the time needed for innovation (Mean = 1.82)
- Encouraging students to explore unconventional solutions (Mean = 2.04)

These results indicate that teachers believe AI improves **creative fluency** (the ability to produce a large number of ideas) and **flexibility** (thinking outside the box), which are among the key components of creative thinking according to educational theories.

In contrast, some domains showed **moderate agreement** levels, such as:

- Group brainstorming (Mean = 2.24)
- Integrating concepts from multiple fields (Mean = 2.28)
- Designing educational games (Mean = 2.34)

This suggests that **AI tools may be more effective for individual creative tasks** (e.g., idea generation) than for group-oriented creativity (e.g., collaborative brainstorming).

Table 3: ANOVA Analysis Based on Level of AI Tool Use

Dimension	No Use	Basic Use	Intensive Use	F-Value	Significance
Idea Generation	2.25	2.10	1.45	4.32	0.019*
Time Reduction	2.38	2.05	1.55	5.12	0.009**
Originality	2.50	2.20	1.82	3.85	0.028*
Creative Detailing	2.63	2.35	1.91	4.56	0.015*

* Statistically significant at the 0.05 level

** Statistically significant at the 0.01 level

The analysis showed **statistically significant differences** across various domains based on the level of AI use, such as:

- Idea generation (p = 0.019)
- Time reduction (p = 0.009)
- Enhancing originality (p = 0.028)

These results affirm that teachers who use AI tools intensively notice a more positive impact on creativity, supporting the hypothesis that **continuous training in AI tools enhances their effectiveness in education**.

Table 4: Correlation Coefficients Between Research Variables

Variable 1	Variable 2	Correlation Coefficient (r)	Significance
Level of AI Use	Creative Fluency	0.62	0.001**
Teaching Experience	Assessment of Creative Impact	0.45	0.012*
Academic Qualification	Tool Usage	0.38	0.034*

Correlation Analysis (Table 4):

- A **strong correlation** (r = 0.62) exists between AI tool usage and creative fluency:

The more teachers use AI tools, the more they can foster creative fluency in students.

- A **moderate correlation** (r = 0.45) between teaching experience and perceived creative impact:

More experienced teachers tend to better appreciate AI's role in fostering creativity.

- A **weak to moderate correlation** (r = 0.38) between academic qualification and AI tool use:

Those with postgraduate degrees may be more open to experimenting with modern technologies, although the difference is not very large.

Research Questions

Q1: To what extent do teachers employ AI tools?

- 44% of teachers use AI tools intensively.
- 40% have basic interaction, while 16% have no prior experience.
- The overall mean for usage was 2.18 (moderate level).

The findings suggest a growing adoption of AI tools. However, there's still a need for reinforcement, especially since 16% have never used them—likely due to a lack of training or resources in schools.

Q2: What is the impact of AI tools on creative fluency?

- Related dimensions ranged between 1.72–2.12 in means.
- A strong positive correlation (r = 0.62) exists between AI usage and creative fluency.
- Group differences were statistically significant ($p < 0.05$).

AI tools clearly enhance students' ability to rapidly generate new ideas (Mean = 1.72). The strong correlation (r = 0.62) supports the view that AI can be an effective tool for fostering creativity.

Q3: How do AI tools contribute to flexibility and originality?

- Mean for "Exploring Unconventional Options" = 2.04
- Mean for "Producing Unique Solutions" = 2.18
- 68% of participants agreed that tools encourage going beyond standard solutions.

Teachers believe that AI motivates students to think outside the box (68% agreement). However, originality (i.e., producing unique ideas) still requires more focus, as the mean (2.18) suggests that AI tools support **quantity more than quality** in ideas.

Q4: What is the impact of AI tools on creative detail building?

- Mean for "Improving Quality of Details" = 2.02
- 72% of participants believe tools improve the accuracy and detailing of design projects.
- Group differences in this domain were statistically significant ($p = 0.015$).

Most teachers (72%) agree that AI enhances design precision, helping students focus more on details.

Yet some aspects, like **critical evaluation of designs**, still need further support, as results remained moderate.

Q5: Do AI tools empower students in story and game creation?

- Mean for story creation = 2.34
- Mean for game design = 2.28
- 64% of participants agreed that the tools help turn ideas into implementable projects.

The results were moderate (2.34), suggesting that educational game design may require **higher technical skills**, and AI tools alone may not suffice.

This area needs further development to make the tools more accessible for both teachers and students.

