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DEVELOPMENT OF THE KIDZ LAND EDUCATIONAL GAME TO IMPROVE MATHEMATICAL PROBLEM-SOLVING SKILLS AMONG SECOND GRADE ELEMENTARY SCHOOL STUDENTS

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ABSTRACT
This study aimed to develop Kidz Land, a game-based mathematics learning media for second-grade elementary school students, and to examine its validity, effectiveness, and practicality in supporting mathematical problem-solving skills. This research employed a Research and Development (R&D) design using the ADDIE model, consisting of five stages: analysis, design, development, implementation, and evaluation. The participants were 20 second-grade elementary school students. Data were collected through material and media expert validation sheets, pretest and posttest instruments, observation sheets, and teacher and student response questionnaires. The results showed that Kidz Land achieved validity scores of 75% from the material expert and 77.5% from the media expert, indicating that the developed media was suitable for use with minor revisions. The effectiveness analysis revealed a significant improvement in students' mathematical problem-solving scores, with the mean score increasing from 49.65 on the pretest to 86.60 on the posttest ($t(19) = -16.316$, $p < .001$). The normalized gain was 0.73, categorized as high. Practicality results indicated that students could operate the game easily and demonstrated high engagement during learning activities, while teachers reported that the media facilitated instruction. Therefore, Kidz Land is a valid, effective, and practical game-based learning medium for supporting elementary students' mathematical problem-solving skills. Further research should involve larger samples and comparison groups.

Keywords: *elementary school students, game-based learning, Kidz Land, mathematical problem-solving skills, mathematics learning media, Research and Development.*

1. Introduction

Mathematics is often perceived by students as a challenging subject, particularly when they encounter difficulties in solving mathematical problems. Hakim et al. (2022) reported that students' mathematical problem-solving skills remained relatively weak, as reflected in their difficulties applying appropriate mathematical procedures when completing tasks. This difficulty was associated with students' inadequate comprehension of the problems they encountered, which often led them to reproduce the questions rather than formulate and carry out appropriate solution strategies. Similar findings were reported by Mulyati (2016), who stated that Indonesian students continued to demonstrate relatively low competence in mathematical problem-solving. Supporting this view, Sari et al. (2020), based on interviews with fifth grade teachers and observations of classroom activities, identified students limited problem-solving skill as one of the significant difficulties encountered in mathematics instruction. Nevertheless, students' negative perceptions of mathematics may be addressed

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through suitable instructional approaches, including the incorporation of educational games into the learning process.

The low mathematics outcomes described above can be traced to at least two sources. The first is the persistence of misconceptions: when students memorize procedures without understanding the concept behind them, they cannot transfer what they know to an unfamiliar problem, even when the calculation itself is within reach. The second is weak reading comprehension. Solving a word problem requires learners to decode the text, form a mental picture of the situation, and only then choose an operation, and research shows that performance on word problems is closely tied to reading comprehension (Vilenius-Tuohimaa et al., 2008). Instruction that treats word problems as a purely numerical task leaves many students unable to represent the problem correctly in the first place (Boonen et al., 2016). This pattern is consistent with the problem-solving difficulties of elementary school students reported by Hakim et al. (2022).

These difficulties are especially pressing in the second grade. Children of about seven to eight years of age are generally in the concrete operational stage, so abstract symbols and long written problems are hard for them to handle unless the ideas are tied to objects, pictures, or actions. A meta-analysis of research on manipulatives showed that teaching mathematics with concrete materials produced better learning than instruction that relies on abstract symbols alone (Carbonneau et al., 2013). A well-designed digital game can fill a similar role. Characters, scenes, and level tasks turn a written problem into a situation the child can see and act on, and immediate feedback lets the child check each step. This is why *Kidz Land* was developed as a concrete, visual, and interactive bridge between everyday situations and mathematical problem-solving for second grade students.

The development of a mathematics-based game requires careful consideration of several important components. One fundamental aspect is an adequate understanding of the curriculum and competency standards governing mathematics education at the elementary school level (Julyananda et al., 2022). Such knowledge is necessary to ensure that the material incorporated into the game corresponds to the intended learning objectives. In addition, the development of the game should reflect the characteristics, developmental needs, and interests of elementary school students. The incorporation of attractive features, including challenges, reward systems, and flexible difficulty levels, may stimulate students' learning motivation and promote greater involvement in classroom activities (Ramadhan et al., 2023).

Beyond increasing engagement, mathematics games can create learning situations that are both interactive and enjoyable. The application of visual representations and simulations within games can assist students in comprehending mathematical ideas that are abstract or relatively complex (Novitasari & Kristin, 2021). Through puzzle-based activities or simulation games, for instance, students may develop their arithmetic skills, explore geometric principles, and apply mathematical reasoning to problems encountered in everyday situations. Nevertheless, producing an effective mathematics game requires a structured and comprehensive development procedure. This procedure generally involves determining learning requirements, formulating the game concept, preparing instructional content, conducting product trials, assessing the results, and subsequently refining the product. The participation of teachers and other relevant educational stakeholders is likewise important throughout the development process because their involvement can help ensure that the final product corresponds to actual educational requirements and expectations for mathematics learning in elementary schools (Sejati & Koeswanti, 2020).

