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Original Article

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Digital Educational Games (GICAME): The Need and Urgency of STEAM-Based Literacy Learning

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Abstract

In the digital age, literacy has become a crucial skill that must be taught to elementary school students. It is essential to equip students with strong reading and writing abilities by integrating technological advancements, such as game-based learning media. This study aims to analyze the need and urgency of developing STEAM-based digital educational games for literacy instruction. A mixed-methods approach (both qualitative and quantitative) was employed, with 100 fifth-grade students and 25 teachers from SDN Pakel Sub-district as research participants. Data were collected through four techniques: questionnaires, interviews, observations, and literature reviews. Descriptive statistics were applied to analyze quantitative data, while triangulation was used for qualitative data. The findings reveal a significant need and urgency to develop STEAM-based digital educational games, as they enhance the literacy learning process by making it more interactive. This approach can accelerate the mastery of reading and writing skills, preparing students to face the challenges of the digital era. The study concludes that the development of STEAM-based digital educational games offers an innovative approach to improving literacy instruction and can serve as a foundation for future research in this area.

1. Introduction

Literacy in primary school is a key foundation in the development of students' cognitive and academic abilities. Under ideal conditions, every student in primary school is able to read fluently and comprehend texts in depth, as well as write clearly and structurally (Laila et al., 2021; Maharani et al., 2023). However, in reality, many students still have difficulty understanding reading and expressing ideas through writing (Kurniasih, 2020; Mailida et al., 2023; Yulistiani & Indihadi, 2020). Factors such as lack of access to innovative media, less varied teaching approaches, and limited time for reading and writing practice are the main challenges (Suparya, 2021). To overcome this problem, a more interactive and fun approach needs to be implemented by providing access to innovative and interesting media and giving more space for students to practice reading and writing regularly (Wibowo et al., 2020). By utilizing technology-based media, literacy learning can be more fun and relevant, and encourage students to be more active in developing their literacy skills (Rachmawati et al., 2023; Rahayu et al., 2023).

Based on the results of observations on May 1-7, 2024, at SDN Pakel Sub-district, the school has adequate technology facilities, such as LCD projectors, laptops, and wifi connections that should support the learning process. However, teachers have not fully utilized these facilities optimally. In order for students to learn with enthusiasm and passion, teachers need to choose learning media that is in accordance with the characteristics of the students (Fajri et al., 2021; Maulani et al., 2022). However, students still have difficulty in understanding the material because the media used seems monotonous and lacks interactive elements or games, which makes students feel bored and uncomfortable. This is evident in literacy learning in

grade V at SDN Pakel Sub-district, where teachers have not adapted the right approach by utilizing technology to the fullest which has an impact on students' low literacy skills. For this reason, the development of technology-based learning media is needed as an effective solution to create learning that is more interesting, interactive and relevant to students' needs (Agustin et al., 2021; Windawati & Koeswanti, 2021).

STEAM (Science, Technology, Engineering, Art, and Mathematics) is a learning method that ideally integrates various disciplines to provide a holistic learning experience and prepare students to solve real problems in creative and innovative ways (Rodiana, 2022; Sa'ida, 2021). Under ideal conditions, this approach teaches students to connect knowledge from different fields to solve complex challenges they face in everyday life. However, the application of the STEAM approach in schools is still relatively low, so many students struggle to utilize the knowledge and skills they learn to solve practical problems outside the classroom (Agusniatih & Muliana, 2022; Akmal & Asikin, 2022). One of the main problems is teachers' lack of understanding on how to integrate STEAM in learning (Parniati et al., 2021; Rodiana, 2022). To overcome this, teachers must understand the application of the STEAM approach in learning as a solution to improve the quality of learning and improve students' ability to solve problems more precisely (Sa'ida, 2021).

The digital era is characterized by the rapid development of technology, which has brought devices such as smartphones connected to the internet, allowing easier and faster access to information, including in the context of learning (Purnasari & Sadewo, 2021; Sitompul, 2022). Technology-based media can now be utilized to encourage active and interactive student involvement in the learning process, making it more interesting and fun (Manurung, 2021; Rachmawati et al., 2023). However, despite the great potential of technology, the use of technology-based media in learning is often less than optimal due to the limited knowledge and skills of teachers in utilizing it (Habib et al., 2020). This causes students to have difficulty understanding the material and find learning monotonous and boring. For this reason, it is important for teachers to understand and master effective ways of utilizing technology-based media, so that the learning process becomes more interesting and educational goals can be achieved optimally (Ginting, 2021; Rubiantica et al., 2021; Wahyudi et al., 2023).

