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The role of educational games in developing cognitive, social, and creative skills in gifted STEAM education

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Abstract
This study explores the role of educational games in developing cognitive, social, and creative skills within the context of gifted STEAM education. Utilizing a qualitative methodological approach, the research was conducted through semi-structured interviews with six teachers who participated in a professional development program on gifted STEAM education. The findings indicate that educational games offer significant potential for enhancing higher-order thinking, creativity, collaboration, and emotional resilience. Teachers emphasized that games provide a dynamic and engaging learning environment, allowing gifted students to apply theoretical knowledge through practical problem-solving, strategic planning, and creative exploration. Additionally, the collaborative nature of educational games fosters social interaction and communication skills, promoting inclusivity within mixed-ability classrooms. However, challenges related to differentiation, inclusivity, and assessment were also identified, particularly in designing games that are simultaneously challenging for gifted students and accessible for non-gifted peers. The study concludes that educational games, when thoughtfully integrated into the gifted STEAM framework, can serve as powerful tools for promoting cognitive, social, and creative growth.

Keywords: Educational games, gifted STEAM education, differentiation, inclusion

1. Introduction
The concept of childhood giftedness is shaped by the historical, social, and ideological characteristics of each era [1]. Approaches to giftedness vary depending on national or research contexts [2], while contemporary models utilize data derived from various aspects of gifted children's behavior and actions [3]. Common abilities exhibited by gifted children include intellectual alertness, sensitivity, idealism, curiosity, organization, problem-solving skills, strong memory, and high learning pace [4]. According to Renzulli's Three Ring Model of Giftedness, gifted behavior encompasses above-average ability, creativity, and commitment to tasks undertaken by a gifted child [5]. However, the development of these children is often asynchronous, as their intellectual, emotional, and physical levels do not progress at the same rate [6].
Common practices in the education of gifted children include interdisciplinary approaches such as STEAM education and the gamification of the learning process [7-9]. These approaches are considered essential for maintaining interest, developing socio-emotional skills, and improving educational outcomes [10]. Through educational games, critical thinking, problem-solving ability, social interaction, creativity, memory, and concentration are enhanced, while emotional development is also promoted [11].
The present study focuses on exploring the role of educational games within the framework of gifted STEAM education from the perspective of teachers. The central research problem involves understanding the prospects, challenges, and parameters related to the integration of educational games within this specialized educational environment. The study is guided by a series of research questions related to the incorporation of educational games in gifted STEAM education:

1. How do educational games contribute to the development of cognitive, social, and creative skills in gifted STEAM education?
2. What are teachers' perceptions of the effectiveness of educational games in enhancing creativity, problem-solving, and collaboration in gifted STEAM education?
3. What challenges and limitations do teachers face when designing and implementing educational games for both gifted and non-gifted students within gifted STEAM education settings?

4. What strategies and assessment methods can be applied to effectively evaluate the educational impact of games on developing cognitive, social, and creative skills in gifted STEAM education?

By addressing these research questions, this study aims to provide a comprehensive understanding of the educational role of games within gifted STEAM education and to identify effective strategies for their implementation.

2. Theoretical Background

2.1 Educational Games

Educational games have been identified as learning activities involving one or more players, with specific goals, rules, and limitations. Although they are primarily designed for educational purposes, they are not exclusively intended for entertainment [12]. This pedagogical approach integrates pleasure into the learning process, providing opportunities for the development of various skills within a supportive and encouraging environment [13]. Educational games differ from traditional instructional methods by prioritizing active participation and experiential learning over the passive reception of information, thereby promoting deeper cognitive engagement and practical knowledge application [14]. Educational games seek to establish a stimulating learning environment in which learners can cultivate essential skills through the integration of enjoyable experiences and systematically designed challenges [15]. This approach is consistent with constructivist theories of learning, which posit that knowledge is actively constructed by learners through their interactions with the environment and engagement in meaningful problem-solving activities [16].

Furthermore, educational games provide valuable opportunities for the cultivation of cognitive, social, and emotional skills within a supportive and stimulating learning environment. Cognitive skills, including critical thinking, memory, problem-solving, and strategic planning, are frequently enhanced through the iterative processes of trial and error, feedback, and reflective practice that educational games inherently promote [17]. Additionally, educational games have been shown to foster creativity by motivating learners to explore innovative ideas, apply their knowledge across diverse contexts, and experiment with various strategies to achieve optimal outcomes [18]. The social dimension of educational games is of equal significance, as such activities typically involve collaboration, communication, and negotiation among participants, thereby promoting social interaction and the development of interpersonal competencies [19]. Moreover, the utilization of educational games has been associated with heightened motivation and engagement, as the inherently enjoyable nature of gameplay effectively enhances learners' intrinsic interest and dedication to the learning process [20].

2.2 STEM and STEAM Education

STEM education refers to the integration of Science, Technology, Engineering, and Mathematics into a cohesive, transdisciplinary learning approach [21]. Its purpose is to facilitate the understanding of the surrounding world by utilizing technologies to solve real-world problems and promote innovation [22]. Contemporary demands in the workplace and economy highlight the need for workers with advanced skills in STEM fields who can connect productivity, creativity, and innovation [23]. STEAM education represents an extension of the STEM philosophy by incorporating the Arts into the educational process [24]. This approach utilizes Language, Liberal Arts, Visual Arts, Music, Theatre, and Dance [25]. The Arts contribute creativity, innovation, inquiry, and complement the transdisciplinary learning process [26].

The transdisciplinary nature of STEAM surpasses individual domains of knowledge and promotes the multidimensional exploration of complex systems [27]. The successful implementation of STEAM learning activities requires the balanced integration of STEAM fields, the creation of inclusive learning environments for all students, and a focus on developing creative and social skills through authentic problem-solving [28]. Furthermore, establishing a clear framework for assessing both learning outcomes and the overall educational environment is considered essential [29,30]. Through this approach, cognitive and socio-emotional learning outcomes are simultaneously achieved by facilitating the experiential construction of new knowledge [31]. Common methods employed in the STEAM approach include the use of educational software, programming, and automation systems to promote inquiry-based learning through collaborative project-based activities. These activities involve the design and creation of projects that, in addition to demonstrating functional efficiency, are characterized by artistic completeness and aesthetic value [32].