A number of previous investigations into game-based learning media have demonstrated their potential to strengthen students' motivation, interest in learning, and academic performance in mathematics. Wildan et al. (2023), through a study entitled Development of GAULL (Wordwall Educational Game) Media on Three Dimensional Geometry Materials for Elementary School Students, developed a game oriented instructional medium intended to meet the criteria of validity, practicality, and effectiveness. The findings showed that GAULL obtained a high validity level based on assessments from material and media experts and was effective in facilitating the teaching of geometry at the elementary school level.

Karseno et al. (2021) conducted another study entitled Development of an Android Based Educational Game Media on Integer Topics for Sixth Grade Elementary School Students. The research originated from the problem of unsatisfactory mathematics learning outcomes, which was associated with the limited availability of instructional media during online learning. The resulting Android based educational game received an excellent assessment with respect to both validity and practicality. Consequently, the product was considered appropriate for application as a mathematics learning media.

Similarly, Enstein et al. (2022), in a study entitled Development of an Educational Learning Game on Exponents and Roots Using Genially, demonstrated the potential of web based instructional media to facilitate students' comprehension of mathematical concepts in a more accessible and engaging manner. The educational game was produced through the Game Development Life Cycle (GDLC) model, and expert evaluation results indicated that the developed product was feasible for implementation.

The research conducted by Oktaviani and Arini (2021), entitled Development of the Geometry Smart Choice Animation Game Media for Mathematics Learning in Elementary Schools, further provided evidence concerning the feasibility of game-based instructional media. The animation game developed in the study received a very high feasibility classification based on evaluations conducted by media experts, subject matter experts, information technology experts, as well as responses obtained from students. The findings also indicated that the media could support the creation of mathematics learning activities that were more engaging and interactive.

Moreover, Rofiqoh et al. (2020), through their research entitled Development of the Math Space Adventure Game as a Learning media for Fraction Topics in Elementary Schools, reported that the educational game fulfilled the required criteria of validity, practicality, and effectiveness. Its implementation in mathematics instruction on fraction materials was accompanied by an improvement in students' learning outcomes.

Evidence from outside Indonesia points in the same direction. Byun and Joung (2018) carried out a meta-analysis of digital game-based learning in K-12 mathematics education, and Tokac et al. (2019) combined 24 experimental and quasi experimental studies of PreK-12 students and found a small positive overall effect of game-based instruction on mathematics achievement, although the effect varied from study to study. More recent syntheses give a similar picture. Hussein et al. (2022) reviewed 43 articles on digital game-based learning in K-12 mathematics and found that most of them reported gains in knowledge acquisition, cognitive skills, and affective outcomes, whereas Hui and Mahmud (2023), who reviewed 28 open access articles published between 2018 and 2022, concluded that game-based learning benefited both the cognitive domain (knowledge and mathematical skills) and the affective domain (achievement, attitude, motivation, interest, and engagement). Hussein et al. (2022) also pointed out that little research has addressed twenty

first century skills such as creativity and critical thinking, which leaves room for studies that target higher order skills such as problem-solving in the early grades.

Taken collectively, the results of these earlier studies indicate that game-based educational media possess considerable potential for supporting improvements in the quality of mathematics instruction at the elementary school level. Previous studies have examined educational games in relation to students' learning outcomes, motivation, and the practicality of instructional media. Building on this research, the present study develops Kidz Land as an educational game designed to support mathematical problem-solving skills among second-grade elementary school students. Accordingly, this research is intended to contribute to the provision of mathematics learning media that are interactive and appealing while simultaneously supporting the development of students' critical thinking and mathematical problem-solving skills.

The successful application of mathematics games is also dependent on adequate teacher support and preparation. Teachers require sufficient knowledge and practical skills to integrate game-based activities effectively into classroom instruction, allowing the available media to be employed in accordance with the established learning objectives. In addition, the use of such games needs to be accompanied by systematic monitoring and periodic evaluation to determine their influence on students' conceptual understanding and academic performance (Pratiwi & Hardini, 2022). Thus, game-based mathematics learning media should not be viewed solely as a form of technological advancement. Rather, they represent a strategic instructional approach capable of contributing to improvements in learning quality and students' comprehension of mathematical concepts in elementary education.

The need to develop game-based learning media becomes increasingly relevant when considering the fundamental position of mathematics as a basis for acquiring more advanced knowledge at subsequent educational levels. The integration of technology with learning strategies that correspond to students' interests can make game-based mathematics instruction a potential response to various challenges encountered in the learning process. Such an approach may contribute to improving the overall quality of elementary education by providing students with learning experiences that are more engaging and meaningful. At the same time, the adoption of technology supported instructional media enables schools to respond to ongoing technological developments while helping students develop the competencies required to address challenges in the future.

Based on the background above, this study aimed (1) to develop Kidz Land, a game-based mathematics learning media for second-grade elementary school students, using the ADDIE model; (2) to assess the validity of the game based on evaluations by material and media experts; (3) to examine changes in students' mathematical problem-solving scores following the implementation of the game; and (4) to assess the practicality of the game based on classroom observations and responses from teachers and students.