Digital educational games are ideal learning media that utilize technology to make the learning process more fun and interesting (Jayanti et al., 2021; Rachmawati et al., 2023; Sulistyarini & Fatonah, 2022). Digital educational games can now be easily accessed by students and teachers through internet services, providing opportunities for students to learn in a fun and non-boring way. However, in reality, the utilization of digital educational games in learning is still limited, so many students feel bored and have difficulty in understanding the material being taught (Hasanah et al., 2023; Nabilah et al., 2023; Rohmatin, 2023). The use of digital educational games that have not been optimized causes a lack of student involvement in the learning process and low understanding of the material presented. As a solution, integrating digital educational games that are relevant to the curriculum can help students more easily understand and remember the material (Fajri et al., 2021; Laila et al., 2021). This will also accelerate the achievement of literacy skills, as digital educational games can make learning more interactive and fun (Sulistyarini & Fatonah, 2022; Windawati & Koeswanti, 2021).

In conclusion, although literacy in primary school is an important skill, many students still have difficulty understanding the material and writing well. This is due to the lack of utilization of technology in learning and the low implementation of the STEAM approach. To overcome this problem, teachers need to utilize technology-based media such as digital educational games to make learning more interesting and interactive. In addition, teachers must be able to use technology and the STEAM approach appropriately in order to improve the quality of learning and students' literacy skills. Thus, more innovative and relevant learning can help students overcome literacy challenges more effectively.

2. Materials and Methods

This study aims to analyze the need and urgency of developing STEAM-based digital educational game learning media to improve students' literacy skills. This research uses a mixed method, which is a combination of qualitative and quantitative methods to analyze complex social conditions and can be classified (Damayanti et al., 2023). This research was conducted in five elementary schools in Pakel Sub-district, including 1) SDN 1 Pakel, 2) SDN 1 Bangunmulyo, 3) SDN 2 Bangunmulyo, 4) SDN 1 Tamban, and 5) SDN 2 Tamban with 100 fifth grade students and 25 teachers as subjects. Data collection techniques were 1) student and teacher questionnaires, 2) teacher interviews, 3) observations, and 4) literature review. Quantitative data were obtained through questionnaires, while qualitative data were obtained through interviews, observations and literature review. The data analysis technique used descriptive statistics using a Likert scale on quantitative data and triangulation on qualitative data. The following are the Likert scale criteria for quantitative data (Cahyono & Irwanto, 2022).

Table 1. Likert Scale Criteria.

Value	Criteria
86% - 100%	Very good
66% - 85%	Good
51% - 65%	Fairly Good
36% - 50%	Not Good
20% - 35%	Not Very Good

In qualitative data, data analysis is carried out using triangulation techniques with stages 1) data reduction, 2) data presentation, and 3) conclusion drawing (Sa'adah et al., 2022). The results of the analysis of the two data are compared and connected so that conclusions can be used as research results.

3. Results

3.1. Media Development Needs

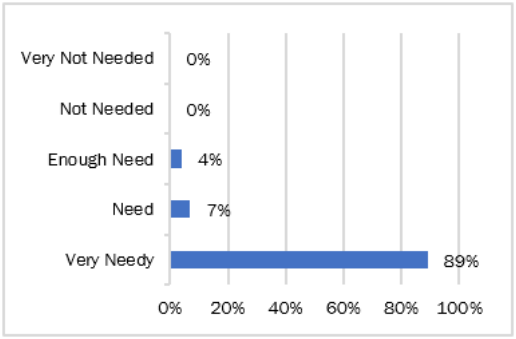
The development of STEAM-based digital educational games is crucial for enhancing learning effectiveness in the digital age, particularly in improving students' literacy skills. Through the analysis of needs and urgency questionnaires administered to students and teachers, along with teacher interviews, observations, and a literature review, an overview was gained regarding how well STEAM-based digital educational game learning media currently support the literacy learning process. The needseds questionnaire for the development of these games covered four main components: media understanding, carrying capacity, challenges, and student learning outcomes. The following outlines the findings from the media development needs questionnaire completed by students and teachers.