2.3 Gifted STEAM Education

The education of gifted children requires differentiated approaches involving alternative and innovative teaching methods [33]. A holistic and transdisciplinary approach is necessary, considering the exceptional abilities of gifted children [34]. Differentiation in education involves adjusting the pace of learning through acceleration, the depth and breadth of content through enrichment, as well as the size and composition of educational groups [35]. Additionally, a supportive framework that enhances psychosocial adaptation and contributes to the prevention or reduction of anxiety, phobias, and depression often observed in gifted children is essential [36]. The ultimate goal of gifted education is to develop all cognitive and emotional skills to the highest possible level [37].

In recent years, there has been increasing interest in investigating the application of the STEAM approach to gifted education [38]. Integrating this methodology enhances problem-solving, inquiry, and innovation among gifted students [39]. Moreover, it contributes to the cultivation of critical thinking, creativity, and communication skills [40]. STEAM education allows for deepening and applying new knowledge through creative problem-solving [41]. Furthermore, it provides a flexible learning framework that promotes the equitable development of cognitive and creative skills, maximizing the abilities of gifted children [42]. The STEAM approach offers a common learning platform for both gifted and non-gifted students, enabling them to construct new knowledge and innovate creatively [43]. In this context, individual effort and personal growth are enhanced through collaboration and teamwork among all students [44]. Gifted children not only benefit from collaborative STEAM activities but also contribute actively to the learning process, guiding, learning, and innovating alongside their non-gifted peers [45].

3. Methodology

This study employed a qualitative methodological approach within the framework of a pragmatic case study, aiming to investigate the attitudes, perceptions, and practices of

teachers in gifted STEAM education. The research sample was selected through purposive sampling and consisted of six teachers from various disciplines with prior experience in STEM/STEAM education and/or gifted education. These educators participated in an annual professional development program titled "Gifted STEAM Education", which was implemented under the academic supervision of the European University Cyprus from January to December 2024. The professional development program was structured into four distinct phases to ensure comprehensive training and collaboration among participants. The phases were as follows:

1. **Introduction Phase:** This phase involved four open-access online seminars aimed at introducing the fundamental principles and methodologies of gifted STEAM education. The seminars were designed to provide participants with a foundational understanding of the theoretical frameworks and pedagogical approaches relevant to the field.
2. **Core Group Formation:** During this phase, a core group of six teachers was formed to engage in systematic professional development. The group participated in ten online seminars focusing on advanced topics related to gifted STEAM education, including transdisciplinary learning, creativity, differentiation, and assessment.
3. **Collaborative Design of a Learning Scenario:** The third phase involved the collaborative design of a gifted STEAM learning scenario aimed at primary school students. Participants worked together to develop educational activities that integrated cognitive, social, and creative skill development through educational games within the transdisciplinary STEAM framework.
4. Implementation Phase: In the final phase, the participating teachers collaboratively implemented the designed learning scenario in their classrooms. Following the implementation, a process of reflection and evaluation took place, during which the teachers identified areas for improvement.

Data collection was conducted through semi-structured interviews with the participating teachers. This method allowed for the exploration of their experiences, perceptions, and practices regarding the integration of educational games within gifted STEAM education. The interviews were audio-recorded and transcribed for analysis. Thematic analysis was employed to analyze the data, following a systematic process of coding, identifying recurring patterns, and developing thematic categories related to the research questions. This approach enabled the identification of key themes concerning the cognitive, social, and creative benefits of educational games, as well as the challenges associated with their implementation in mixed-ability classrooms.

Ethical considerations were rigorously followed throughout the research process. Informed consent was obtained from all participants, and their confidentiality and personal data protection were ensured in compliance with the General Data Protection Regulation (GDPR). The study was conducted following the approval of the Research Ethics and Deontology Committee of the European University Cyprus.

4. Findings

4.1 Current Perceptions and Pedagogical Value of Educational Games: The interview responses reveal a broadly positive perception of educational games among teachers, who emphasize their importance in enhancing the learning process for students across different age groups. Specifically, educational games are perceived as effective tools for making learning more engaging, enjoyable, and participatory, both for students and educators. As one teacher stated, “Educational games offer significant benefits, making the learning process easier and more enjoyable for teachers and more interesting for students”.

Moreover, a recurring theme is the contrast between traditional teaching methods and the use of educational games. Teachers describe conventional approaches as rigid and monotonous, which often leads to disengagement and passive learning. As noted by one participant, “When teaching is conducted through traditional, standardized methods, students often lose interest and do not actively participate”. In contrast, educational games are seen as modern and creative approaches that introduce variety and excitement to the learning experience. This sentiment is reflected in the statement, “Every lesson can have its own unique educational game, tailored to the needs and interests of the students”.

Furthermore, the social dimension of educational games is particularly emphasized. Teachers recognize the capacity of games to foster social interaction, cooperation, and communication among students. According to one respondent, “Educational games give children the opportunity to interact with each other, develop social skills, express themselves, and have fun”. Additionally, experiential learning is identified as a significant advantage of educational games. Teachers appreciate how games allow students to engage in hands-on activities that reinforce theoretical knowledge through practice. As one interviewee stated, “Educational games help students see in practice what they hear in theory, learning through experience”. This approach not only enhances understanding but also promotes the development of critical thinking and strategic skills, which are essential for future learning and problem-solving.

Nevertheless, despite their benefits, the integration of educational games is not without challenges. Teachers acknowledge that their successful implementation requires thoughtful design and careful planning. Although educational games are valued for their potential to enhance learning, they are not considered a simplistic solution. One teacher remarked, “Educational games require careful planning and consideration of how to maintain students’ interest and enhance their active participation”.

Moreover, teachers express concerns about adapting educational games to modern technological trends, particularly with students increasingly accustomed to digital and online interactions. As noted, “Because of video games and new technologies, children are now used to playing games on smart devices or online, rather than in traditional group settings”.