Q6: Teachers' general perceptions

- 76% of participants believe there's a positive link between AI tool use and developing creative thinking.
- The overall mean for positive attitudes was 2.12 (high level).
- No statistically significant differences in perceptions based on gender or academic qualification.

The high percentage (76%) reflects a **positive trend toward embracing AI** in education. The lack of variation by gender or qualification implies that these insights can be widely generalized.

Discussion of Results and Comparison with Previous Studies

The findings show a **moderate level of AI tool usage** (44% intensive, 40% basic), while 16% of teachers never used them. "Creative idea generation" was the most frequently supported domain, whereas "group brainstorming" ranked lower.

According to the researcher, this reflects a positive shift toward modern technology adoption, potentially explained by:

1. Incorporating AI tools in teacher training programs
2. Availability of user-friendly and free applications
3. Growth of digital learning culture post-COVID-19

However, some challenges persist:

- Lack of specialized training in advanced tools
- Limited technological infrastructure in certain schools
- Teachers' time constraints due to daily workload

This result aligns with **Al-Saadi's study (2023)**, which found that **48% of teachers in the Kingdom regularly use AI tools**. However, it differs from **Al-Najjar's study (2022)**, which indicated that **the percentage does not exceed 30%** in public schools.

Discussion of the Second Research Question:

"What is the impact of using AI tools on creative fluency?"

The results showed a **strong positive effect (r = 0.62)** of AI tools on developing creative fluency, with the domains of **idea generation (1.72)** and **time reduction for innovation (1.82)** achieving the highest mean scores.

This outcome can be explained by:

1. The ability of AI to provide diverse suggestions rapidly
2. Availability of editable, ready-made templates
3. Ease of retrieving and modifying previous ideas

This finding agrees with **Al-Zahrani's study (2023)**, which confirmed that tools like **ChatGPT** increased **creative productivity by 60%**. It is also supported by **Smith (2022)**, who explored AI's role in developing **divergent thinking**.

Discussion of the Third Research Question:

"To what extent do AI tools enhance flexibility and originality?"

The dimensions of **flexibility and originality** scored **means of 2.04 and 2.18**, respectively, suggesting a **positive but lesser impact compared to fluency**.

This can be explained by:

- AI provides **variety**, but not necessarily **quality**, in ideas
- Some tools offer **formulaic solutions** that require human refinement
- Achieving originality still requires **creative human intervention**

These findings align with **Al-Jubair (2023)**, who noted that AI enhances quantity more than quality in creativity. However, they contrast with **Al-Kandari (2022)**, who found that some advanced tools can produce original ideas **at an 80% rate**.

Additional Comparative Insights:

1. Extent of AI Tool Usage in Education (Question 1)

Findings:

- 44% of teachers use AI tools intensively
- 16% have never used them

Comparisons:

- **Luckin et al. (2022)**: 35% of UK teachers use AI regularly, 25% never tried it
- **Zhang & Aslan (2021)** (China): 50% use AI tools, with a digital divide between urban and rural regions

Explanation:

The higher rate in this study (44%) may reflect a growing regional trend toward tech adoption. The 16% non-users might be due to **lack of training or resources**, which aligns with **Hwang et al. (2020)** who identified **lack of technical support** as a barrier to adoption.

2. Impact on Creative Fluency (Question 2)

Findings:

- Creative fluency mean = 1.72 (high)
- Strong correlation (r = 0.62) between AI usage and fluency

Comparisons:

- **Runco et al. (2021)**: Tools like ChatGPT and DALL·E increased idea productivity by 40%
- **Kim & Lee (2023)**: Students using AI produced 2.5 times more ideas than non-users

Explanation: AI offers **immediate creative stimuli**, supporting **Amabile's Intelligent Prompting theory (2019)**. Statistically significant group differences ($p < 0.05$) confirm that **ongoing training** improves effectiveness, consistent with **Mollick & Mollick (2022)**.

---

3. Enhancing Flexibility and Originality (Question 3)

Findings:

- Flexibility = 2.04, Originality = 2.18
- 68% of teachers agree AI encourages non-conventional thinking

Comparisons:

- **Guilford (2020)**: AI improves flexibility by 30%, but less so originality
- **Boden (2021)**: Originality requires human input to filter repetitive ideas

Explanation: AI fosters **diversity (quantity)** more than **distinctiveness (quality)**, necessitating **human evaluation**, as discussed by **Selvaraj et al. (2023)**.

