Development of MEOM-Based Digital Learning Media Using (GBL) to Improve Mathematical Problem-Solving Skills of Grade 5 Primary School Students

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ABSTRACT

This research to develop, assess the feasibility, and evaluate the effectiveness of the MEOM digital learning media based on Game-Based Learning (GBL) to improve the mathematical problem-solving skills of Grade 5 primary school students. The development process used the Research and Development (RnD) method with the Four-D (4D) model, consisting of the Define, Design, Develop, and Disseminate stages. Expert validation indicated that the media is highly feasible based on evaluations from media experts (91%), content experts (87.5%), and language experts (80%). Both limited and expanded feasibility tests showed highly feasible results, with average percentages above 88%. A preliminary practicality test conducted in three schools (SDS Taruna Mandiri, SDIT Al-Lauzah, and SDI Kaffah) revealed a feasibility rate above 94%. The effectiveness test showed a significant improvement in students' mathematical problem-solving skills, with higher post-test scores compared to pre-test scores in the experimental class. The Mann-Whitney statistical test yielded a significance value of 0.000 (<0.05), indicating a significant difference between the control and experimental groups. Thus, the MEOM digital learning media based on GBL is effective and feasible to be used as a learning tool for mathematics in primary schools.

INTRODUCTION

Science and technology in the field of education continue to evolve as renewed innovations. In the learning process, technology plays a crucial role as a tool to support teaching and learning activities in schools. The utilization of technology is essentially intended to simplify human tasks in daily life. One example of this is the emergence of instructional delivery tools known as Computer-Assisted Instruction (CAI). The advancement of technology in the educational field signifies that, on a global scale, education is entering the era of Society 5.0, which significantly influences both the dissemination of information and the learning process in schools. Teaching materials and learning media that were once delivered manually have now shifted into digital formats [1]. Teachers' technological proficiency is a fundamental requirement, as it reflects their readiness to facilitate meaningful learning experiences for students. Moreover, technological literacy is one of the core competencies that teachers must possess in the 21st century, including information, media, and technology skills. This encompasses information literacy, media literacy, and ICT (Information and Communication Technologies) literacy [2]. In addition, a teacher's ability to master and utilize technology can support the implementation of the curriculum, improve the quality of instruction, and bridge the gap between students and the information they need. Technologically skilled teachers can deliver learning materials in more interactive, visual, and contextual ways, which significantly enhances students' interest and motivation to learn [3]. Game-Based Learning (GBL) is one alternative that has gained popularity among students in schools. The games referred to here are educational games designed to serve as tools that motivate students by stimulating curiosity and interest [4]. GBL incorporates game elements into instructional methods, creating an engaging and enjoyable learning

experience that fosters students' enthusiasm. The implementation of GBL has shown a positive impact on mathematics learning, particularly at the primary school level.

LITERATURERIVIEW

Theoretical Framework

Mathematical problem-solving ability is a fundamental skill that students must acquire in mathematics education, as it enables them to think critically, reason logically, and apply their knowledge to solve real-life problems they encounter [5]. According to Polya (1957), the process of mathematical problem-solving consists of four essential steps: understanding the problem, devising a plan, carrying out the plan, and reviewing or reflecting on the solution [6]. Learning media are defined as elements of learning resources that contain instructional materials within the student's environment and are designed to stimulate learning [7]. One approach that has shown promise in increasing learning effectiveness is Game-Based Learning (GBL). GBL is a learning method that utilizes games or game applications specifically designed to support the learning process. According to Pivec (2003), four key elements characterize GBL-based media: fantasy, curiosity, challenge, and control. In line with cognitive development theory, Piaget stated that children at this stage are in the concrete operational phase, where logical thinking begins to replace intuitive reasoning. Concepts that were previously unclear become more understandable. Children begin to think rationally and perform logical activities, although still limited to tangible objects and real-life situations [8].

Previous Research

Several prior studies support the development of game-based and digital learning media. García [9] emphasized that mathematics is not only about counting and memorizing but also about mental processes that support problem-solving. Haleem [10] explained that digital technology in education helps students learn independently and improves critical thinking through digital tools. Ramaila and Mpinga [11] found that digital learning significantly increased students' academic performance and motivation. Students became more engaged and motivated through instant feedback and well-integrated digital resources. Fokides [12] showed that students who used digital educational games performed better than those taught with traditional methods. The experimental group had higher average scores across different grade levels. Gorev [13] suggested that puzzles could be an effective tool in math learning, helping students develop logical thinking, abstraction, and combinatorial skills. Traditional teaching was seen as less engaging. Hsiao [14] confirmed that Digital Game-Based Learning (DGBL) had a positive impact on children's creativity and manual skills, showing significant improvement compared to traditional instruction. These studies support the use of interactive, game-based, and digital approaches in mathematics education to improve students' problem-solving skills and engagement.