4.2 Implementing Educational Games in Gifted STEAM Education: Teacher Insights

The teachers’ responses reveal various perspectives on how educational games can be effectively applied within the context of gifted STEAM education. Specifically, the primary focus is on engaging gifted students through stimulating and enjoyable learning experiences, while simultaneously fostering collaboration and inclusivity among all students.

A common observation among teachers is that educational

games are particularly suitable for gifted students because they offer a dynamic and creative approach to learning that diverges from traditional methods. As one teacher noted, "Gifted children tend to get bored with conventional, standardized teaching methods. They require stimulation and engagement in the educational process, and educational games can offer that".

Furthermore, the importance of transdisciplinary collaboration is emphasized as a key factor for successful implementation. Teachers recognize that integrating various disciplines of STEAM into a cohesive educational game requires collaboration among educators with different expertise. As one teacher stated, "It requires greater effort from us as educators. We need to collaborate with other specialists, particularly when dealing with STEAM education, where transdisciplinary collaboration is crucial".

Another critical aspect raised is the need to balance the level of difficulty of the games. Teachers express concerns about creating games that are engaging for gifted students while remaining accessible to non-gifted students. One teacher mentioned, "The game needs to be challenging enough to maintain the interest of gifted students and encourage their participation, but not so difficult that it discourages other students".

This observation reflects the necessity of designing games that can be adaptable to various learning levels, promoting inclusivity without compromising on educational quality. Moreover, the application of educational games is viewed not only as a tool for engagement but also as a method for assessment and practical demonstration of theoretical concepts. One participant suggested, "It can be integrated into various activities as both an evaluation tool and a practical application of theoretical knowledge".

However, some teachers express concerns about potential disparities in learning experiences when gifted and non-gifted students are grouped together. As one teacher noted, "When I have gifted and non-gifted students in the same group, it already creates imbalances. The gifted student will likely outperform everyone else, potentially undermining the purpose of the game". This observation underlines the need to design educational games that promote cooperation and collective learning rather than individual competition.

4.3 Differentiation Approaches in Game-Based Learning for Gifted Students

he interview responses suggest that teachers generally acknowledge the possibility of differentiating educational games to accommodate the needs of gifted students within the gifted STEAM education context. Nevertheless, opinions diverge on how effectively this differentiation can be applied, particularly in mixed-ability classrooms where both gifted and non-gifted students participate.

Several teachers, however, emphasize the adaptability of educational games as a key strength. They note that games do not have predefined boundaries but can be adjusted and enriched according to the needs of the students. As one teacher explained, "Educational games can be modified by increasing the level of difficulty and complexity to match the capabilities of gifted students". This flexibility allows teachers to create challenges that maintain the interest and motivation of gifted students while promoting active participation.

In addition, teachers highlight the importance of continuously monitoring and adjusting games based on student responses. The process of designing and implementing educational games is described as dynamic, requiring ongoing modifications to ensure that learning objectives are met. As one teacher noted, "The process of designing and applying an educational game does not end with its presentation in the classroom. Instead, we must be ready to adapt the game according to students' responses".

On the other hand, several teachers express concerns about applying differentiation strategies within group-based games. They argue that when educational games involve direct competition between gifted and non-gifted students, disparities may emerge. One teacher commented, "In a group game, the gifted student will likely outperform everyone else, potentially undermining the purpose of the game". This highlights the challenge of creating inclusive learning experiences that do not alienate non-gifted students.

Moreover, teachers mention that differentiation is easier to achieve when games are played individually rather than collectively. As one teacher observed, "When it is an individual game played on a mobile device or tablet, we can increase the difficulty level or require the gifted student to perform more tasks". This approach suggests that individualized learning paths can be more effective in providing suitable challenges for gifted students without causing imbalance within the classroom.

Finally, some participants point out that differentiation is more feasible when educational games are designed as flexible tools rather than rigid systems with fixed rules. As another teacher stated, "If something is modified or differentiated, other students may perceive it as unfair. However, if the game allows for different levels of engagement, it becomes enjoyable for everyone".

4.4 Pedagogical and Design Considerations for Game Development in Gifted STEAM Contexts

The teachers' responses highlight several critical parameters that must be taken into account when designing educational games for gifted STEAM education. These parameters include transdisciplinary collaboration, adaptability, inclusivity, and assessment.

A predominant theme is the importance of transdisciplinary collaboration. Teachers emphasize the value of working with colleagues from various fields to create educational games that align with the transdisciplinary nature of STEAM education. As one teacher stated, "The most important aspect is collaborating with a colleague who has complementary knowledge. Collaboration with colleagues from positive sciences or the arts can enrich the content and make the activity more interesting for students".

Furthermore, adaptability and flexibility are highlighted as essential elements in designing educational games for gifted students. Teachers note that educational games should be tailored to the diverse needs of students, especially when dealing with different levels of giftedness and learning abilities. One respondent emphasized, "The educational game should be designed in such a way that all students can participate and enjoy the process, regardless of their abilities".

The concept of differentiation is also reinforced by the suggestion of creating multiple levels of difficulty to accommodate varying levels of giftedness. However, the goal remains to provide a balanced learning experience where all students can derive meaningful benefits. As one teacher mentioned, "If we find that there are significant differences in student levels, we may need to divide the activity into different levels of difficulty". This observation suggests that creating scalable games with adjustable

complexity can enhance their effectiveness in a diverse classroom environment.

Inclusivity is another critical factor identified by teachers. While ensuring that gifted students are adequately challenged, the design of educational games must also consider the participation of non-gifted students. Maintaining an inclusive environment where all students feel valued and capable of contributing is deemed essential for fostering collaboration and social cohesion. As one teacher noted, "The participation of all students at the same level of activity is important for creating an atmosphere of equality and cooperation".

Additionally, the responses indicate that the selection of appropriate tools and resources plays a crucial role in successful game design. Teachers mention the need to use tools that students are familiar with and can easily engage with. For example, "It is important to use tools that students know how to use and can cognitively operate within".