Table 2. Result of the need for the development of STEAM-based digital educational games,

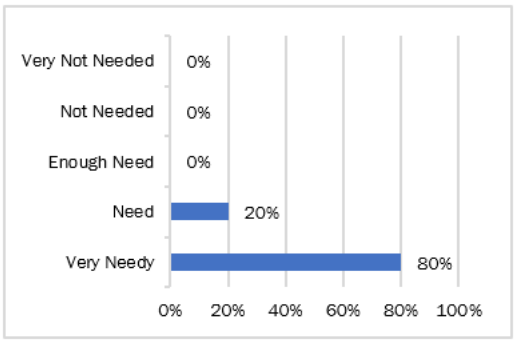
Respondents	Score	Decision
Students	89,8%	Very Needy
Teacher	90,3%	Very Needy

Table 2 presents the results of the questionnaire administered to both students and teachers regarding the need for the development of STEAM-based digital educational games, which were found to be highly significant. The student questionnaire yielded a result of 89.8%, categorized as "very needed," while the teacher questionnaire showed a slightly higher value of 90.3%, also falling within the "very needed" category. The combined average of the student and teacher questionnaire results was 90.1%, highlighting the strong demand for this media to support students' literacy learning.

These findings emphasize the importance of introducing STEAM-based digital educational games as an effective tool to enhance the quality of classroom learning. The responses from both students and teachers demonstrate a high level of positive support for the development of these games. The following presents the detailed results from the student and teacher questionnaires regarding the need for developing STEAM-based digital educational games.



a) Response of Students



b) Response of Teachers

Figure 1. Results of Media Development Needs

Figure 1 illustrates the strong positive response from both students and teachers regarding the need for the development of STEAM-based digital educational games. Among students, 89% deemed it "very necessary," 7% considered it "necessary," and 4% rated it as "moderately necessary" for media development. Similarly, 80% of teachers rated the need for media development as "very high," while 20% rated it as "high." These results highlight significant interest and support from both students and teachers for the innovation of learning through the development of STEAM-based digital educational games, which are expected to enhance engagement and effectiveness in learning. To further explore the need for these games in literacy education, interviews with teachers were conducted. The following section presents the results from these teacher interviews.

Table 3. Result of Interviews (Teachers)

Question(s)	Answer(s)
Use of STEAM-based Digital Educational Games in Literacy Learning	Mr. Ka: Believes digital games can provide fun and interactive learning but hasn't applied them to literacy learning. Mrs. Am: Sees digital games as effective for improving literacy skills, especially with a STEAM-based approach, but hasn't applied them in practice. Mrs. Re: Thinks digital educational games can support literacy if adapted to the STEAM approach, but feels her previous designs weren't engaging.
Carrying Capacity in the School Environment for Digital Educational Games	Mrs. Su: Limited computer devices and internet access can hinder use, but students enjoy learning through digital games when available. Mrs. Is: More affordable technology has enabled schools to provide computers or tablets, facilitating the use of digital educational games. Mrs. An: The school provides good internet, computer facilities, and allows students to bring cellphones, supporting smooth use of digital educational games.
Challenges in Using Media Technology in the Classroom	Mrs. Fi: Varying cellphone specifications and memory issues limit the effective use of technology in learning. Mrs. Ik: The lack of basic technology skills among teachers and students is a challenge that requires additional training. Mrs. Mi: Lack of supervision leads to students using technology for non-educational purposes, like switching to other applications.
Effect of Digital Educational Games on Student Learning Outcomes in Literacy	Mrs. Na: Digital games can positively affect literacy outcomes if designed in an engaging and interactive way. Mr. Al: The impact on literacy depends on the quality and design of the games. Mr. Ar: Digital games can improve literacy but require supervision to ensure students focus on the educational content rather than the entertainment.

Table 3 presents the need for developing STEAM-based digital educational games. Additionally, observation results indicate that the use of digital educational games in literacy instruction effectively captures students' attention. Students appear more enthusiastic and focused when learning through applications that integrate game elements with educational content. The technological resources available at the school, such as LCD projectors, laptops, and Wi-Fi connections, are generally adequate to support the use of this media. However, occasional technical issues, such as malfunctioning devices or internet connectivity problems, sometimes disrupt the learning process. Despite these challenges, students demonstrate increased motivation in reading and writing activities. One challenge faced by teachers is the limited time available to incorporate digital educational games into their regular teaching schedule. Overall, despite these obstacles, the use of digital educational games positively impacted students' learning outcomes, particularly in enhancing their engagement with literacy activities.