Gap Analysis

Although numerous studies explore GBL or digital learning independently, few examine the integration of escape room-style games into digital media for mathematical problem-solving at the primary level. Prior research mainly focuses on the psychological impact of digital learning, such as reducing anxiety or improving motivation. Studies integrating gamification with mathematics often neglect structured development processes and subject-specific applications. This research bridges that gap by developing a structured, validated, and effective digital media specifically tailored to the mathematical problem-solving context for Grade 5 students.

METHODOLOGY

The research conducted in this study is categorized as Research and Development (R&D), which focuses on developing a product that can be utilized in the learning process. R&D serves as a method to refine or enhance existing products to make them more effective for educational use [15]. The development process employed the 4-D model, consisting of four stages: Define, Design, Develop, and Disseminate. The study was conducted at three primary schools located in South Tangerang City, Banten Province: SDS Taruna Mandiri, SDI Kaffah, and SDIT Al-Lauzah.

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RESULTS AND DISCUSSION

Validation Results

The MEOM digital learning media underwent validation by three experts: media, content, and language. The media expert provided a feasibility score of 91%, indicating an "excellent" rating. The content expert gave a score of 87.5%, while the language expert rated it at 80%, both categorized as "very feasible". These results confirm that the MEOM media is valid and suitable for classroom use.

Feasibility Testing

Feasibility tests were conducted in two phases: limited and expanded trials. In the limited trial, teachers and students evaluated MEOM and provided an average feasibility score of over 88%. The expanded trial, carried out in three schools (SDS Taruna Mandiri, SDIT Al-Lauzah, and SDI Kaffah), showed an even higher average feasibility score of 94%, reflecting strong positive responses in terms of usability, interest, and ease of use.

Effectiveness Testing

Effectiveness was assessed using pre-test and post-test results in experimental and control groups. The experimental group, which used the MEOM media, showed a significant increase in their post-test scores compared to the control group. The Mann–Whitney U test yielded a p-value of 0.000 (< 0.05), indicating a statistically significant difference between the two groups. This result confirms that the MEOM digital media had a positive effect on students' mathematical problem-solving abilities.

DISCUSSION

The findings align with previous studies emphasizing the effectiveness of game-based digital media in education (Fokides, 2018; Ramaila & Mpinga, 2022). The MEOM media integrates game-based learning (GBL) principles that support student engagement, motivation, and active learning. Furthermore, its design based on Polya's problem-solving steps (understanding the problem, devising a plan, carrying out the plan, and looking back) reinforces mathematical reasoning and structured thinking. The significant improvement in students' performance demonstrates that GBL-oriented digital media can address common classroom challenges, such as low motivation and difficulty in abstract problem-solving. By presenting content in a narrative, interactive escape-room format, MEOM fosters deeper student involvement and makes mathematical learning more enjoyable and effective.

CONCLUSION

This study concludes that the MEOM digital learning media based on Game-Based Learning (GBL) is both feasible and effective for enhancing the mathematical problem-solving skills of Grade 5 primary school students. The development process, guided by the Four-D model (Define, Design, Develop, and Disseminate), yielded a product that was validated by media, content, and language experts with excellent ratings. Feasibility tests at various stages, as well as the effectiveness test using statistical analysis, demonstrated a significant improvement in students' performance after using MEOM. The digital media not only facilitated interactive and enjoyable learning experiences but also supported the achievement of critical thinking and problem-solving competencies in mathematics.

RECOMMENDATIONS

Based on the findings of this research, the following recommendations are proposed, For Teachers: Integrate MEOM into regular mathematics instruction to enhance student engagement and comprehension through interactive, game-based activities. For Schools: Support the implementation of digital learning media by providing necessary infrastructure, training, and policy encouragement, especially for 21st-century learning skills. For Educational Developers: Further improve MEOM by expanding its content to cover broader mathematical concepts and adapting it for different grade levels or learning needs. For Future Research: Conduct

broader trials in diverse educational settings and explore the long-term impact of GBL-based digital media on students' cognitive and affective learning outcomes.

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