



# Development of the Smartphone-Based Edutainment Game “MathVenture” as a Learning Medium Oriented Towards Creative Thinking Skills

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## Abstrak

Penelitian ini bertujuan untuk mengembangkan dan mengevaluasi MathVenture, sebuah game edukasi berbasis smartphone yang dirancang untuk meningkatkan kemampuan berpikir kreatif dan keterlibatan siswa dalam pembelajaran matematika. Proses pengembangan mengikuti model ADDIE yang terdiri dari lima fase: Analisis, Desain, Pengembangan, Implementasi, dan Evaluasi. Penelitian ini melibatkan 30 siswa dan 10 guru dari sebuah Sekolah Menengah Pertama. Data dikumpulkan melalui pre-test dan post-test untuk mengukur kemampuan berpikir kreatif siswa, serta angket untuk mengevaluasi kepraktisan game dari perspektif siswa dan guru. Hasil pre-test dan post-test menunjukkan adanya peningkatan signifikan dalam skor berpikir kreatif siswa, dengan skor rata-rata pre-test 8,0 dan skor post-test 13,0 ( $t = 5,00, p < 0,05$ ). Game ini menerima penilaian kepraktisan yang tinggi, dengan skor rata-rata kepraktisan guru sebesar 4,29 (Sangat Baik), dan skor rata-rata siswa sebesar 4,82 (Sangat Baik). Penelitian ini menyimpulkan bahwa MathVenture merupakan alat yang efektif untuk meningkatkan kemampuan berpikir kreatif dan motivasi siswa dalam pembelajaran matematika, serta memberikan kontribusi pada pengembangan penelitian tentang pembelajaran berbasis game dalam pendidikan.

## Abstract

This study aims to develop and evaluate *MathVenture*, a smartphone-based educational game designed to enhance students' creative thinking and engagement in mathematics learning. The development process followed the ADDIE model, consisting of five phases: Analysis, Design, Development, Implementation, and Evaluation. The study involved 30 students and 10 teachers from a Junior High School. Data were collected through pre- and post-tests to assess students' creative thinking, as well as questionnaires to evaluate the practicality of the game from both students' and teachers' perspectives. The pre-test and post-test results showed a significant increase in students' creative thinking scores, with an average pre-test score of 8.0 and a post-test score of 13.0 ( $t = 5.00, p < 0.05$ ). The game received high usability ratings, with the teachers' average score for practicality being 4.29 (Very Good), and the students' average score being 4.82 (Very Good). The study concludes that *MathVenture* is an effective tool for enhancing creative thinking and student motivation in mathematics learning, contributing to the growing body of research on game-based learning in education.

## INTRODUCTION

One of the main challenges in education related to students' critical and creative thinking skills lies in the low level of creative thinking ability among students in Indonesia, particularly in the field of mathematics. According to data from the Programme for International Student Assessment (PISA), Indonesia continues to score poorly in creative and critical thinking, especially in mathematical problem solving. The PISA 2018 results showed that Indonesia ranked 72nd out of 78 countries in mathematical proficiency. Furthermore, the Organisation for Economic Co-operation and Development (OECD) highlights that this is closely linked to Indonesian students' general struggle to understand mathematical concepts and apply them in real-life contexts (OECD, 2019; Schleicher, 2020; Sari et al., 2021; Gunawan et al., 2020; Zubaidah, 2022).

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A major contributing factor to the low creative thinking ability in mathematics is the persistent use of conventional and uninspired teaching methods. In most classrooms, teaching remains dominated by an expository approach, where teachers act as the central source of knowledge and students passively receive information. Such approaches have proven ineffective in developing higher-order thinking skills, including creative thinking (Rusman, 2018; Darmaji et al., 2019; Hermita et al., 2020; Arends, 2015; Hosnan, 2017). Additionally, the lack of diverse learning media contributes to students' low interest and motivation in learning mathematics. When students are not engaged with the material, they are less likely to be motivated to think creatively and explore mathematical concepts deeply (Suherman & Wahyudin, 2019; Fitria et al., 2020; Susanti & Roza, 2022; Riyadi & Aulia, 2021; Muhtadi et al., 2019).