3.2. Urgency of Media Development

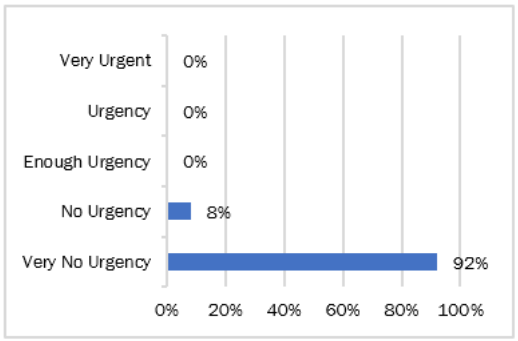
The urgency of developing STEAM-based digital educational games has become increasingly significant in response to the growing need to enhance the quality of education in the digital age. This urgency was assessed through questionnaires completed by students and teachers, along with teacher interviews, observations, and theoretical research to evaluate the role of STEAM-based digital educational games in supporting literacy instruction. The urgency questionnaire focused on four primary factors: learning needs, student interest and engagement, technological advancements, and challenges in the learning process. The following presents the findings from the urgency questionnaire regarding the development of this media, as provided by both students and teachers.

Table 4. Result of Urgency of Media Development

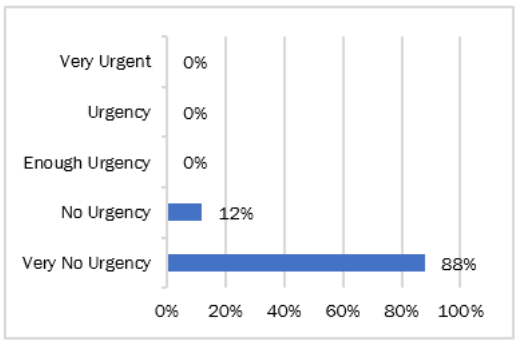
Respondents	Score	Criteria
Students	86%	Very Urgent
Teacher	88%	Very Urgent

Table 4 presents the urgency of developing STEAM-based digital educational games, with both students and teachers providing highly positive assessments. The students' questionnaire received a score of 86%, categorized as "very urgent," while the teachers' questionnaire achieved a score of 88%, also falling under the "very urgent" category. The combined average score from both student and teacher questionnaires was 87%, reflecting a strong sense of urgency to develop STEAM-based digital educational games for literacy instruction. These results underscore the critical need for such media to enhance students' reading and writing literacy in a more effective and engaging manner. The findings from the student and teacher questionnaires further highlight the significant support for the urgency of developing

these games. The following presents the detailed results from the student and teacher questionnaires regarding the urgency of STEAM-based digital educational game development.



a) Response of Students



b) Response of Teachers

Figure 2. Results Urgency of Media Development

Figure 2 illustrates the strong sense of urgency regarding the development of STEAM-based digital educational games, as reported by both students and teachers. Among students, 92% considered it "very urgent," while the remaining 8% also recognized the importance of developing this learning media. Similarly, 88% of teachers rated it as "very urgent," and 12% considered it "urgent," reflecting a broad consensus among educators in favor of using digital educational games as interactive tools to enhance students' literacy skills. These results highlight widespread agreement on the need for innovation in the development of STEAM-based digital educational games to improve both the effectiveness and engagement of students in literacy instruction. To further explore the urgency of this development, interviews were conducted with teachers, and the following section presents the findings from these interviews.

Table 5. Result of Teacher Interviews for Urgency of Media Development

Question	Answers
How can the learning process using textbooks and lecture methods create effective learning?	Mr. Nu: Lectures and textbooks are still used, but they are not effective enough, especially for visual or kinesthetic learners, as the material can be hard to understand without a more interactive explanation. Mrs. Su: Lectures are effective for some topics, but other materials would be better understood if delivered interactively or with other media like digital educational games. Mrs. En: Lectures and textbooks are less effective for most students because they often get bored and lose focus. Mrs. Dh: Students are more interested and focused when learning using technology, such as digital educational games, as they are more active in the learning process.
How interested are students in a more interactive and technology-based learning process, such as STEAM-based digital educational games?	Mrs. Sr: Students are more interested in technology-based learning, as it helps them understand material more quickly and keeps them from getting bored. Mr. Az: Students prefer interactive learning, especially games that combine entertainment and learning, as it makes them more enthusiastic about learning.
How does the technology infrastructure in schools support the use of digital educational games?	Mrs. In: The school infrastructure is quite adequate, though internet access is limited. Most students have devices they can use at school when needed. Mr. Za: The infrastructure is good, with a computer room and stable Wi-Fi, and most students have devices at home. Mr. Aa: Technology such as computers and Wi-Fi is supportive at school, and all students can access devices at home, but there are challenges in supervising students when they access these devices.
What are the challenges in making the subject matter more engaging and easily understood by all students, regardless of their ability level?	Mrs. Lu: The challenge is conveying the same material in ways that can be understood by students with varying ability levels, and digital educational games can help visualize the material in a more engaging way. Mrs. Al: The challenge is when students have difficulty with reading or writing. Interactive games can offer variety in how the material is delivered.