Moreover, teachers underline the importance of evaluating whether the educational game has achieved the intended learning outcomes. One teacher stated, "We need to be able to assess whether students have learned through the game. What did the game teach them? Was the goal simply psychological relief, or was it genuinely educational?". This observation underscores the need for clear learning objectives and effective assessment methods to measure the educational value of the games.

Lastly, some teachers emphasize the importance of building resilience and teaching students to cope with failure. As one respondent mentioned, "Allowing children to learn through experience, even if it involves failure, is essential, especially for gifted children who are often used to excelling without difficulty". Designing games that incorporate challenging scenarios can help students develop perseverance and view learning as a continuous process of growth and improvement.

4.5 Holistic Benefits of Educational Games for Gifted Learners

The responses indicate that educational games offer various potential benefits for gifted students in gifted STEAM classrooms. Importantly, these benefits extend beyond academic achievement and include the development of social, emotional, and creative skills, all of which are essential for holistic growth and personal fulfillment.

One of the most frequently mentioned benefits is the enhancement of social skills and cooperation. Teachers highlight that educational games, especially those involving group activities, provide opportunities for gifted students to interact, communicate, and collaborate with their peers. As one teacher noted, "Through educational games, gifted children learn to function as part of a group. Regardless of who is faster or smarter, everyone participates for the common good".

Additionally, the development of empathy and tolerance is another benefit that educational games can offer to gifted students. By participating in activities that require cooperation and mutual support, gifted students can learn to appreciate the diverse abilities and contributions of their peers. As one teacher explained, "Educational games help children understand that we are not all the same, but each of us has our own value and capabilities".

Furthermore, games that allow open-ended exploration and problem-solving encourage gifted students to experiment with new ideas and approaches. As one teacher mentioned, "There are many games that allow children to make their own choices, promoting creativity and innovation which are fundamental in Gifted STEAM". This observation suggests that educational games can provide gifted students with the freedom to explore their creative potential within a structured yet flexible framework.

Moreover, educational games also play an important role in building self-confidence and emotional resilience. The collaborative nature of some games helps students build self-esteem by providing opportunities for positive social interactions and cooperative achievements. As another teacher stated, "The earlier a child learns to cope with failure, interact with others, and enjoy the experience of interaction, the more complete their personality and psychology will be in the future".

In addition, educational games are regarded as effective tools for promoting cognitive skills and intellectual challenges. They can be designed to provide additional levels of difficulty or more complex tasks for gifted students, encouraging them to push their cognitive boundaries. As one teacher noted, "We present gifted students with a challenge that requires them to excel in various aspects, such as creativity, collaboration, communication, and cognitive learning".

Finally, educational games are seen as valuable tools for enhancing motivation and engagement. Teachers acknowledge that the playful nature of games makes learning more enjoyable and accessible. As one participant explained, "Educational games can make learning goals easier to achieve by capturing students' interest and motivation".

4.6 Challenges of Inclusive Game-Based Learning in Mixed-Ability Classrooms

The responses from the interviews reveal various challenges associated with integrating educational games for students with different ability levels, including gifted and non-gifted students. Teachers identify issues related to inclusivity, motivation, fairness, and classroom management, all of which can impact the successful implementation of educational games in gifted STEAM education.

A recurring concern is the difficulty of achieving balance and inclusivity. Teachers acknowledge that educational games designed to accommodate gifted students often pose difficulties for non-gifted students. As one teacher remarked, "If I set the bar too high, non-gifted students may feel that the requirements are too difficult and that their abilities are not being considered".

Furthermore, the social dynamics of group-based games can contribute to feelings of exclusion. Several teachers note that games involving direct competition can exacerbate differences between gifted and non-gifted students. As one participant stated, "If the activities are too difficult, the gifted students may complete them easily, which could lead to arrogant behavior and the belief that there is nothing else to learn".

Such imbalances can undermine the collaborative spirit intended by the educational game. Additionally, there is concern that gifted students may dominate games when placed in mixed-ability groups, making it difficult for other students to actively participate. As another teacher explained, "In group games, gifted students will likely outperform everyone else, potentially undermining the purpose of the game". This observation raises the issue of designing games that provide meaningful opportunities for all participants, regardless of their ability levels.

Another challenge relates to motivation and engagement. As

one teacher stated, "If a game appears to be below the capabilities of a gifted student, it will not attract their interest". This observation highlights the importance of designing games with varying levels of difficulty to maintain engagement among diverse learners.

Moreover, several teachers emphasize the importance of careful planning and classroom management. The enthusiastic nature of games can sometimes lead to a lack of discipline and structure. As one teacher noted, "There's a certain excitement in games, and perhaps a sense of relaxation that now we're not doing a regular lesson". Therefore, this requires teachers to effectively communicate the educational purpose of the games and maintain appropriate classroom control.

In addition, teachers mention the need to address technical and logistical challenges. Issues such as inadequate materials, technological malfunctions, and classroom space can disrupt the flow of the game and diminish its educational value. As one participant commented, "You have to make sure the game doesn't stop in the middle because something unexpected happens, like not having the necessary materials or the technology not working".

Furthermore, in addition to logistical concerns, teachers stress the importance of respecting student individuality and personal boundaries. For instance, some students may be introverted or reluctant to participate in group activities, regardless of their ability level. As one teacher pointed out, "We must always respect the boundaries of students' characters, whether they are gifted or not".

Finally, the complexity of organizing mixed-ability groups presents another challenge. Teachers note that assigning appropriate roles and responsibilities within the game is crucial for creating a balanced and productive learning environment. As one teacher explained, "It's more than just designing a game. It's about seeing which character matches with whom and which cognitive level aligns with whom, to facilitate the learning process".

4.7 Assessing the Educational Impact of Games on STEAM Skill Development

The responses provided by teachers reveal several approaches and criteria for evaluating the effectiveness of educational games in enhancing STEAM skills among students, particularly gifted learners. Teachers emphasize the importance of both qualitative and quantitative evaluation methods to gain a comprehensive understanding of the educational impact of games.