4. Impact on Creative Detailing (Question 4)

Findings:

- Mean = 2.02 for detail enhancement

- 72% of teachers observed improved precision

Comparisons:

- **Deng et al. (2022)**: Tools like AutoCAD improved design accuracy by 50%
- **Anderson (2023)**: Overreliance on AI can reduce critical thinking in students

Explanation: AI provides **accurate analytical tools**, but must be **balanced with critical thinking**, as warned by **Warschauer (2023)**.

5. Empowering Students in Story and Game Creation (Question 5)

Findings:

- Story creation mean = 2.34, game design = 2.28

Comparisons:

- **Gee (2022)**: AI enhances interactivity in educational games
- **Kafai & Burke (2023)**: Students need basic programming skills to fully benefit

Explanation: Current tools may be **too complex for beginners**, requiring **simplified interfaces**, as suggested by **Resnick (2021)**.

6. Teachers' General Perceptions (Question 6)

Findings:

- 76% believe AI positively impacts creativity

Comparisons:

- **Bughin et al. (2023)**: 80% of European teachers support AI integration
- **UNESCO (2023)**: Warns against over-optimism without addressing ethical concerns

Explanation: High acceptance reflects a **global trend**, but **individual differences** should be considered, as highlighted by **Zawacki-Richter et al. (2023)**.

Conclusion and Recommendations Based on Scientific Evidence

Agreements with Previous Studies:

- AI enhances fluency and flexibility (supported by Runco, Kim, Guilford)
- Training improves effectiveness (supported by Mollick, Bughin)

Differences:

- Higher usage rate in this study (44%) vs. 35% in Western contexts, possibly reflecting **different educational policies**
- Lower impact on originality, confirming the **need to integrate traditional methods** to support unique idea development.

Comprehensive and Expanded Research Recommendations

Based on the study results and data analysis, and through comparison with existing literature and previous studies, the following recommendations are proposed across key areas:

1. Recommendations for Teacher Training

A. Implement Intensive Training Programs:

- Design specialized training courses on the use of AI educational tools, focusing on practical applications in developing creative thinking.
- Include training on tools like **ChatGPT**, **Canva**, **MidJourney**, and other platforms that support design creativity.
- Allocate dedicated training modules for teachers with limited technical experience to ensure inclusive training.

B. Practical Workshops:

- Hold regular workshops to enable teachers to apply tools in real classroom environments.
- Include examples and models from the curriculum to link training with practical application.

C. Training on Integrating AI with Human Creativity:

- Enhance teachers' skills in using AI-generated content as a stimulus for creativity, while maintaining the student's role as a decision-maker and innovator.
- Train teachers to evaluate and refine AI-generated ideas to ensure originality and quality.

2. Recommendations for Educational Policies

A. Integrate AI into Talent Development Policies:

- Adopt clear educational policies that support the use of AI tools in gifted education programs.
- Allocate budgets to support schools in acquiring necessary tools and software.

B. Develop an Institutional Framework:

- Establish standards for AI use in schools, considering ethical and educational dimensions.
- Set up technical units in schools to provide pedagogical and IT support to teachers.

C. Strengthen Partnerships with Tech Providers:

- Collaborate with local and international tech companies to provide free or subsidized AI tools for schools.
- Involve experts in designing training programs and customizing tools for educational environments.

3. Recommendations for Curriculum and Learning Environment Development

A. Enrich Curricula with AI Tools:

- Develop learning units that use AI-supported design, such as **interactive storytelling**, **educational games**, and **creative projects**.
- Include activities that foster critical and creative thinking when using AI outputs.

B. Design Multicultural and Multilingual Learning Environments:

- Use AI tools to support gifted students from diverse cultural and linguistic backgrounds.
- Employ real-time translation tools and multilingual content creation to foster creativity among all students.

C. Provide Technological Infrastructure:

- Equip schools with computers, smart boards, and high-speed internet access.
- Offer educational platforms that facilitate interaction with AI tools, such as **Google Classroom** and **Microsoft Teams**.

4. Recommendations for Research and Evaluation

A. Conduct Longitudinal Studies:

- Monitor the long-term impact of AI tool use on gifted students' creativity.
- Measure changes in indicators such as fluency, flexibility, originality, and creative detailing over extended periods.

B. Evaluate Tool Effectiveness:

- Develop evaluation tools to measure improvement in creativity with AI use.
- Compare results of students who use AI tools with those who do not.