If this situation is not addressed promptly, future generations may face significant challenges in dealing with the complexity of global problems. Creativity is among the most vital 21st-century skills, and without adequate development, Indonesian students risk falling behind in global competitiveness (Trilling & Fadel, 2009; Binkley et al., 2012; OECD, 2018; Redecker et al., 2020; Mishra et al., 2021). A lack of creative thinking skills can also hinder students' capacity to generate innovative solutions to everyday problems, potentially stalling national economic and social progress (Anderson et al., 2014; Garton et al., 2017; UNESCO, 2021; Harrell et al., 2018; Van Laar et al., 2020).

To address the low levels of creative thinking in mathematics, a breakthrough in the development of more interactive and innovative learning media is essential. One promising approach is the development of smartphone-based edutainment games. These games are not merely learning aids but serve as pedagogical innovations offering enjoyable and engaging learning experiences, which simultaneously enhance students' motivation to learn mathematics. Designed specifically to stimulate creative thinking skills, such games aim to transform students' perceptions of mathematics from something rigid and intimidating to a subject that is engaging and exploratory (Prensky, 2012; Cheng et al., 2019; An & Cao, 2020; Wijaya et al., 2021; Sa'diyah et al., 2023).

The advantages of smartphone-based edutainment games extend beyond interactivity. They also incorporate principles of modern pedagogy that support active learning. Through exploration, problem-solving, and experimentation—three key components in the development of creative thinking—students are encouraged to engage more deeply with mathematical content. This learning experience is expected to foster both critical and creative thinking skills more effectively than traditional, passive learning methods (Gee, 2013; Yusuf et al., 2020; Su et al., 2021; Ardiansyah et al., 2022; Pratama et al., 2023). Moreover, by utilizing smartphones—a device already deeply integrated into students' daily lives—this approach maximizes accessibility and allows for the creation of flexible, digitally connected learning environments (Hidayat, 2018; Nugroho et al., 2020; Sahid et al., 2021; Suryani et al., 2022; Farida et al., 2023). Furthermore, the integration of gamification elements such as real-time feedback, progressive challenges, and reward systems significantly enhances students' engagement and motivation. These elements not only make the learning process more enjoyable but also help students maintain focus and motivation toward their learning goals. When students feel challenged and recognized for their efforts, they are more likely to persist in learning and to develop their creative thinking abilities (Suh & Wagner, 2013; Hamari et al., 2014; Simões et al., 2021; Mubarok et al., 2022; Fitriani et al., 2023).

This research holds significant importance in the context of efforts to enhance the quality of education in Indonesia. By developing an effective edutainment game grounded in current technological advancements, this study aims to produce a learning medium capable of addressing the persistent issue of students' low creative thinking skills. More than just a supplementary tool, the game has the potential to serve as a catalyst for transformative change in mathematics learning approaches across Indonesian classrooms. It is expected that increased student engagement and motivation will result in a notable improvement in their creative thinking abilities, ultimately contributing to the advancement of human resource quality in Indonesia (Taspinar, Schmidt, & Schuhbauer, 2016). Furthermore, this study is envisioned to serve as a

foundational reference for the development of other interactive learning media applicable across various subjects, not limited to mathematics. In today's increasingly competitive global era, creative thinking is considered a crucial 21st-century skill. Therefore, the research carries strategic significance in the broader context of designing an education curriculum that is both relevant and adaptive to contemporary societal demands (Voogt & Roblin, 2012).

In recent years, there has been a significant increase in the development and integration of educational technologies aimed at enhancing students' higher-order thinking skills, particularly creative thinking. Among various instructional innovations, edutainment-based digital games have emerged as a powerful pedagogical tool, merging entertainment with educational objectives to promote student engagement and learning outcomes (Anastasiadis, Lampropoulos, & Siakas, 2018; Hussein et al., 2019; Qian & Clark, 2016; Tsai, Yu, & Hsiao, 2018; Wijaya et al., 2020). The effectiveness of such game-based media lies in its ability to create interactive and immersive learning experiences, which in turn stimulate curiosity, exploration, and creative problem-solving—core components of creative thinking development.