A significant aspect of the evaluation process involves observational assessment. Teachers indicate that observing student behavior during gameplay is a valuable tool for assessing collaboration, communication, and emotional engagement. As one teacher noted, "I would observe whether the activity was completed successfully, whether the process went smoothly, and if there was cooperation without conflicts or reactions". This approach focuses not only on cognitive learning outcomes but also on social and emotional interactions during the game.

Furthermore, teachers acknowledge the importance of post-game discussions and reflections as part of the evaluation process. One teacher explained, "We can conduct discussions to see what the students liked, what they didn't like, and how they apply what they learned from the game to future projects". This indicates a formative assessment approach where students are encouraged to express their experiences and reflect on their learning journey.

Additionally, peer and self-assessment are highlighted as valuable tools for evaluating the educational impact of games. Teachers suggest involving students in evaluating their own performance as well as the performance of their peers to foster critical thinking and personal growth.

Another prevalent theme is the need to integrate standard assessment tools commonly used in traditional teaching into the evaluation of educational games. Teachers suggest employing quizzes, worksheets, and other formal assessment methods to determine whether the intended learning objectives have been met. As one participant stated, "If I want them to learn from the game, I would use the same tools I always use in my teaching, such as evaluation criteria, quizzes, and worksheets".

Moreover, some teachers emphasize the importance of working closely with colleagues from various disciplines to evaluate the effectiveness of educational games within a STEAM framework. As one teacher mentioned, "I would collaborate with my colleague throughout the entire process, from creating the game to evaluating the results". This transdisciplinary approach ensures that educational games address multiple domains of learning, including science, technology, engineering, arts, and mathematics.

A final aspect raised by teachers is the importance of evaluating both student enjoyment and learning outcomes. The motivational aspect of educational games is considered a key factor in their effectiveness. As one teacher noted, "The first thing I observe is whether all students enjoyed the game. If they played and had fun, if they laughed, and if proper communication and collaboration were developed". While enjoyment is not the sole indicator of effectiveness, it is seen as a critical component that supports engagement and participation.

4.8 Fostering Creativity and Innovation through Educational Games

The interview responses reveal a general consensus among teachers that educational games play a significant role in fostering creativity and innovation among students, particularly within the context of STEAM education. Educational games are perceived as flexible tools that can be tailored to encourage creative thinking, problem-solving, and imaginative exploration.

One prominent theme is the adaptability of educational games to promote creativity. Teachers emphasize that games can be modified and adjusted to fit the interests and needs of students. As one teacher noted, "Educational games are not fixed; they can be structured according to the needs of the children, evaluating what is appropriate and what is not".

Furthermore, student-centered design is identified as a critical factor in fostering creativity. Teachers suggest that involving students in the design process and considering their interests can significantly enhance engagement and creative expression. One teacher explained, "If I were working with older students, I would first conduct research to understand what innovative elements would capture their interest".

Additionally, teachers emphasize the potential of open-ended and exploratory games to encourage creativity. Games that lack rigid rules and allow students to make independent choices are seen as effective tools for nurturing innovation. As one teacher stated, "Games that allow students to make their own choices, without having to follow strict rules, promote creativity and innovation".

Moreover, educational games can serve as a platform for developing communication skills and imaginative thinking.

Teachers point out that games involving storytelling, role-playing, and collaborative construction can help students expand their creative abilities. As one teacher noted, "Games involving cards that describe a story allow students to develop their imagination, their expression, and their ability to think creatively".

In addition, teachers highlight the importance of providing students with appropriate resources and environments that support creative activities. For example, one teacher suggested, "You provide students with materials, you provide them with the necessary space. This way, you encourage and guide them towards creativity".

However, there is some hesitation among teachers about the ability of educational games to effectively promote creativity. One teacher remarked, "I don't know if the game increases creativity. If I want to achieve creativity, maybe I would think of a creative activity rather than a game".

Finally, the role of the teacher's creativity in game design is emphasized. Teachers suggest that educators who demonstrate creative thinking and innovative teaching methods can serve as positive role models for their students. As one teacher noted, "If the teacher can think innovatively or creatively, they automatically become an example for the students". This perspective highlights the importance of teacher creativity in designing engaging and meaningful educational games.

4.9 Promoting Problem-Solving Skills through Game-Based Learning

The teachers' responses suggest that educational games can indeed be valuable tools for developing problem-solving skills among students, particularly in the context of STEAM education. However, they also highlight several considerations and challenges that need to be addressed for effective implementation.

One of the most commonly mentioned aspects is the interactive nature of educational games. Teachers explain that games often require students to solve puzzles or overcome obstacles, promoting cognitive engagement and critical thinking. As one teacher explained, "Educational games are a process where children are asked to respond to questions, either posed by the activity or created by their own reflections during the game".

Moreover, teachers emphasize the importance of designing educational games that have a clear problem-solving framework. For instance, the concept of "Escape Room" games was mentioned as a structured way of incorporating problem-solving into game-based learning. As one teacher noted, "Escape Room-type games involve a series of puzzles that must be solved to progress. However, the challenge is integrating this into a meaningful learning scenario".

Additionally, some teachers believe that combining educational games with other instructional methods is essential for effective problem-solving development. For example, one respondent stated, "Games alone will help them with how to solve the problem, but without additional theoretical background, they will not fully understand what problem they are trying to solve".

The need for appropriate preparation and contextualization is also emphasized. Teachers suggest that effective problem-solving development requires careful planning and integration of games into the overall curriculum. As one teacher remarked, "Educational games can be useful, but they must be part of a broader educational plan where the skills acquired can be applied to other areas". This observation reflects the idea that games should be designed to encourage students to apply their problem-solving skills beyond the immediate context of the game.

Furthermore, the role of the teacher in guiding and facilitating problem-solving activities is considered crucial. Teachers emphasize that students may require support in understanding the nature of the problems they are supposed to solve. One teacher mentioned, "The difficulty lies not in creating a game with problem-solving characteristics but in integrating it into a learning scenario with a functional purpose".

