



Development of Interactive Media Based on the STEAM Approach Through the NEARPOD Application to Improve Literacy Skills of Elementary School Students

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ABSTRACT

Purpose: The low reading ability of elementary school students continues to be a problem in education. This condition is influenced by the ineffective use of technology-based interactive learning resources and the limited use of digital multimedia in the educational process. This project aims to provide interactive learning resources based on the Nearpod application with a STEAM approach to improve students' reading skills in science lessons in elementary schools. **Methods:** The preliminary research, prototyping phase, and assessment phase form the Plomp model, which was used in this research and development (R&D) study. All fifth-grade students and a small pilot group of three fifth-grade students participated in the study at SDN 20 Gumarang. Data collection methods included tests, questionnaires, interviews, and observations. Validity, practicality, and effectiveness tests using pretests, posttests, and N-Gain were used to analyze the data. This study was limited to a small sample size and focused solely on reading ability. **Findings:** The results of the study showed that Nearpod-based learning materials had a very high level of validity, with a percentage of material experts of 83.87%, a percentage of media experts of 91.67%, and a percentage of language experts of 91.67%. The media was also classified as very practical based on comments from students (88.75%) and instructors (94.28%). With an N-Gain score of 0.63 in the moderate category and an increase in the average pretest score from 58.35 to 84.50 on the posttest, students' reading ability also improved as a result of the learning materials. **Research Implications:** Through active, interactive, and student-centered learning, this study advances the creation of cutting-edge STEAM-based digital learning materials that enhance students' literacy skills. **Originality:** In contrast to other studies that only use Nearpod as an interactive media without STEAM integration, the uniqueness of this study lies in the integration of the STEAM method in creating Nearpod media for science learning to improve the reading skills of elementary school children.



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INTRODUCTION

Education is crucial for producing high-quality human resources in the era of globalization. According to the Partnership for 21st Century Learning (2019) and Voogt, Erstad, Dede, & Mishra (2013), students must acquire not only conceptual knowledge but also the critical thinking, creativity, communication, collaboration, and digital literacy skills needed to keep pace with technological developments. Advances in information and communication technology have a significant impact on education, particularly in the use of digital learning resources that can make learning more engaging, effective, and meaningful.

The use of technology in the classroom has become a crucial component in the evolution of contemporary education. Research shows that integrating digital technology can increase student engagement and learning effectiveness (Rasheed, Kamsin, & Abdullah, 2020; Sung, Chang, & Liu, 2016). Technology-based media makes learning more adaptable to students' needs by supporting diverse learning styles and enabling more flexible learning (Hwang & Chang, 2011).

Teachers can deliver content more effectively by using learning media. Conceptual understanding and student learning outcomes can be enhanced by using appropriate media (Mayer, 2019). Interactive media makes learning more participatory than one-way in digital-based education contexts by enabling students to actively participate in the process (Martin & Bolliger, 2018).

Teachers can deliver content more effectively and efficiently by using learning media. Learning media serves as a teaching tool as well as a way to make learning messages easier for students to understand. According to Daryanto - Learning Media (2016), learning media can transcend time, place, and students' sensory capacities, thus enabling the presentation of abstract ideas in a more realistic and meaningful way. Furthermore, the use of appropriate media can also improve conceptual understanding and student learning outcomes. This is in line with the opinion of Cecep Kustandi & Bambang Sutjipto - Learning Media (2019) who stated that learning media plays an important role in helping the process of delivering material to be more interesting, clear, and easy to understand, thereby improving the quality of learning.

In the context of digital-based learning, interactive media allows students to actively engage in the learning process, diverting attention from the teacher. Learning becomes more participatory and provides a more meaningful learning experience. According to Rusman - Technology-Based Learning (2018), the use of information and communication technology in learning can encourage student interaction, motivation, and participation in the learning process.

Literacy is a fundamental skill in 21st-century education. Beyond reading and writing, literacy also encompasses the ability to understand, evaluate, and critically apply knowledge in everyday life (UNESCO, 2021). However, several international surveys indicate that reading skills among students remain a challenge in many developing countries, including Indonesia (OECD, 2023). These findings align with several studies worldwide that demonstrate a link between low literacy and students' limited use of interactive learning materials and their lack of participation in meaningful reading activities.