Several studies have emphasized the potential of mobile-based educational games in improving learners' cognitive and affective outcomes. Mobile learning platforms provide flexibility, accessibility, and personalization, making them highly effective in contemporary educational settings (Ally & Tsinakos, 2014; Sung, Chang, & Liu, 2016; Crompton & Burke, 2018; Hwang & Tsai, 2017; Chou, Block, & Jesness, 2012). These affordances are especially relevant in developing countries like Indonesia, where smartphone penetration among students is significantly higher than access to other digital infrastructure. Thus, integrating smartphone-based edutainment games into mathematics learning can bridge the digital divide while offering a relevant and contextually appropriate intervention to address the low levels of students' creative thinking skills.

The application of gamification elements such as reward systems, progressive challenges, instant feedback, and narrative structures has also been proven to foster intrinsic motivation and sustained engagement in learning processes (Hamari, Koivisto, & Sarsa, 2014; Suh, Wagner, & Liu, 2018; Subhash & Cudney, 2018; Mekler et al., 2017; Shi & Cristea, 2016). These elements not only enhance enjoyment and user experience but also activate cognitive and metacognitive processes that are essential for creative thinking. By engaging students in tasks that require divergent thinking, idea generation, and innovative solution strategies, educational games can be purposefully designed to cultivate creative cognition.

In the context of mathematics education, the integration of game-based learning approaches has shown promising results. Research by Ke (2008), Hung et al. (2014), and Cheng et al. (2019) demonstrated that game-based learning environments significantly improved students' ability to think creatively and apply mathematical concepts in novel contexts. Moreover, studies focusing on localized content and culturally relevant themes have highlighted the importance of contextualization in increasing the efficacy of educational games in mathematics (Nasir et al., 2020; Syahrir et al., 2022; Yilmaz & Baydas, 2017; Daryanto & Karim, 2021; Ariffin et al., 2020). These findings provide a solid foundation for developing edutainment games that not only align with curricular goals but also resonate with students' real-life experiences and cultural backgrounds.

Despite the growing body of literature supporting the effectiveness of educational games, there remains a limited number of studies that specifically target creative thinking skills in mathematics using smartphone-based edutainment platforms in the Indonesian context. Existing studies often focus on cognitive achievement or general attitudes toward mathematics, rather than on fostering domain-specific creative competencies (Setiawan et al., 2020; Zainuddin et al., 2021; Asrial et al., 2021; Ramdani et al., 2023; Isnawati et al., 2022). This research seeks to fill that gap by offering an empirically grounded, theoretically informed, and culturally sensitive game-based learning model designed to enhance students' creative thinking skills in mathematics through a smartphone platform.

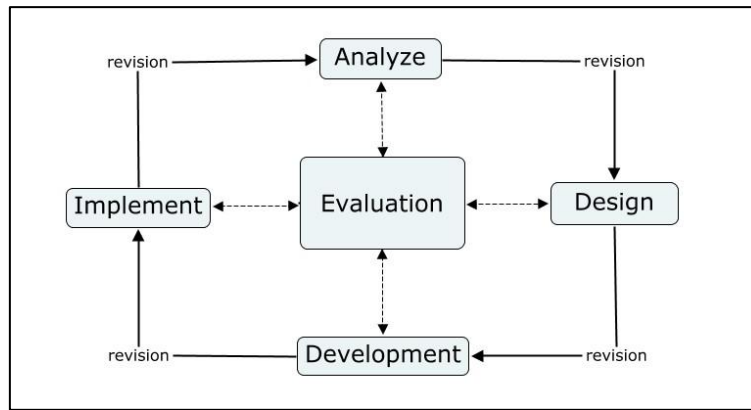
The main objective of this research is to produce a smartphone-based edutainment game that is not only functional but also demonstrably effective in improving students' creative thinking

skills. As such, the study seeks to contribute meaningfully to the enhancement of mathematics education quality in Indonesia, while also serving as a reference point for the broader development of educational media (Sugiyono, 2018). The R&D approach further allows for the creation of innovative products that can be adapted for use in other educational contexts, addressing the evolving challenges of education in the global era (Richey & Klein, 2014).