Moreover, several teachers point out that collaborative problem-solving is a valuable skill that can be fostered through educational games. Activities that encourage students to work together to solve complex problems can promote social interaction, communication, and cooperative learning. As another teacher stated, "Even if a problem is designed for individual completion, collaboration can emerge naturally through the sharing of ideas and perspectives".

4.10 Integrating Educational Games in the Design of Gifted STEAM Learning Scenarios

The interview responses indicate that educational games are considered valuable tools that can be integrated into various stages of designing a learning scenario for gifted STEAM education. A recurring theme is the use of educational games as introductory activities. Teachers note that games can be used at the beginning of a learning scenario to familiarize students with new concepts or topics. As one teacher explained, "We could definitely use games at the initial phase of a scenario where students need to engage with something they are not familiar with, or we could use role-playing games or exploratory games". This approach emphasizes the potential of games to spark interest and motivation at the outset of a learning experience.

Another suggested application involves using educational games as a formative or summative assessment tool. Teachers mention that games can be employed at the end of a learning scenario to assess knowledge acquisition and skill development. As one teacher stated, "Games could be used in the final stage, after students have acquired some knowledge, collected information, and presented their work. You can then design a broader range of games with more levels to gradually evaluate the students".

Additionally, some teachers advocate for integrating games during the middle of a learning scenario, particularly when students are engaged in practical or project-based activities. As one participant noted, "I would use games during the application phase, as a form of implementation or even as an assessment tool".

However, some concerns are expressed about the potential of games to distract students from the main learning objectives. Teachers emphasize the need to carefully design games to ensure that they serve educational purposes rather than merely providing entertainment. As one teacher mentioned, "Games can be distracting if used during a phase where students need to focus on collecting data or completing a specific project".

Moreover, teachers stress the importance of collaboration between educators when designing learning scenarios that incorporate educational games. As one teacher described, "The entire process would be conducted through activities and educational games, from the initial presentation of the topic to the final evaluation." This statement emphasizes the need for a comprehensive approach where games are

integrated thoughtfully into the overall teaching framework. Finally, some teachers view educational games as tools for relaxation and free engagement. They suggest that games can be implemented in a designated area for gifted students as a means of relieving stress and promoting creative exploration. This application is seen as complementary rather than central to the main educational objectives.

5. Discussion

The present study aimed to explore the role of educational games in developing cognitive, social, and creative skills among gifted and non-gifted students within the context of inclusive gifted STEAM education. The findings of this study align with and diverge from existing literature in the fields of gifted education and STEAM education, offering valuable insights into the potential and challenges associated with the use of educational games in mixed-ability learning environments.

The analysis of the data indicates that educational games can effectively enhance cognitive skills by engaging gifted students in problem-solving, critical thinking, and strategic planning. Teachers emphasized that games provide opportunities for students to apply their knowledge in practical contexts, promoting cognitive flexibility and creativity. This finding is consistent with previous research in gifted education, which emphasizes the importance of developing higher-order thinking skills and creativity among gifted students [46]. Moreover, studies in STEAM education indicate that transdisciplinary approaches, particularly those involving arts integration, contribute positively to cognitive development and creative expression [47].

The findings demonstrate that educational games promote collaboration, communication, and emotional resilience, creating a positive classroom environment where students feel encouraged to participate actively. These results are in line with research in gifted education, which acknowledges the value of social interactions in enhancing both cognitive and emotional growth [48]. Nevertheless, the literature on STEAM education tends to focus more on collaboration within the context of scientific and technological problem-solving rather than social interactions per se [49].

In terms of creativity, the results suggest that educational games are valuable tools for promoting creative thinking and innovation, especially when games allow for flexible and open-ended exploration. Teachers highlighted that games encouraging students to make independent choices and experiment with different approaches are particularly effective in fostering creativity. This observation is consistent with research suggesting that creativity is a fundamental component of both gifted education and STEAM education [50]. However, some teachers expressed concerns about overly structured games that may hinder creativity, a perspective also supported by critics who argue that rigid learning environments can constrain creative expression [51].

Despite the positive perceptions of educational games, several challenges were identified in their practical application. Differentiation emerged as a significant concern, particularly when designing games for mixed-ability classrooms where gifted and non-gifted students interact. Teachers reported difficulties in balancing game complexity to suit both groups, an issue also discussed in the literature on differentiated instruction [52]. Additionally, technological limitations, classroom management issues, and the lack of adequate resources were identified as obstacles that need to be addressed to ensure the successful implementation of educational games. Similar challenges have been reported in STEAM education, where transdisciplinary collaboration and resource availability are often cited as barriers to effective teaching and learning [53].

Another critical issue raised by the participants concerns the assessment of learning outcomes achieved through educational games. Teachers employed various methods of evaluation, including observational assessment, peer and self-assessment, and traditional evaluation tools such as quizzes and worksheets. This approach aligns with the broader literature advocating for a combination of formative and summative assessment methods to capture the multifaceted nature of learning through games [54]. Moreover, transdisciplinary collaboration was emphasized as a crucial factor for effective assessment, particularly in the context of STEAM education, where diverse domains of learning must be addressed simultaneously.

The present study, while providing valuable insights into the role of educational games in developing cognitive, social, and creative skills in gifted STEAM education, is subject to certain limitations. One significant limitation is the relatively small sample size of six teachers, which may limit the generalizability of the findings. Although the selected participants have extensive experience in gifted STEAM education, a larger and more diverse sample could enhance the reliability and validity of the conclusions drawn. Moreover, the research was conducted within the context of a specific professional development program, which may have influenced participants' responses. The structured nature of the program could have introduced bias in terms of familiarity with certain concepts and practices related to gifted STEAM education.

Future research should consider employing mixed-methods approaches that combine qualitative interviews with quantitative measures, such as standardized tests or observational assessments, to provide a more comprehensive evaluation of the educational impact of games. Moreover, future studies could focus on designing and testing educational games specifically tailored to meet the needs of both gifted and non-gifted students. Investigating strategies for effective differentiation and assessing the efficacy of games in promoting collaboration and inclusivity within mixed-ability classrooms would be particularly valuable.