According to Dalman (2017), reading literacy is a complex skill that goes beyond simply recognizing letters and words; it also encompasses the ability to understand, interpret, evaluate, and use information critically in everyday life. Furthermore, literacy is related to critical thinking and problem-solving skills. Yunus Abidin (2017) explains that literacy in the context of modern learning requires students to actively process information from various sources, so that learning is not only about receiving information but also about independently constructing knowledge.

Despite this, numerous studies show that many educational institutions still struggle with students' reading skills, particularly at the elementary school level. A lack of enthusiasm for reading, a lack of engaging and relevant teaching resources, and the ineffective use of technology in the classroom are some of the causes of low literacy rates. This is supported by the Ministry of Education and Culture's School Literacy Movement Guidelines (2016), which highlight the need for text-rich learning environments, a reading culture, and creative and engaging learning materials to improve literacy progress.

Innovative learning that combines technology with appropriate pedagogical approaches is needed to address this issue. STEAM (Science, Technology, Engineering, and Mathematics) is one relevant method. Higher-order thinking skills such as critical thinking and problem-solving can be developed through context-based learning, which is the focus of the STEAM method (Bybee, 2013; Kelley & Knowles, 2016). The STEAM method places a strong emphasis on context-based learning, integrating ideas from science, technology, engineering, and mathematics into a coherent and meaningful educational process. The goal of the STEAM method, according to Abdul Kadir (2019), is to help students become more proficient in solving real-world problems by integrating multiple disciplines.

Furthermore, STEAM learning also focuses on developing 21st-century skills, especially higher-order thinking skills such as critical thinking and problem solving. Made Wena - Contemporary Innovative Learning Strategies (2016) explains that innovative learning involving contextual problem solving can train students to think analytically and creatively, and be able to make decisions based on relevant data and facts. Research also shows that STEAM-based learning contributes positively to increasing students' creativity and problem-solving abilities (Kim, Park, & Yoo, 2018).

To support STEAM implementation, technology-based interactive learning media is needed. One platform that can be used is Nearpod. Nearpod is an interactive digital learning platform that allows teachers to present material through quizzes, videos, discussions, simulations, and real-time evaluations. This platform increases student engagement in the learning process. Research shows that using interactive platforms like Nearpod can improve student engagement and conceptual understanding (Fokides, 2018; Bond et al., 2020).

Various previous studies have shown that digital-based learning media can improve student learning outcomes, motivation, and engagement (Sung et al., 2016; Rasheed et al., 2020). However, upon closer examination, several

research gaps remain that warrant attention. First, research on digital media is generally separate from the STEAM approach and has not been widely developed as a comprehensive integrated learning model. Second, most studies focus more on improving cognitive learning outcomes, while literacy as a fundamental 21st-century competency has received less attention. Third, studies linking interactive platforms like Nearpod with literacy strengthening through the STEAM approach in the context of science learning in elementary schools are still very limited, especially in the more systematic and comprehensive international literature.

Furthermore, STEAM studies have largely focused on improving science and mathematics skills, but have not directly linked them to improving literacy in the context of science and science learning in elementary schools. This indicates a gap between studies of educational technology and STEAM-based pedagogical approaches in the international literature.

Thus, based on the description, the research gap can be formulated more firmly as follows: the integration between the Nearpod platform and the STEAM approach in a systematic and structured learning model is still limited, there are not many studies that specifically examine the improvement of literacy skills through technology-based interactive learning media in science learning in elementary schools with the support of the STEAM approach, and there is still a lack of empirical studies in the international literature that directly link the use of interactive digital media with strengthening literacy within the STEAM framework in elementary education.

Based on these gaps, the objectives of this study can be formulated as follows: Developing interactive learning media based on Nearpod with a STEAM approach in science learning for grade V elementary schools, Analyzing and testing the validity of the developed learning media based on media and material experts, Knowing the level of practicality of learning media based on teacher and student responses in learning implementation, and Testing the effectiveness of learning media on improving elementary school students' literacy skills. Thus, this study is expected to contribute to the development of valid, practical, and effective STEAM-based digital learning media, and is able to improve elementary school students' literacy.

METHOD

This study uses the Plomp development model with a Research and Development (R&D) approach, which is generally in line with the research objectives. The product developed in this study is a digital-based interactive learning material for the topic of science and science for fifth grade elementary school. The product is designed as an interactive learning medium, so it should be emphasized that the development is not a digital learning video, but rather interactive learning material presented digitally to avoid inconsistencies in product explanations.