2. Method

This study employed a mixed-methods approach within a Research and Development (R&D) framework, integrating quantitative and qualitative data. The purpose of this study was to develop Kidz Land, a mathematics educational game designed to improve the mathematical problem-solving skills of second-grade elementary school students. The development process focused on evaluating the validity and practicality of the game and examining changes in students' mathematical problem-solving scores following its implementation. Sugiyono (2021), as cited in Novyanti et al. (2019), explains that

development research is intended not only to produce a particular product but also to examine its effectiveness.

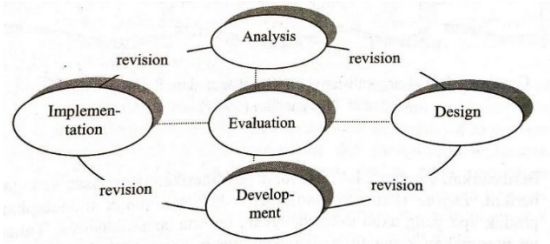


Figure 1. ADDIE Development Model Flowchart
Source: Sugiyono, *Educational Research Methods*, 2019.

The ADDIE model was adopted as the development framework in this study and comprised five stages: Analysis, Design, Development, Implementation, and Evaluation. This model was selected to guide the systematic development of the technology-based instructional media. In the Analysis stage, a needs assessment was conducted to examine learning requirements, school conditions, student characteristics, curriculum components, and mathematics topics to be incorporated into the educational game. This stage aimed to identify challenges in mathematics instruction among second-grade elementary school students, particularly those related to mathematical problem-solving skills.

The Design stage focused on developing the overall structure of the Kidz Land game, including its interface, gameplay sequence, instructional materials, questions, and supporting features. Research instruments were also prepared, including expert validation sheets, response questionnaires, and pretest and posttest items designed to measure students' mathematical problem-solving skills. Smart Apps Creator was used to develop the game as an interactive Android-based learning media for elementary school students. In the Development stage, the game design was transformed into a functional learning product. The product was then evaluated by media experts and subject-matter experts to assess the feasibility of its media components and instructional content.

In the Implementation stage, the Kidz Land game was tested with second-grade elementary school students and their classroom teacher. Before using the game, students completed a pretest to assess their initial mathematical problem-solving skills. After using the game, they completed a posttest to measure changes in their performance. Teachers and students also completed response questionnaires to provide feedback on the learning media. The final phase, Evaluation, was conducted by examining the overall quality of the developed media through validation findings, user responses, and changes in student learning outcomes. The information obtained from this stage was subsequently used to revise and improve the product.

Several instruments were utilized for data collection, including material expert validation sheets, media expert validation sheets, observation sheets, teacher and student response questionnaires, and mathematical problem-solving tests consisting of pretests and posttests. The validation instruments were intended to examine the validity of the developed media from the perspectives of instructional content and media design. Meanwhile, the response questionnaires were employed to determine the practicality of the learning media when used by teachers and students. The resulting dataset comprised quantitative and qualitative information. Quantitative data were derived from validation scores, questionnaire results, and student test scores, whereas qualitative information was obtained from the

comments, recommendations, and suggestions submitted by the validators concerning the developed product.

The research variable was the mathematical problem-solving skills of second grade students. Following the four steps of problem-solving proposed by Polya (1945), the skills were measured through four indicators: (1) understanding the problem, that is, identifying what is known and what is asked; (2) devising a plan, that is, choosing an operation or strategy that fits the situation; (3) carrying out the plan, that is, performing the calculation accurately and in the correct order; and (4) looking back, that is, checking the answer and stating a conclusion that fits the context of the problem. The pretest and posttest items were story problems on whole number arithmetic operations arranged according to these four indicators, and the scores were expressed on a scale of 0 to 100.

Quantitative and qualitative techniques were used to analyze the collected data. Quantitative analysis was conducted to assess the validity and practicality of the learning media and to examine changes in students' mathematical problem-solving scores. The normalized gain (N-gain) was calculated to measure the improvement in students' scores following the implementation of Kidz Land. The N-gain results were interpreted using the classification proposed by Hake (1999): high ($g > 0.7$), medium ($0.3 \leq g \leq 0.7$), and low ($g < 0.3$). In addition, a paired-samples t-test was used to examine the difference between students' pretest and posttest scores. Qualitative analysis focused on feedback and recommendations from validators, teachers, and students, which were used to inform revisions to the learning media.