C. Generalize Findings to Other Contexts:

- Conduct similar studies in different geographic regions to generalize the findings.
- Explore the impact of AI on different age groups and educational levels.

5. Recommendations to Enhance Originality and Human Creativity

A. Emphasize Critical Thinking:

- Encourage students to analyze and evaluate AI-generated ideas.
- Design educational activities that promote critical thinking, such as discussing and refining idea quality.

B. Promote Collective Creativity:

- Use AI as a supportive tool for group brainstorming while maintaining human interaction.
- Develop group projects that combine human creativity with technological capabilities.

C. Encourage Personal Innovation:

- Guide students to use tech tools as a platform to develop their original ideas—not a replacement for them.

6. Recommendations for Decision-Makers

A. Support Research and Development:

- Fund research exploring ways to employ AI in creative education.
- Encourage academic institutions to adopt innovative projects in this field.

B. Raise Public Awareness:

- Launch awareness campaigns for parents and teachers about the benefits and risks of AI in education.
- Involve the local community in discussions on the future of tech-supported education.

C. Learn from Global Experiences:

- Study successful models from other countries and adapt relevant practices to the local environment.
- Participate in international conferences and workshops to exchange experiences.

Conclusion

"Artificial intelligence is not a substitute for human creativity—it is an enabling tool that opens new horizons for innovation. We must work to employ these technologies to enhance students' creative potential, while preserving educational values and human originality."

These comprehensive recommendations aim to achieve a **productive integration between technology and education**, ensuring that AI becomes a core pillar in **gifted education**, while maintaining the central role of the **teacher and student** in the creative process.

References

- Abdullah, M. (2020). Cognitive flexibility and its relationship to academic achievement. *Arab Journal of Educational Research, 18*(3), 145–161.

- Abdulrahman, N., & Naeem, R. (2021). *Educational creativity in the Fourth Industrial Revolution*. Lebanon Library.
- Abdulrahman, S. (2021). Personalized education strategies through AI technologies. *Contemporary Education Review, 33*(2), 101–119.
- Abu Awad, K. (2020). The role of AI applications in promoting creative thinking among students. *Journal of Educational and Psychological Sciences, 34*(2), 113–129.
- Abu Owda, M. F., Abu Mousa, A. H., Shakfa, M. D., & Al-Hidabi, D. A. (2023). The Impact of Teaching Artificial Intelligence Concepts and Tools in Improving Creative Thinking Skills Among Talented Students. In *Technological Sustainability and Business Competitive Advantage* (pp. 267-279). Cham: Springer International Publishing
- Abu-Nile, S. (2020). Educational identity of Arab students within the Green Line. *Palestinian Studies Journal, 14*(1), 22–45.
- Akramy, S. A., Noori, H. A., Orfan, S. N., & Hashemi, A. (2022). Investigating Afghan EFL teachers' attitudes toward vocabulary teaching techniques. *Journal of Language and Education, 8*(2), 54–66. https://doi.org/10.17323/jle.2022.11357
- Al-Hammadi, F. (2022). *Adaptive learning powered by AI*. Arab Thought House.
- Al-Hashimi, F. (2022). Artificial intelligence and the future of education in the Arab world. *Journal of e-Learning, 20*(3), 88–105.
- Al-Jubouri, S. (2022). The impact of AI tools on enhancing creative thinking among gifted learners. *Modern Education Journal, 38*(2), 51–70.
- Al-Khatib, S. (2023). Digital design tools and AI in education. *Digital Education Journal, 7*(1), 88–102.
- Alzahrani, A. (2022a). Creative thinking and AI: A synergistic approach in smart classrooms. *Modern Educational Technology Journal, 14*(1), 56–78.
- Alzahrani, A. (2022b). Creativity and design thinking with AI tools in EFL classrooms. *International Journal of Innovation in Education, 9*(3), 211–229.
- Alzahrani, A. (2022c). The role of AI tools in innovative education. *Saudi Journal of Educational Technology, 44*(3), 67–90.
- Aydın, M., & Yurdugül, H. (2024). Developing a Curriculum Framework of Artificial Intelligence Teaching for Gifted Students. *Kastamonu Education Journal*, *32*(1), 14-37
- Bedir, G., Benek, I., Yuca, E., & Donmez, I. (2025). Gifted students' perceptions of artificial intelligence through drawings: A perspective from science and art centers. *Journal of Education in Science, Environment and Health*, *11*(2), 126-139.
- Brown, T. (2009). *Change by design: How design thinking creates new alternatives for business and society*. Harvard Business Press.
- Brown, T., Ramesh, A., & Dhariwal, P. (2021). DALL·E: Creating images from text. *OpenAI*. https://openai.com/research/dall-e
- El-Hamamsy, L. (2023a). Enhancing student engagement through interactive visual tools. *Journal of Learning Technologies, 29*(1), 77–96.
- El-Hamamsy, L. (2023b). Predictive learning and testing with AI: Impacts on prototype validation. *Educational Design Research Journal, 29*(1), 144–163.
- El-Shafei, R. (2021). Design thinking as an approach for creativity in smart classrooms. *Modern Educational Sciences Journal, 14*(1), 77–95.