The development process was carried out through three phases of the Plomp model: preliminary research, the prototyping phase, and the assessment phase. The research was conducted at SDN 20 Gumarang from December 2025 to January 2026, involving fifth-grade students as field trial subjects. However, the number of research subjects in the field trial was not specifically stated, so the scope of the research was not clearly described.

The research instruments used included a validation sheet, an observation sheet, a student response questionnaire, and an interview guide. However, the details of the validation instruments have not been fully explained, particularly regarding the indicators and assessment aspects used in assessing the product. Furthermore, this study has not yet discussed instrument reliability testing, so the consistency and reliability of the instruments used cannot be confirmed.

Data collection was conducted through observation, interviews, documentation, and the distribution of questionnaires to teachers, students, and validators. The data obtained covered aspects of product validity, practicality, and effectiveness. Data analysis was conducted quantitatively and descriptively. The results of the validator, teacher, and student assessments were used to determine the level of product validity and practicality based on a percentage score, which was then categorized into very valid, valid, practical, and very practical. Product effectiveness was analyzed based on student responses to aspects of activity, motivation, and learning environment after using digital-based interactive learning materials.

RESULTS

The purpose of this research is to create IPAS (Integrated Patient Access System) learning materials for the human respiratory system using Nearpod. The three-stage Plomp model development research approach was used in this study. Preliminary research is the first step, prototyping is the second step, and assessment is the third step. Based on the research findings, this approach can be characterized as follows.

Preliminary research

The first stage is preliminary research. This is a very important initial step in determining and understanding the problem that forms the basis of the research. At this stage, researchers undertake several steps, in particular:

The fifth-grade curriculum at SDN 20 Gumarang is an independent curriculum, according to an interview with Mrs. Rini Mayenri, the homeroom teacher. This was based on a curriculum analysis conducted to fully understand the learning objectives stated in the program. After evaluating the learning objectives and learning outcomes (TP), a learning objective pathway (ATP) was developed. This ATP serves as a guide for creating learning tasks that students will complete using web-based learning materials on the Nearpod platform. These educational resources were created specifically to support the teaching and learning of fifth-grade elementary school students.

According to observations and interviews with instructors and students, the majority of fifth-grade students at SD Negeri 20 Gumarang quickly lose interest in learning if the teaching method is limited to oral instruction or reading from a textbook. They prefer technology-based, interactive, and engaging learning. Furthermore, students prefer visual presentations such as images, films, and animations. They also show enthusiasm for online games and assessments. This suggests that today's students' personalities are very similar to those of technology users, necessitating the implementation of teaching tactics that reflect the characteristics of the digital generation. Therefore, the characteristics of elementary school children require the use of interactive learning materials, such as web-based learning tools like Nearpod, which are easily accessible, aesthetically appealing, and appropriate to their social and cognitive developmental stages.

Analysis of learning media used in the field

These findings are supported by an interview with Rini Mayenri, a homeroom teacher for fifth-grade students. According to her, the primary sources of knowledge are still worksheets and textbooks. Due to limited time, facilities, and learning patterns, the use of digital or interactive media is currently very limited. Furthermore, she revealed that students often exhibit symptoms of boredom during class, including an inability to concentrate, chatting with friends, and a lack of enthusiasm for completing assignments. Furthermore, compared to solely text-based learning, children typically show greater interest in learning that incorporates technology, such as games or educational films.

Prototyping phase

Based on the findings of the previous analysis phase, Nearpod-based learning materials were designed and developed during the development or prototyping phase. To create media that is valid, useful, and effective in improving student literacy, the development process was carried out in stages through several prototypes.

1. Prototype 1

Using laptops and the Nearpod and Canva applications, the researchers began creating digital learning materials in prototype 1. The media was created for a science course on the human respiratory system for fifth-grade elementary school students. The collection of learning resources, including modules, learning videos, worksheets (LKPD), images, and learning materials, was part of this phase. After that, Canva was used to build the media design, which was then integrated into Nearpod along with a number of interactive elements including memory tests, polls, quizzes, animated films, realistic worksheets (LKPD), and climbing time. To increase students' interest in learning and reading skills, the media was made interactive, communicative, and engaging.