## METHOD

This study employed a Research and Development (R&D) approach aimed at producing a practical educational product, namely a smartphone-based edutainment game titled *MathVenture*. The R&D approach was selected as it is particularly well-suited for studies that focus on the creation or enhancement of educational products through a series of systematic and structured stages (Sugiyono, 2018). This approach not only emphasizes the development of a new product but also includes its validation and evaluation in authentic educational settings to ensure that the final product meets users' needs effectively. The development model applied in this study is the ADDIE model, one of the most widely recognized and utilized models in the field of instructional design. The acronym ADDIE represents five critical phases in the development process: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). The model's iterative and flexible nature allows for continual revisions at each stage to ensure the production of a high-quality, user-responsive educational product (Molenda, 2015). Within the framework of this study, the ADDIE model provides a comprehensive structure for the design, development, and assessment of the *MathVenture* game, aligning it with pedagogical objectives and practical classroom needs while fostering students' creative thinking in mathematics.

**Analysis.** This initial phase involves conducting a needs analysis, wherein the researcher identifies the specific learning problems to be addressed, defines learning objectives, and analyzes the characteristics of the target users (students and teachers). In this study, the analysis focused on the low levels of students' creative thinking in mathematics and the necessity for engaging learning media capable of enhancing these skills (OECD, 2019). **Design.** In the design phase, the *MathVenture* edutainment game was conceptualized by determining its gameplay structure, storyline, specific learning objectives, and gamification elements to be integrated. The design was informed by constructivist learning theories, which emphasize learning through exploration and problem-solving (Jonassen, 2014). **Development.** The development phase entailed the creation of a game prototype based on the previously established design. This prototype underwent internal testing by the development team to ensure its functionality and alignment with predetermined pedagogical criteria (Gustafson & Branch, 2002). **Implementation.** During this stage, the *MathVenture* game was piloted among students in real educational settings. This phase included training sessions for both teachers and students on how to use the game, as well as data collection on its classroom integration and usage (Taspinar, Schmidt, & Schuhbauer, 2016). **Evaluation.** Evaluation was carried out to assess the effectiveness of *MathVenture* in improving students' creative thinking skills. This process involved both formative evaluations during development and summative evaluations after implementation to determine the overall impact of the game (Branch, 2009). By adopting the ADDIE model, this study aims to produce an innovative and effective edutainment game that enhances students' creative thinking abilities and is adaptable for widespread implementation in mathematics education across Indonesia.



**Figure 1.** ADDIE Model

The research instruments utilized in this study consisted of a product practicality assessment questionnaire, an effectiveness evaluation questionnaire, and a creative thinking test. The practicality assessment questionnaire was designed to collect feedback from both teachers and students regarding the usability and practicality of the MathVenture game, while the creative thinking test and student perception questionnaire were employed to evaluate the game's impact on students' creative thinking abilities. The practicality assessment questionnaire gathered data concerning ease of use, content relevance, and the game's influence on learning motivation. Responses were recorded on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree) (Likert, 1932).

The Creative Thinking Test was adapted from the Torrance Tests of Creative Thinking (TTCT), a validated tool designed to measure the dimensions of fluency, flexibility, and originality in students' responses (Torrance, 2008). The test featured a series of open-ended tasks that encouraged students to generate innovative ideas and creative solutions to posed problems, administered both before and after the intervention to capture any cognitive development. The Student Perception Questionnaire was employed to collect students' subjective evaluations of the game, including aspects such as satisfaction, engagement, and perceived learning benefits in mathematics. This instrument utilized the same Likert scale as the practicality assessment tool.

To ensure the validity and reliability of the research instruments, several rigorous procedures were followed. Content validity was assessed through expert judgment by subject matter experts in mathematics education and psychometricians, who reviewed each item's alignment with the study's objectives. Construct validity was examined using factor analysis to confirm that the instruments accurately measured the intended constructs, such as creative thinking skills and student perceptions (Cohen, Manion, & Morrison, 2018). Reliability was evaluated through a pilot test and retest procedures, complemented by internal consistency analysis using Cronbach's Alpha. A coefficient above 0.70 was considered indicative of good reliability (Field, 2018). All instruments were piloted on a small sample prior to their deployment in the main study to identify and rectify any design flaws.

The primary data sources for this study were students and teachers who used the MathVenture game. A purposive sampling technique was adopted, targeting classes that implemented the game and the mathematics teachers instructing those classes. The sample consisted of 100 students and 10 teachers from both urban and rural schools to ensure representativeness (Creswell & Creswell, 2017).