3. Results and Discussions

3.1 Results

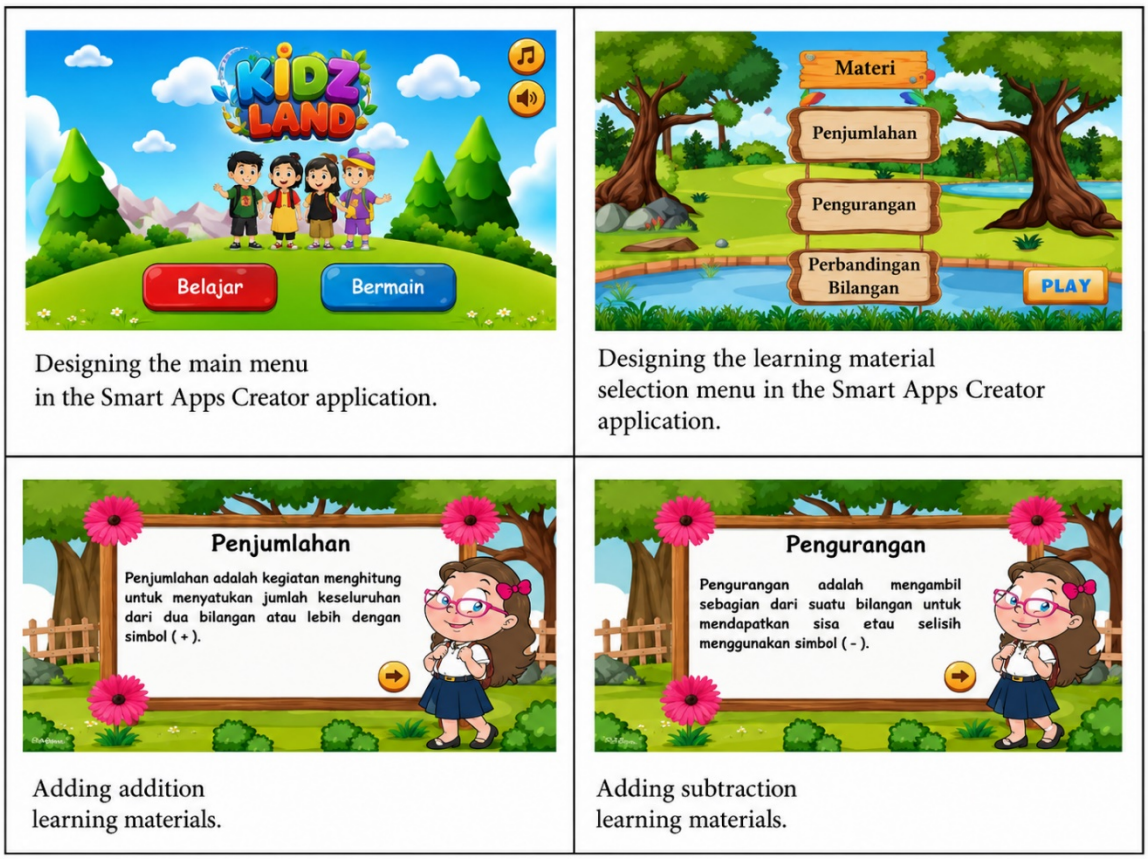
This study developed an educational game called Kidz Land to support the mathematical problem-solving skills of second-grade elementary school students. The development process followed the ADDIE model, comprising five stages: Analysis, Design, Development, Implementation, and Evaluation. The results include expert validation, pretest and posttest scores, and observations of the learning process.

The analysis stage confirmed the problems outlined in the background of this study. Mathematics instruction in the second-grade classrooms was still predominantly conventional and made limited use of interactive learning media, and students had difficulty understanding mathematical problem-solving tasks. This condition is consistent with earlier findings that young students often fail to grasp what a problem is asking and therefore cannot plan a solution, partly because understanding a word problem depends on reading comprehension (Hakim et al., 2022; Vilenius-Tuohimaa et al., 2008). The learning media in use did not match the characteristics of elementary school learners. Because second grade students are generally at the concrete operational stage of cognitive development, they require media that are visual, engaging, and interactive, so that a written problem can be presented in a form they can see and act on (Carbonneau et al., 2013). Based on the curriculum analysis, topics related to whole number arithmetic operations and simple problem-solving were considered appropriate for development into an educational game-based learning media, and these topics became the basis for the design of *Kidz Land*.

The design stage aimed to develop the initial blueprint of the *Kidz Land* game before it was transformed into the final product. At this stage, the researcher designed a game-based learning concept tailored to the characteristics of second grade elementary school students. The design process began with determining learning objectives based on the basic competencies and achievement indicators of mathematics learning. Subsequently, the

researcher developed learning materials and mathematical problem-solving questions to be integrated into the game.

Furthermore, the researcher designed the game flowchart, game levels, scoring system, and an attractive child friendly visual interface. The game interface was designed using bright colors, engaging animated characters, and simple language to ensure ease of understanding for students. At this stage, research instruments were also developed, including material expert validation sheets, pretest and posttest questions, and observation guidelines. These instruments were designed to assess the validity, effectiveness, and practicality of the *Kidz Land* game.



Designing the main menu in the Smart Apps Creator application.

Designing the learning material selection menu in the Smart Apps Creator application.

Adding addition learning materials.

Adding subtraction learning materials.

Figure 2. Kidz Land Game

The researcher used Smart Apps Creator as the software application for the development process. Subsequently, the researcher designed the initial concept and layout of the content to be delivered through the learning application. The development of the Kidz Land game began with selecting characters, background images that matched the storyline, font styles, music, and appropriate language usage. At this stage, the learning media design was adapted to the characteristics and needs of the students. The researcher also selected Smart Apps Creator as the primary software for developing the game. This initial concept and design remained at the conceptual stage and served as the foundation for further development of the learning media.