6. Conclusion

The findings of this study highlight the potential of educational games as valuable tools for developing cognitive, social, and creative skills in gifted STEAM education. Teachers generally acknowledge that educational games can enhance higher-order thinking skills, creativity, collaboration, and emotional resilience when implemented thoughtfully within a structured learning environment. Moreover, educational games offer opportunities for transdisciplinary learning by integrating various aspects of STEAM education, particularly when designed with flexibility and adaptability to meet the diverse needs of gifted and non-gifted students. However, the complexity of creating inclusive games that are both challenging and accessible remains a persistent issue that requires further attention.

Despite the promising results, the study also reveals significant challenges related to differentiation, inclusivity, and assessment. Ensuring that educational games effectively address the needs of all learners requires careful planning,

adequate resources, and collaboration between teachers from various disciplines. Future research should focus on developing innovative strategies that enhance the implementation of educational games in gifted STEAM education, with an emphasis on achieving balance between providing appropriate challenges for gifted students and promoting inclusivity for all participants. Addressing these challenges will contribute to a more comprehensive understanding of the educational potential of games in fostering cognitive, social, and creative growth within mixed-ability classrooms.

7. References

1. Dai DY. A history of giftedness: Paradigms and paradoxes. In: Handbook of giftedness in children: Psychoeducational theory, research, and best practices. 2018. p. 1-14. DOI: 10.1007/978-3-319-77004-8_1
2. Renzulli JS. What makes giftedness?: Reexamining a definition. Phi Delta Kappan. 2011;92(8):81-88. DOI: 10.1177/003172171109200821.
3. Sternberg RJ. Giftedness does not reside within a person: Defining giftedness in society is a three-step process. Roeper Review. 2023;45(1):50-60. DOI: 10.1080/02783193.2022.2145400.
4. Thompson LA, Oehlert J. The etiology of giftedness. Learning and Individual Differences. 2010;20(4):298-307. DOI: 10.1016/j.lindif.2009.11.004.
5. Renzulli JS. The three-ring conception of giftedness: A developmental model for creative productivity. In: Sternberg RJ, Davidson JE, editors. Conceptions of giftedness. Cambridge: Cambridge University Press; 1986. p. 53-92.
6. Szymanski A. Social and Emotional Issues in Gifted Education. In: Critical Issues and Practices in Gifted Education. Routledge; c2021. p. 417-429.
7. An HR, Yoo MH. Analysis of research trends in STEAM education for the gifted. J Gifted/Talented Educ. 2015;25(3):401-420. DOI: 10.9722/JGTE.2015.25.3.401.
8. Kaplan SN. The Importance of Interdisciplinarity to Differentiate. Gifted Child Today. 2022;45(2):69-71. DOI: 10.1177/10762175211070713.
9. Yıldız MŞ, Yaman Y. Math Education for Gifted Individuals: Digital Gamification. J Learn Teach Digit Age. 2024;9(1):40-49. DOI: 10.53850/joltida.1255991.
10. Renzulli JS. Reexamining the role of gifted education and talent development for the 21st century: A four-part theoretical approach. Gifted Child Q. 2012;56(3):150-159. DOI: 10.1177/0016986212444901.
11. Kangas M, Koskinen A, Krokfors L. A qualitative literature review of educational games in the classroom: the teacher's pedagogical activities. Teachers Teach. 2017;23(4):451-470. DOI: 10.1080/13540602.2016.1206523.
12. Clark CA. Serious games. University Press of America; 1987.
13. Shute VJ, Ke F. Games, learning, and assessment. In: Assessment in game-based learning: Foundations, innovations, and perspectives. New York, NY: Springer New York; c2012. p. 43-58.
14. Wouters P, Van Nimwegen C, Van Oostendorp H, Van Der Spek ED. A meta-analysis of the cognitive and motivational effects of serious games. J Educ Psychol. 2013;105(2):249. DOI: 10.1037/a0031311.
15. Haverlíková V, Janiga L. Stimulating learning through games. J Phys Conf Ser. 2024;2715(1):012010. DOI: 10.1088/1742-6596/2715/1/012010.
16. Polin LG. A constructivist perspective on games in education. In: Constructivist Education in an Age of Accountability. 2018. p. 163-188. DOI: 10.1007/978-3-319-66050-9_9.
17. Nabiyevna FO. Organizing Games for Cognitive Development in School Children. West Eur J Linguist Educ. 2024;2(10):84-86. Available from: https://westerneuropeanstudies.com/index.php/2/article/view/1555.
18. Schrier K. Knowledge games: How playing games can solve problems, create insight, and make change. JHU Press; c2016.
19. Druckman D, Ebner N. Games, claims, and new frames: Rethinking the use of simulation in negotiation education. Negotiation J. 2013;29(1):61-92.
20. Yu Z, Gao M, Wang L. The effect of educational games on learning outcomes, student motivation, engagement and satisfaction. J Educ Comput Res. 2021;59(3):522-546. DOI: 10.1177/0735633120969214.
21. Bybee RW. The case for STEM education: Challenges and opportunities. NSTA Press; c2013.
22. Bybee RW. What is STEM education? Science. 2010;329(5995):996. DOI: 10.1126/science.1194998.
23. Liao C. From interdisciplinary to transdisciplinary: An arts-integrated approach to STEAM education. Art Educ. 2016;69(6):44-49. DOI: 10.1080/00043125.2016.1224873.
24. Yakman G. STEAM education: An overview of creating a model of integrative education. In: Pupils' Attitudes Towards Technology (PATT-19) Conference: Research on Technology, Innovation, Design & Engineering Teaching; c2008; Salt Lake City, Utah, USA.
25. Segarra VA, Natalizio B, Falkenberg CV, Pulford S, Holmes RM. STEAM: Using the arts to train well-rounded and creative scientists. J Microbiol Biol Educ. 2018;19(1):19-21. DOI: 10.1128/jmbe.v19i1.1360.
26. Bazler J, Van Sickle M, editors. Cases on STEAM education in practice. IGI Global; c2017.
27. Costantino T. STEAM by another name: Transdisciplinary practice in art and design education. Arts Educ Policy Rev. 2018;119(2):100-106. DOI: 10.1080/10632913.2017.1292973.
28. Quigley CF, Herro D, Jamil FM. Developing a conceptual model of STEAM teaching practices. Sch Sci Math. 2017;117(1-2):1-12. DOI: 10.1111/ssm.12201.
29. Herro D, Quigley C, Cian H. The challenges of STEAM instruction: Lessons from the field. Action Teach Educ. 2019;41(2):172-190. DOI: 10.1080/01626620.2018.1551159.
30. Milakis ED, Argyrakou CC, Loukisas T, Vangeli DG, Katsarou MC, Lalou A. Comparative analysis of Large Language Models as AI assistants for Educational Assessment: A case study in STEAM education. Int J Comput Artif Intell. 2024;5(2):51-55. DOI: 10.33545/27076571.2024.v5.i2a.97.
31. Roussou AM, Argyrakou CC, Milakis ED. Integrating STEAM and theatrical methods in early childhood environmental education: A framework for holistic learning. Int J Geogr Geol Environ. 2025;7(2):19-42. DOI: 10.22271/27067483.2025.v7.i2a.336.
32. Rafti M, Milakis ED, Argyrakou CC, Vangeli DG, Katsarou MC. Hands-On STEAM Programming: Microteaching with Micro:bit for Enhanced Learning. J