Product practicality data were derived from teacher and student questionnaire responses. Descriptive statistical analysis was applied to compute the mean and standard deviation of each item, providing a comprehensive overview of the game's usability and effectiveness from the users' perspectives (Tuckman, 2012). To evaluate the product's effectiveness, data were collected from the creative thinking tests and student perception questionnaires. Pre- and post-intervention creative thinking test scores were analyzed using paired sample t-tests to determine statistically significant differences in students' creative thinking abilities (Pallant, 2016).



Additionally, data from the student perception questionnaire were analyzed using descriptive statistics to assess levels of student satisfaction and engagement with the game.

## RESULT AND DISCUSSION

### Result

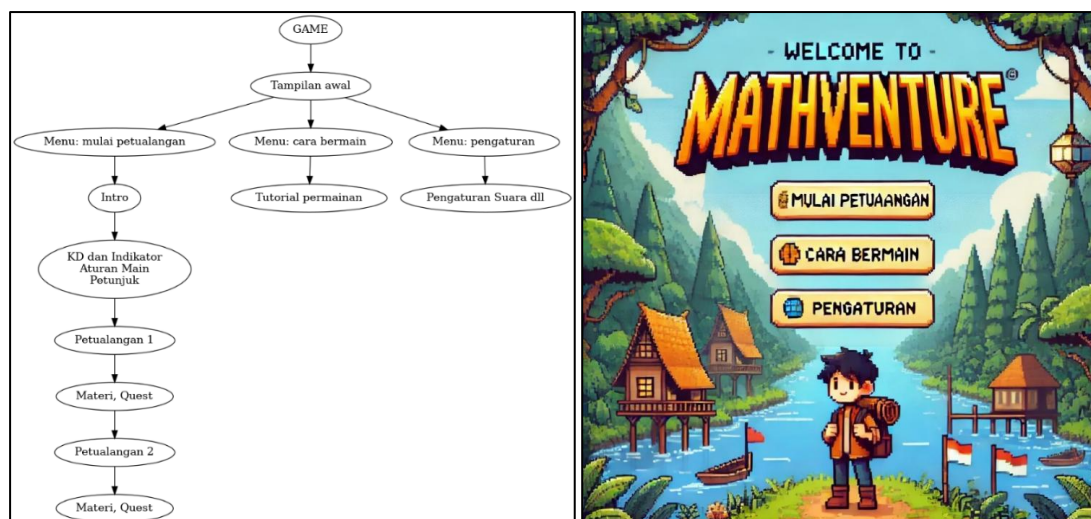
This study involved the development of the edutainment game *MathVenture* through collaboration with 30 middle school students and 10 mathematics teachers. The research adopted the ADDIE development model to ensure that the game was designed and evaluated systematically. The findings are presented according to each phase of the ADDIE model:

#### Analysis Phase Result

The analysis phase began with a needs assessment aimed at identifying the learning challenges faced by students in mathematics. Through interviews with five mathematics teachers and surveys of 30 students, it was found that students frequently struggled with creative thinking and the resolution of complex mathematical problems. This diagnosis was corroborated by baseline tests of creative thinking skills, which revealed low levels of student creativity. These results align with international assessments such as PISA, which have highlighted deficiencies in Indonesian students' critical and creative thinking abilities (OECD, 2019). In response to these challenges, *MathVenture* was conceptualized as an interactive learning solution intended to enhance creative thinking through a game-based learning environment.

#### Design Phase Result

During the design phase, *MathVenture* was structured around elements that specifically target the development of students' creative thinking. The game included mathematical challenges that required innovative problem-solving and encouraged "out-of-the-box" thinking. A detailed storyboard and scenario were crafted to align with the junior high school mathematics curriculum. Gamification elements such as points, levels, and rewards were integrated to boost student motivation and engagement (Jonassen, 2014). The game's visual design and interactive mechanisms were carefully developed to capture students' attention and sustain interest throughout the learning sessions.



**Figure 2.** Flowchart Design and Result of MathVenture

#### Development Phase Result

In the development phase, a prototype of *MathVenture* was constructed based on the finalized design. The development team focused on integrating essential game components, including programming, graphic design, and functionality testing. The initial prototype underwent internal testing to ensure it operated according to the intended pedagogical goals.