Figure 3. Kidz Land Game

The development stage represented the realization of the design that had previously been prepared. The Kidz Land game was developed as a game-based mathematics learning media that could be operated independently by students. The game consists of several levels, each containing mathematical problem-solving tasks. Each level was designed with progressively increasing difficulty to help students develop logical and systematic thinking skills. In addition, the game is equipped with a scoring system and feedback features that provide reinforcement and encouragement to students throughout the learning process.

Documentation of the Kidz Land game interface is presented in the form of screenshots in the appendices as physical evidence of the product development process.

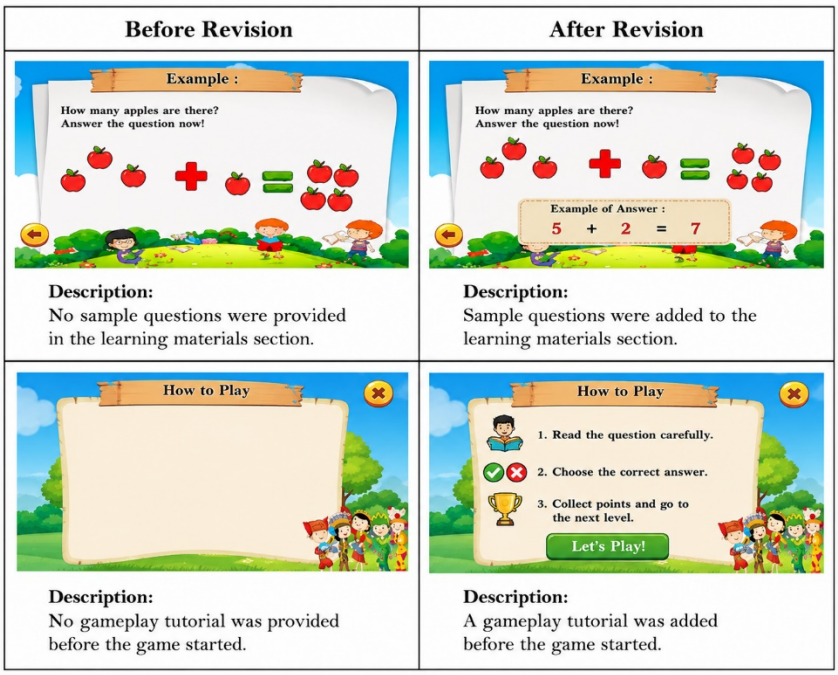


Figure 4. Kidz Land Game

The *Kidz Land* game was validated by both subject matter experts and media experts to determine the feasibility and quality of the developed product. The validation process included revisions based on the experts' suggestions and recommendations. The results before and after revision from the media experts are presented as follows:

The material expert validation yielded a score of 30 out of 40, equivalent to 75%, which was classified as "Good/Feasible." The assessment covered the alignment of the learning materials with the Core Competencies (KI) and Basic Competencies (KD), the suitability of the learning indicators, the organization of the content, and the extent to which students could understand mathematical concepts through the game.

Table 1. Material Expert Validation R1esults

Assessment Aspect	Score	Percentage	Category
Material and Learning Feasibility	30/40	75%	Good/Feasible

Source: Material Expert Validation Results

The media expert validation yielded a score of 31 out of 40, equivalent to 77.5%, which was categorized as "Good." The assessment indicated that the game had an attractive design, was appropriate for elementary school students, and was easy to use in mathematics learning. The validator also considered the game capable of stimulating students' curiosity.

Table 2. Media Expert Validation Results

Assessment Aspect	Score	Percentage	Category
Media Feasibility and Durability	31/40	77.5%	Good/Feasible

Source: Media Expert Validation Results

Pretest and posttest scores from 20 students in Class II A were analyzed to examine changes in mathematical problem-solving performance following the implementation of Kidz Land.

The mean score increased from 49.65 on the pretest to 86.60 on the posttest, representing an increase of 36.95 points. The standard deviation decreased from 11.891 to 7.549, indicating less variability in posttest scores than in pretest scores.

Table 3. Pretest and Posttest Statistical Results

Data	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	20	27	67	49,65	11,891
Posttest	20	67	98	86,60	7,549

Source: SPSS 26 Data Analysis Results (2026)

The results of the normality test using the Shapiro–Wilk test showed a significance value of 0.084 for the pretest and 0.268 for the posttest. However, the normality assumption for a paired-samples t-test should be assessed using the distribution of the paired difference scores. The paired-samples t-test indicated a statistically significant difference between the pretest and posttest scores, $t(19) = -16.316$, $p < .001$. The class-mean normalized gain was calculated as $(86.60 - 49.65) / (100 - 49.65) = 0.73$, which falls in the high-gain category according to Hake (1999). These results indicate that students' scores improved following the implementation of Kidz Land; however, the one-group pretest–posttest design does not establish that the game alone caused the improvement.