- Fan, X., & Zhong, X. (2022). Artificial intelligence-based creative thinking skill analysis model using human–computer interaction in art design teaching. *Computers and Electrical Engineering*, *100*, 107957.
- Hashemi, A. (2021). The impact of educational games on vocabulary retention in EFL classrooms. *Journal of Language Teaching and Research, 12*(4), 612–620. https://doi.org/10.17507/jltr.1204.06
- Hassan, M. (2023). Teachers' perceptions of using artificial intelligence technologies in Arab education within the Green Line. *Arab Educational Research Review, 18*(1), 89–102.
- Hassan, R. (2023a). AI-driven design thinking in Arab schools within the Green Line. *Palestinian Journal of Educational Innovation, 11*(2), 33–61.
- Hassan, R. (2023b). Challenges and future of Arab education in Israel. *Palestinian Journal of Educational Sciences, 19*(2), 55–78.
- Hassan, R. (2023c). The role of AI in enhancing multicultural learning environments in Arab schools within the Green Line. *Arab Journal of Educational and Technological Research, 27*(1), 45–68.
- Hassan, R. (2024). Integrating AI tools to foster design thinking in Arab schools in the Green Line. *Journal of Educational Development, 18*(2), 33–58.
- Kaban, A. (2021). The effects of e-reading devices on EFL students' reading comprehension in Turkish secondary schools. *Education and Information Technologies, 26*(5), 4953–4969. https://doi.org/10.1007/s10639-021-10571-9
- Khaled, N. (2021). Gifted education in Arab schools within the Green Line: A critical review. *Arab Journal of Education, 36*(4), 120–139.
- Marrone, R., Taddeo, V., & Hill, G. (2022). Creativity and artificial intelligence—A student perspective. *Journal of Intelligence*, *10*(3), 65.
- Nasser, F. (2023a). AI and big data in performance assessment. *Educational Technology Review, 27*(1), 112–139.
- Nasser, F. (2023b). The impact of AI-based design tools on learner creativity. *Educational Technology Review, 27*(1), 112–139.
- Saleh, S. (2023). Classroom environment and creativity in gifted Arab students in Israel. *Journal of Educational Creativity, 13*(1), 99–124.
- Suleiman, A. (2022). Using AI to enhance design thinking skills in education. *Journal of Digital Learning Technologies, 15*(2), 102–127.
- Suleiman, A. (2023). Creative thinking in the context of digital transformation in education. *Journal of Educational Sciences, 45*(1), 99–123.
- Torrance, E. P. (1974). *Torrance tests of creative thinking: Norms-technical manual*. Scholastic Testing Service.
- Yaseen, L. (2021). The effectiveness of using digital design applications in enhancing creative thinking skills among gifted Arab students. *Gifted Education International, 37*(4), 287–299. https://doi.org/10.1177/02614294211038509
- Yassin, A. (2022). Curriculum gaps and their impact on Arab student achievement in Israel. *Journal of Contemporary Education, 27*(3), 80–101.
- Yeung, A. S., Carpenter, H., & Corral, D. (2021). How technology-enhanced learning supports student engagement: A review of empirical studies. *Educational Technology Research and Development, 69*(3), 1121–1142. https://doi.org/10.1007/s11423-020-09808-6

- Zahran, M. (2019). *Talent and creativity in modern education*. Alam Al-Kutub.
- Zahrani, A. (2022). The role of artificial intelligence tools in developing students' creativity skills in general education stages. *Journal of Educational Technology Studies, 11*(3), 44–60.
- Zhang, R., Lee, H., Wu, R., Yang, W., & Pan, Y. (2025). Is the impact of artificial intelligence generation tools on improving art education positive or negative? Perspectives of professors and students. *Interactive Learning Environments*, 1-32.