Question	Answers
	Mr. If: Students find it easier to understand material through digital devices that offer interactive learning experiences, as conventional methods tend to be boring and monotonous.

Table 5 presents the results of interviews with teachers regarding the urgency of developing STEAM-based digital educational games. Additionally, observations indicate that although traditional teaching methods, such as lectures and textbook-based instruction, are still in use, many teachers find these methods less effective, particularly for students with visual or kinesthetic learning styles. Students often become bored and lose focus when material is presented in a conventional manner. In contrast, learning that incorporates technology, such as digital educational games, has proven to be more engaging, helping to increase student participation, focus, and enthusiasm for learning. The school's technological infrastructure is sufficient to support the use of digital educational games, and most students have access to adequate devices at home. The primary challenge identified is the wide range of student abilities, but digital educational games offer a promising solution by delivering content in an engaging and accessible manner that caters to the diverse needs of all students.

4. Discussion

The results of the needs questionnaire given to students and teachers show that the need for the development of STEAM-based digital educational games is very high, with an average value of 90.1% which is included in the very need criteria. This indicates that there is a strong need for the use of technology-based learning media to improve the literacy of elementary school students. The results of interviews, observations and theoretical studies also reinforce the development of STEAM-based digital educational games that can help improve learning that is more interesting and interactive. In the context of literacy, STEAM-based digital educational games provide various challenges and interactions that enrich students' learning experience (Ginting, 2021; Nabilah et al., 2023). Existing problems such as the lack of interesting and fun media and low student motivation in conventional learning, can be resolved with the use of this digital educational game (Agustina & Desyandri, 2020; Pratiwi et al., 2024). With STEAM (Science, Technology, Engineering, Arts, and Mathematics) based in the development of digital educational games, students will more easily understand the concept of literacy as a whole that integrates various disciplines (Akmal & Asikin, 2022; Manurung, 2021; Wulandari et al., 2023).

The results of the urgency questionnaire given to students and teachers also show that the urgency of developing STEAM-based digital educational games obtained an average score of 87% with very urgent criteria, which indicates the importance of developing this media. Strengthened by the results of interviews, observations, and theoretical studies, it shows that STEAM-based digital educational games have high effectiveness in attracting students' attention and facilitating more dynamic and contextualized learning. In the context of literacy, the use of STEAM-based digital educational games can improve students' ability to understand texts and improve their writing skills in a fun and non-boring way (Abidin et al., 2022; Sulistyarini & Fatonah, 2022). With the development of technological capabilities, students and teachers need media that is relevant and easily accessible, so the existence of media such as STEAM-based digital educational games is very urgent to be realized (Manurung, 2021). The development of STEAM-based digital educational games will also support students' ability to use technology more optimally, and provide a more interesting and effective learning experience (Rachmawati et al., 2023; Wedayanti & Wiarta, 2022; Windawati & Koeswanti, 2021). The urgency of developing STEAM-based digital educational games lies in their ability to provide solutions to improve the quality of learning in the digital era, which will certainly have a positive impact on student learning outcomes (Pratiwi et al., 2024; Sitompul, 2022).

5. Conclusions

The development and implementation of STEAM-based digital educational games is both necessary and urgent to enhance the literacy skills of fifth-grade elementary school students. The needs questionnaire results, which indicated an average value of 90.1% with a "very needed" criterion, and the urgency questionnaire results, which showed an average value of 87% with a "very urgent" criterion, further emphasize the importance of developing such games. Additionally, interviews, observations, and theoretical studies support the notion that the use of digital educational games can significantly increase student engagement and motivation in the learning process.

By integrating STEAM, literacy learning becomes more enjoyable, engaging, and interdisciplinary, which helps students gain a deeper understanding of the material. Consequently, the development of STEAM-based digital educational games is highly suitable for fostering effective and enjoyable literacy learning experiences. However, this study has certain limitations, particularly as the information gathered on the need and urgency of developing these games pertains specifically to literacy instruction. Future research should explore the

application of STEAM-based digital educational games in other areas of learning.

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