Table 4. Paired Sample t Test Results

Mean Difference	t	df	Sig. (2-tailed)
-36.950	-16.316	19	0.000

Source: SPSS 26 Data Analysis Results (2026)

During the implementation stage, students showed enthusiasm while using Kidz Land in mathematics lessons. They actively engaged with the challenges at each game level, while the teacher facilitated the learning activities. Classroom observations suggested that the game was easy to use and supported an engaging learning environment.

3.2 Discussion

3.2.1. The Kidz Land Game in Mathematics Learning at Karangkancana Elementary School, Kuningan

The development of the *Kidz Land* game was carried out based on the results of a needs analysis and the characteristics of second grade elementary school students. The analysis indicated that students at this level were interested in play-based activities and visual, interactive learning media. These findings informed the development of Kidz Land as a game-based learning medium for mathematics. This approach is consistent with Absar et al. (2025), who reported that game-based learning can support elementary school students' motivation through enjoyable and interactive learning experiences. Aulia and Indrapangastuti (2025) also discussed the potential of game-based learning to support students' interest and learning outcomes. Accordingly, Kidz Land was designed to present mathematical content through interactive challenges and gameplay.

The interpretation of the development findings indicates that *Kidz Land* was designed to accommodate the cognitive development stage of second grade elementary school students, who are generally in the concrete operational stage. At this stage, students require learning experiences that are visual, contextual, and involve direct activities. Game

elements such as levels, scores, animations, and simple challenges in *Kidz Land* help students understand mathematical concepts gradually and concretely. These findings are supported by Amelia and Purbanyati (2025), who explained that the implementation of game-based learning in mathematics instruction can assist students in understanding concepts more gradually through engaging problem-solving activities. In addition, Karina (2025) stated that the use of game-based learning media in mathematics can improve conceptual understanding and learning outcomes among elementary school students. Thus, the game provides an interactive context in which students can engage with mathematical concepts through play.

These findings are closely related to constructivist learning theory, which emphasizes that knowledge is actively constructed by learners through learning experiences. In the context of *Kidz Land*, students do not merely receive information passively; instead, they actively engage in the process of solving mathematical problems through gameplay. This is consistent with Piaget's view that learning becomes more meaningful when students actively participate and gain learning experiences that are appropriate to their developmental stage. Research conducted by Aryati, Mualimah, Araina, and Putri (2025) also demonstrated that game-based learning supports the constructivist approach because students learn through direct interaction, experience, and exploration. Furthermore, Jusrianto et al. (2025) explained that twenty first century learning based on digital technology and educational games can strengthen students' active involvement in constructing knowledge. The *Kidz Land* game provides opportunities for students to explore, experiment, and learn independently from their mistakes, thereby providing opportunities for active engagement with mathematical tasks.

Furthermore, the development of *Kidz Land* is also consistent with learning motivation theory, particularly the theory of intrinsic motivation. Game-based learning media can foster learning motivation by providing challenges, stimulating curiosity, and offering immediate feedback to students. Reward elements, such as scores and level progression in *Kidz Land*, encourage students to continue attempting and completing mathematics problems without feeling pressured. Research conducted by Absar et al. (2025) demonstrated that game-based learning has a positive effect on students' learning motivation because it creates a learning environment that is both competitive and enjoyable. Similarly, Aditama (2025) reported that computer assisted learning and educational games can improve both learning effectiveness and student motivation at the elementary school level. Therefore, this game supports the development of learning motivation that originates from within the students themselves.

When compared with previous studies, the development of *Kidz Land* is consistent with the research conducted by Wildan et al. (2023), who developed the GAULL (Wordwall Educational Game) learning media for elementary school students. That study was motivated by the continued dominance of conventional learning media and students' low interest in mathematics learning. The similarity between the two studies lies in the objective of developing game-based learning media tailored to the characteristics of elementary school students and designed to increase student engagement in mathematics learning. Several previous studies have shown that educational games can help students understand mathematical concepts more easily and enjoyably, particularly at the elementary school level. These similarities strengthen the argument that *Kidz Land* is a relevant learning media that meets the needs of second grade elementary school students.

The distinction between the development of *Kidz Land* and previous studies lies in its adaptation to the curriculum and the local characteristics of students, as well as the

design of progressive game levels that correspond to students' skills. The game was developed not only to improve learning outcomes but also to train students' mathematical problem-solving skills in a simple and systematic manner. Therefore, *Kidz Land* offers advantages as a learning media that is not only visually appealing but also grounded in strong pedagogical principles and aligned with the needs of mathematics learning in elementary schools.

The same direction is visible at the international level. Hussein et al. (2022) reviewed 43 articles on digital game-based learning in K-12 mathematics and reported that most of them found gains in knowledge, cognitive skills, and affective outcomes, that arithmetic operations were a topic of particular interest, and that a considerable number of the games were built on a specific design feature or learning theory. *Kidz Land* follows this pattern, since it addresses arithmetic operations and rests on constructivist and concrete learning principles. The same review also noted the scarcity of research on twenty first century skills such as creativity and critical thinking, and by targeting mathematical problem-solving, *Kidz Land* contributes to this line of work.