Feedback from this testing was used to refine the game. The final prototype was then prepared for broader implementation in classroom settings (Gustafson & Branch, 2002).

**Table 1.** Content Expert Validation Results

| No              | Aspect                         | Score |
|-----------------|--------------------------------|-------|
| 1               | Content and Objectives Quality | 4.1   |
| 2               | Instructional Quality          | 4.3   |
| Overall Average |                                | 4.2   |
| Category        |                                | Good  |

The results of expert validation indicated that the *MathVenture* game scored an average of 4.1 for content and objectives quality and 4.3 for instructional quality. The overall mean score of 4.2 places the product in the "Good" category, suggesting strong alignment with pedagogical goals.

#### Implementation Phase Result

During the implementation phase, *MathVenture* was introduced to 30 students and 3 teachers in junior high school classrooms as a component of mathematics instruction. Teachers were trained in how to use the game within instructional contexts, while students received guidance on gameplay. Data were collected using a practicality assessment questionnaire completed by both teachers and students following the game-based learning sessions. These data provided insights into the ease of use, content relevance, and the game's impact on student motivation (Taspinar, Schmidt, & Schuhbauer, 2016).

**Table 2.** Teacher Assessment Results

| No      | Aspect          | Score | Classification |
|---------|-----------------|-------|----------------|
| 1       | Engagement      | 4.5   | Very Good      |
| 2       | Ease of Use     | 4.125 | Good           |
| 3       | Content Quality | 4.25  | Very Good      |
| Average |                 | 4.29  | Very Good      |

Teacher evaluations revealed that the game was highly engaging (mean = 4.5), easy to use (mean = 4.125), and possessed strong content quality (mean = 4.25), with an overall average score of 4.29 categorized as "Very Good."

**Table 3.** Student Assessment Results

| No      | Aspect      | Score | Classification |
|---------|-------------|-------|----------------|
| 1       | Engagement  | 4.85  | Very Good      |
| 2       | Ease of Use | 4.80  | Very Good      |
| Average |             | 4.82  | Very Good      |

Student assessments further confirmed the practicality of the learning media. The average score for engagement was 4.85, and for ease of use was 4.80, both classified as "Very Good." The overall mean of 4.82 illustrates that *MathVenture* was not only highly effective but also well-received by students in terms of its usability and educational value.

#### Evaluation Phase Result

The evaluation phase was conducted to assess both the practicality and effectiveness of the *MathVenture* game. Practicality data were gathered through structured questionnaires completed by teachers and students. The results revealed that both teachers and students perceived the game as user-friendly and effective in enhancing learning motivation. To determine its effectiveness, pre-test and post-test scores measuring students' creative thinking abilities were compared. A paired-sample t-test was utilized to examine whether there was a statistically significant improvement in students' creative thinking following the use of the game. The analysis indicated a substantial increase in creative thinking test scores after the implementation of

*MathVenture*, suggesting the game's potential in fostering students' creative thinking (Pallant, 2016).

**Table 4.** Pre-test and Post-test Results

| Assessment | Pre-test Score | Post-test Score |
|------------|----------------|-----------------|
| Total      | 240            | 390             |
| Average    | 8.0            | 13.0            |
| t-test     | t = 5.00       | p < 0.05        |

Table 4 presents the findings of the paired-sample t-test used to measure the difference in students' creative thinking abilities before and after playing *MathVenture*. The mean pre-test score was 8.0, while the mean post-test score rose to 13.0, reflecting an average increase of 5.0 points. The statistical results— $t = 5.00$  and  $p < 0.05$ —indicate that the improvement in test scores is statistically significant at the 95% confidence level. This confirms that the observed increase was not due to random chance, but rather a direct outcome of the game intervention.

These findings support the conclusion that *MathVenture* is effective in improving students' creative thinking skills. The statistically significant improvement reinforces that a game-based edutainment approach can have a meaningful impact on mathematics learning. This outcome aligns with prior research showing that educational games can boost student motivation and engagement in the learning process (Suh & Wagner, 2013; Hung, Kinshuk, & Chen, 2019; Ke, 2020; Sung, Chang, & Liu, 2022; Zheng, Li, & Tsai, 2020). The effectiveness test also demonstrated that the *MathVenture* intervention led to a measurable enhancement in students' creative thinking skills, as evidenced by higher post-test scores. Additionally, data from student perception surveys indicated that the game provided stimulating challenges that encouraged creativity and made mathematics learning more enjoyable.