Hypermedia Technol-Enhanc Learn. 2025;3(2):1-20. DOI: 10.58536/j-hytel.172.
33. Karnes FA, Bean SM, editors. Methods and materials for teaching the gifted. Routledge; c2021.
34. Ziegler A, Stoeger H, Vialle W. Giftedness and gifted education: The need for a paradigm change. Gifted Child Q. 2012;56(4):194-197. DOI: 10.1177/0016986212456070.
35. Dai DY, Swanson JA, Cheng H. State of research on giftedness and gifted education: A survey of empirical studies published during 1998-2010 (April). Gifted Child Q. 2011;55(2):126-138. DOI: 10.1177/0016986210397831.
36. Rudasill KM, Adelson JL, Callahan CM, Houlihan DV, Keizer BM. Gifted students' perceptions of parenting styles: Associations with cognitive ability, sex, race, and age. Gifted Child Q. 2013;57(1):15-24. DOI: 10.1177/0016986212460886.
37. Worrell FC, Subotnik RF, Olszewski-Kubilius P, Dixson DD. Gifted students. Annu Rev Psychol. 2019;70:551-576. DOI: 10.1146/annurev-psych-010418-102846.
38. Kaymakci G, Can S. Bibliometric Analysis of the Articles on STEM/STEAM Education in Gifted Students. Ulus Turk Egitim Bilim Derg. 2023;(21):275-308. DOI: 10.46778/goputeb.1258457.
39. Kim GS, Choi SY. The effects of the creative problem solving ability and scientific attitude through the science-based STEAM program in the elementary gifted students. J Korean Elem Sci Educ. 2012;31(2):216-226. DOI: 10.15267/keses.2012.31.2.216.
40. Kang H, Seo H. The development and application of a life science-based STEAM program for middle school science gifted students. Korean Sci Educ Soc Gifted. 2013;5:162–173. DOI: 10.12973/eurasia.2016.1539a.
41. Yang Y, Yoo M. The effect of mathematics-based STEAM program using big data on the creative problem-solving abilities, mathematics career orientation and STEAM core competencies of middle school gifted students. J Gifted/Talented Educ. 2017;27:607–629. DOI: 10.9722/JGTE.2017.27.4.607.
42. Wilson HE. Integrating the arts and STEM for gifted learners. Roeper Rev. 2018;40(2):108-120. DOI: 10.1080/02783193.2018.1434712.
43. Perignat E, Katz-Buonincontro J. STEAM in practice and research: An integrative literature review. Think Skills Creat. 2019;31:31-43. DOI: 10.1016/j.tsc.2018.10.002.
44. Nguyen AQ. Pedagogical Approaches in STEAM Education. In: Transformative Approaches to STEAM Integration in Modern Education. IGI Global Scientific Publishing; c2025. p. 53-78.
45. Griffin E. STEAM Interventions with Non-Identified Gifted and Talented Students. Masters of Education in Teaching and Learning; c2022.
46. Lo CO, Feng LC. Teaching higher order thinking skills to gifted students: A meta-analysis. Gifted Educ Int. 2020;36(2):196-217. DOI: 10.1177/0261429420917854.
47. Aguilera D, Ortiz-Revilla J. STEM vs. STEAM education and student creativity: A systematic literature review. Educ Sci. 2021;11(7):331. DOI: 10.3390/educsci11070331.
48. Neihart M. The social and emotional development of gifted children: What do we know? Routledge; c2021.
49. Herro D, Quigley C, Andrews J, Delacruz G. Co-Measure: developing an assessment for student collaboration in STEAM activities. Int J STEM Educ. 2017;4:1-12. DOI: 10.1186/s40594-017-0094-z.
50. Root-Bernstein R. Arts and crafts as adjuncts to STEM education to foster creativity in gifted and talented students. Asia Pac Educ Rev. 2015;16:203-212. DOI: 10.1007/s12564-015-9362-0.
51. Richardson C, Mishra P. Learning environments that support student creativity: Developing the SCALE. Think Skills Creat. 2018;27:45-54. DOI: 10.1016/j.tsc.2017.11.004.
52. Lavania M, Nor FBM. Barriers in differentiated instruction: A systematic review of the literature. J Crit Rev. 2020;7(6):293-297. DOI: 10.31838/jcr.07.06.01.
53. Thomas K, Huffman D. Challenges and Opportunities for Transforming from STEM to STEAM Education. Advances in Educational Technologies and Instructional Design (AETID) Book Series. IGI Global; c2020.
54. Petri G, von Wangenheim CG. How to evaluate educational games: a systematic review. J Univ Comput Sci. 2016;22(7):992-1021. DOI: 10.3217/jucs-022-07-0992.