3.2.2. The Validity of the *Kidz Land* Game in Mathematics Learning at Karangkancana Elementary School, Kuningan

The validity of the *Kidz Land* game was determined based on the assessment conducted by subject matter experts who evaluated the alignment of the learning content with established educational standards. The validation results indicated that the materials presented in the game met the feasibility criteria for use as a mathematics learning media for second grade elementary school students. This finding suggests that the instructional content was systematically developed and is relevant to students' learning needs, making it suitable for supporting classroom learning activities. These findings are consistent with the study conducted by Hayati and Ramadhani (2025), which stated that mathematics educational game media can be considered valid when the content, media design, and presentation are aligned with the learning needs of elementary school students. Furthermore, Adnyana (2025) explained that mathematics educational games developed based on curriculum requirements and learning objectives demonstrate a high level of validity and are therefore appropriate for implementation in elementary schools.

The interpretation of the validation results indicates that the learning materials contained in the *Kidz Land* game have been aligned with the applicable curriculum, learning objectives, and competency achievement indicators. The materials were organized progressively and presented through game activities that correspond to the cognitive skills of second grade students. Consequently, the game not only provides mathematics exercises but also assists students in understanding mathematical concepts in a structured and comprehensible manner. This finding is supported by the study of Islami and Rachmawati (2025), which concluded that educational game-based learning media developed according to curriculum requirements and student characteristics can improve students' conceptual understanding of mathematics more effectively. Similarly, Ratnasari and Suastika (2025) found that game-based learning media designed according to learning indicators can help students understand instructional content gradually and in a more engaging way.

These validity findings are closely related to learning media development theory, which emphasizes the importance of alignment among learning materials, instructional objectives, and learner characteristics. According to instructional design theory, effective learning media should support the achievement of learning objectives and be developed based on the competencies that students are expected to attain. The *Kidz Land* game fulfills these principles by presenting relevant learning materials that are appropriate to the

developmental stage of elementary school students. This finding is in line with the study conducted by Wahyudi et al. (2025), which stated that educational game-based learning media can be considered valid when the content, visual design, and learning activities are aligned with students' competencies and the applicable curriculum. In addition, Hidayanti et al. (2025) explained that digital learning media designed according to the needs of elementary school students can improve the quality of mathematics instruction.

Furthermore, the validity of the learning materials contained in the *Kidz Land* game reflects the implementation of meaningful learning principles. The materials are presented through contextual and engaging game activities, enabling students to construct conceptual understanding through enjoyable learning experiences. This is consistent with learning theories that emphasize that instruction becomes more effective when content is presented in a contextualized manner and actively involves learners in the learning process. Wulandari et al. (2025) found that interactive educational game-based media can create more meaningful learning experiences because students are actively engaged throughout the learning process. When compared with previous studies, the validity results of the *Kidz Land* game are consistent with findings indicating that educational game-based learning media can be considered valid when the instructional content is developed in accordance with the curriculum and learning indicators (Hayati & Ramadhani, 2025; Adnyana, 2025).

A previous study conducted by Karseno et al. (2021) developed an Android based educational game for teaching integer concepts to sixth grade elementary school students. The study demonstrated that the developed learning media achieved a very high level of validity based on evaluations conducted by both subject matter experts and media experts. The similarity between that study and the present research lies in the validation process, which involved expert evaluations to assess the alignment of the learning content with curriculum requirements and instructional objectives. This finding highlights the importance of expert validation as a critical step in ensuring the quality and feasibility of game-based learning media before their implementation in educational settings. However, the distinction between *Kidz Land* and the learning media developed in previous studies lies in its more interactive presentation of learning materials through a system of levels and challenges that are tailored to students' skills.

The validity results indicate that the game not only meets content standards but also successfully integrates pedagogical principles and game elements in a balanced manner. Therefore, the *Kidz Land* game can be considered feasible and ready for implementation as a mathematics learning media for second grade elementary school students.

3.2.3. The Effectiveness of the *Kidz Land* Game in Mathematics Learning at Karangkancana Elementary School, Kuningan

The effectiveness of Kidz Land was examined by comparing students' pretest and posttest scores. The results showed an increase in students' mathematical problem-solving scores following the implementation of the game. This finding suggests that Kidz Land may support students' performance on mathematical problem-solving tasks.

One possible explanation for the observed improvement is that the game provides structured mathematical challenges that require students to work through problems. Through gameplay activities that require students to solve mathematical challenges at each level, students are trained to understand problems, determine appropriate solution strategies, and independently arrive at solutions. These activities may provide opportunities for students to practise mathematical problem-solving strategies.

These effectiveness findings are closely related to active learning theory, which emphasizes that learning becomes more effective when students are directly involved in

the learning process. The *Kidz Land* game provides students with opportunities to interact with learning materials through play based learning activities, allowing them not only to receive information passively but also to actively engage in problem-solving processes. This interpretation is consistent with the emphasis of active learning theory on students' direct involvement in learning activities.

Furthermore, the effectiveness of the *Kidz Land* game can also be explained through the perspective of Problem Based Learning (PBL) theory. In the game, students are presented with mathematical problems that must be solved in order to progress to the next level. This learning process encourages students to analyze problems, apply their prior knowledge, and develop appropriate solution strategies. As a result, students become more accustomed to solving mathematical problems independently, which ultimately contributes to the improvement of their mathematical problem-solving skills.