## Discussion

The findings of this study align with a growing body of literature emphasizing the positive impact of technology-based learning media, particularly educational games, on student motivation and learning outcomes. Several previous studies have affirmed that interactive digital tools can significantly enhance students' academic engagement and performance. For instance, Chen et al. (2020) demonstrated that the integration of educational games in classroom settings improved both student engagement and academic achievement, findings that resonate with the significant post-test creativity gains observed after the implementation of *MathVenture*. Similarly, Nouri et al. (2019) reported that interactive media substantially improved conceptual understanding in mathematics, echoing this study's findings on the high perceived practicality of *MathVenture* by both students and teachers.

The effectiveness of *MathVenture* is theoretically underpinned by the principles of constructivist learning, which advocate for active student involvement in the learning process (Piaget, 1973; Vygotsky, 1978). Piaget emphasized the role of interaction and exploration in fostering understanding and creativity, a notion supported by the empirical evidence from this study that shows a marked increase in creative thinking scores following gameplay. Vygotsky (1978) highlighted the importance of social interaction in learning, a factor likely contributing to the favorable practicality evaluations by students, as the game may have facilitated collaborative and interactive learning experiences.

The second core assumption of this study—that instructional media aligned with curricular requirements and student characteristics would yield more effective learning outcomes—was also supported. The game *MathVenture* received high ratings for both content relevance and instructional quality, with average scores of 4.1 and 4.2, respectively. This supports prior research by Sweeney et al. (2019) and Pilli & Aksu (2021), which found that educational media tailored to curriculum standards and responsive to student feedback tend to produce better learning outcomes. Sweeney et al. (2019) showed that curriculum-aligned instructional tools that incorporate student feedback significantly improve learning, while Pilli & Aksu (2021) highlighted



the importance of integrating pedagogical content with effective instructional design to enhance media practicality and effectiveness.

In the context of this study, the success of MathVenture in fostering students' creative thinking skills can also be interpreted through motivational and engagement theories. Deci and Ryan's (2000) theory of intrinsic motivation posits that learners who perceive activities as enjoyable and challenging are more likely to engage deeply and perform better. The high practicality ratings from students suggest that MathVenture succeeded in creating an engaging and motivating learning environment. This interpretation is consistent with Randel et al. (2019), who found that engaging and interactive learning media positively influence student motivation, thereby contributing to enhanced cognitive outcomes such as creative thinking.

Collectively, the findings affirm that MathVenture is an effective educational tool for enhancing students' creativity and engagement in mathematics learning. The first assumption—that active engagement through educational gaming fosters creativity—is supported by both constructivist theories and empirical evidence from related studies (Hung et al., 2019; Ke, 2020; Kiili et al., 2022; Sung et al., 2022). The second assumption—that instructional media designed to align with curricular goals and student needs are more effective—is reinforced by studies on instructional design and learner motivation (Chen et al., 2020; Sweeney et al., 2019; Pilli & Aksu, 2021; Nouri et al., 2019; Randel et al., 2019).

These results contribute to the broader discourse on educational technology and its role in shaping modern pedagogy, particularly in the context of mathematics education. They underscore the potential of game-based learning to serve not only as an instructional supplement but also as a transformative medium for cultivating higher-order thinking skills such as creativity.

## CONCLUSION

In conclusion, this study demonstrates that *MathVenture*, a smartphone-based educational game, effectively enhances students' creative thinking and engagement in mathematics learning. The significant improvement in creativity scores post-intervention, as evidenced by paired t-test analysis, indicates the positive impact of game-based learning on cognitive skills. Furthermore, the high practicality ratings from both students and teachers highlight the game's usability and its alignment with curricular objectives, confirming its effectiveness as an instructional tool. These findings contribute to the growing body of research on the role of technology in education, emphasizing the potential of game-based learning to foster active engagement and improve learning outcomes. The results also support the theoretical foundations of constructivism and intrinsic motivation, further validating the design and effectiveness of *MathVenture* as a valuable educational resource.

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