When compared with previous studies, these findings are consistent with numerous research results indicating that the use of educational games in mathematics learning can improve both problem-solving skills and learning outcomes among elementary school students.

Rofiqoh et al. (2020) developed the Math Space Adventure game for teaching fractions in elementary school and reported improvements in students' learning outcomes based on pretest and posttest comparisons. The similarity between these findings and the present results suggests that educational games may provide a useful format for presenting mathematical tasks to elementary school students.

The difference between the findings of this study and those of previous research lies in the specific competency being developed, namely mathematical problem-solving skills among second grade elementary school students through a level-based game designed according to students' developmental characteristics. The present study focuses specifically on the use of Kidz Land to support mathematical problem-solving performance among second-grade elementary school students.

The size of the improvement should also be read against international evidence. Tokac et al. (2019) reported only a small average effect of game-based learning on mathematics achievement across 24 studies, while Hui and Mahmud (2023) concluded that game-based learning supports mathematical skills as well as motivation and engagement. The gain found in this study, from a mean of 49.65 to 86.60, is considerably larger than the small average effect reported by Tokac et al. (2019). The findings should be interpreted in light of several limitations. The study involved only 20 students from one class and used a one-group pretest–posttest design without a control group. The observed improvement may also reflect familiarity with the test or the novelty of the game. Further research involving larger samples and a comparison group is needed to examine the effectiveness of Kidz Land more conclusively.

3.2.4. The Practicality of the *Kidz Land* Game in Mathematics Learning at Karangkancana Elementary School, Kuningan

The practicality of the *Kidz Land* game can be observed from the results of classroom observations conducted during the learning process. Based on the observation findings, students were able to operate the game easily without experiencing significant difficulties. The simple interface, clear instructions, and structured gameplay appeared to support students' use of the game during mathematics lessons.

Kidz Land was refined through the ADDIE stages based on expert and user feedback. The final product can be accessed online and offline and can be used individually or in small groups, providing flexibility for classroom activities.

The interpretation of these findings suggests that the *Kidz Land* game was designed in accordance with the characteristics and skills of elementary school students. Classroom observations indicated that students showed enthusiasm, actively engaged with the game's challenges, and expressed interest in progressing to subsequent levels.

This condition indicates that the game is not only easy to use but also capable of creating an enjoyable learning environment. In addition to students' responses, the practicality of the *Kidz Land* game was also reflected in teachers' feedback throughout the learning process. Teacher feedback suggested that Kidz Land could support the delivery of mathematics instruction and the presentation of mathematical concepts. These responses, together with classroom observations, provide preliminary evidence of the game's usability in the trial setting.

These findings are closely related to the theory of learning media practicality, which states that a learning media can be considered practical when it is easy to use, does not require specialized skills, and can be implemented directly in the learning process. The *Kidz Land* game fulfills these criteria because it can be used without complicated procedures and can be seamlessly integrated into classroom learning activities.

When compared with previous studies, the practicality results of the *Kidz Land* game are consistent with research findings indicating that educational game-based learning media tend to be practical because they are interactive and engaging for elementary school students. The findings can be considered alongside Enstein et al. (2022), who developed a web-based mathematics educational game using Genially and reported that the media were feasible and easy to use. Similarly, Oktaviani and Arini (2021) reported positive student responses to animation-based game learning media. The similarity between these studies and the present research lies in the ease of use of the learning media and the positive responses from users, both of which serve as primary indicators of learning media practicality.

The difference between the practicality of *Kidz Land* and the media developed in previous studies lies in the simplicity of its design and the suitability of its features for the needs of second grade elementary school students. The game was intentionally designed without overly complex features, making it easy for young learners to operate independently. Therefore, the *Kidz Land* game can be considered practical for use in mathematics learning and has strong potential for broader implementation in elementary schools.

4. Conclusions

Based on the results of the research and development process, Kidz Land was developed as a mathematics learning medium for second-grade elementary school students using the ADDIE model, which comprises five stages. The Analysis stage identified the learning needs, student characteristics, and suitable curriculum content; the Design stage produced the blueprint of the game, including its flowchart, levels, scoring system, and research instruments; the Development stage turned the design into a working product and subjected it to validation by material and media experts; the Implementation stage tried out the game with second grade students and their teacher; and the Evaluation stage reviewed the validation results, test scores, and user responses to refine the product. The validation results indicated that Kidz Land received positive assessments from the material and media experts. Students' mean mathematical problem-solving scores increased from 49.65 on the pretest to 86.60 on the posttest, representing an increase of 36.95 points. A paired-samples t-test indicated a statistically significant difference between the two measurements, $t(19) = -16.316$, $p < .001$. The media was also found to be practical, as students were able to

operate the game easily and showed high levels of enthusiasm throughout the learning process, while teachers reported that the game assisted them in delivering instructional content. Therefore, the *Kidz Land* game can be utilized as an interactive and engaging mathematics learning media that effectively enhances the mathematical problem-solving skills of second grade elementary school students.

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