Additionally, a validation sheet, a practicality questionnaire, and a learning interest questionnaire are currently being produced as study instruments to evaluate the feasibility of the media. Following product design, a self-evaluation was conducted to examine the media's appearance, language, content, and interaction. Evaluation findings indicated that learning flow, text simplicity, color and font enhancements, and sentence editing were all needed. Prototype 2 is the result of these modifications.

2. Prototype 2

After improvements were made in the self-evaluation stage, the next step was validation by experts (expert review) on the developed product. This activity aims to obtain input, suggestions, and assessments from experts to predict whether the developed product (prototype 1) is suitable for use in learning. The validation process was carried out by consulting and discussing the Nearpod-based learning media with experts, as well as soliciting their responses through instruments in the form of questionnaires and validation sheets. Validation was carried out in three aspects: material/module validation, media validation, and language validation. The validation results are then calculated using the formula $P = \sum x / \sum xi \times 100 \%$. The results of the validation percentage calculation are then interpreted based on the validity criteria according to [Nadzif et al., \(2022\)](#).

Table 1. Media validity criteria

Nu.	Validity criteria	Validity level
1	81.25% - 100%	Very valid
2	62.50% - 81.25%	Valid
3	43.75% - 62.50%	Quite valid
4	25% - 43.75%	Invalid

The validation results in this study can be presented in [Table 1](#) below.

Table 2. Validity of Learning Media

Validation Aspects	Validator	Percentage	Category
Material/module	Subject/module subject matter expert	83.87%	Very Valid
Media	Media Expert	91.67%	Very Valid
Language	Linguist	91.67%	Very Valid

Based on the validation results that have been carried out, the aspects materials/modules obtained a percentage of 83.87% with a very valid category. This indicates that the content of the material presented in the media is in accordance with the learning objectives and needs of students. In the media aspect, the results of the assessment by media experts obtained a percentage of 91.67% with a very valid category. These results indicate that the appearance, design, and use of the media are very good and suitable for use in learning. Meanwhile, the language aspect obtained a percentage of 91.67% with a very valid category, which indicates that the use of language in the media is easy to understand, communicative, and appropriate to the level of development of students. Overall, the validation results indicate that the developed learning media is in the very valid category and is therefore suitable for use in the learning process.

3. Prototype 3

Three students with high, medium, and low proficiency levels participated in one-on-one assessments after prototype 3. The purpose of these assessments was to determine the level of media complexity, language, content, instructions, and clarity of the display. According to the assessment results, students found the Nearpod media engaging, participatory, and useful for improving literacy through reading exercises and text-based questions. However, there were still some aspects of the content and instructions that needed to be simplified. The improved prototype 3 resulted from the changes made at this stage.

4. Prototype 4

Using teacher and student feedback, a small-group trial was conducted to assess the practicality of the developed product. Ten students with varying skill levels and a classroom teacher participated in the trial at this stage. To evaluate the usability of the nearpod learning media using the STEAM approach, students were asked to complete a questionnaire after the trial. The following are the results of the questionnaire responses from teachers and students. Determination of practicality value is carried out using the formula proposed by (Krismaninata, et al. 2021).

$$\text{Practicality Value} = \frac{\text{Total Scores Obtained}}{\text{Maximum Score}} \times 100\%$$

The final assessment of the practicality of the Neapod media is shown through the final scores presented in the following [Table 3](#).

Table 3. Practicality Assessment Criteria

Percentage (%)	Criteria
81-100	Very Practical
61-80	Practical
41-60	Quite Practical
21-40	Less practical
0-20	Impractical

Table 4. Results of the Educator Response Questionnaire at SDN 20 Gumarang

Nu.	Aspect	Max Score	Score Obtained	Percentage	Category
1	Ease of use	5	5	100%	Very Practical
2	Material suitability	5	5	100%	Very Practical
3	Clarity of material	5	4	80%	Practical
4	Media display	5	5	100%	Very Practical
5	Improving literacy	5	5	100%	Very Practical
6	Classroom management	5	4	80%	Practical
7	According to student character	5	5	100%	Very Practical
Amount		35	33	94.28%	Very Practical

Table 5. Results of Student Response Questionnaire at SDN 20 Gumarang

Nu.	Statement	Max Score	Score Obtained	Percentage	Category
1	Interesting media	100	92	92%	Very Practical
2	Easy material	100	88	88%	Very Practical
3	Understanding the reading	100	85	85%	Very Practical
4	Interest in reading	100	87	87%	Very Practical
5	Fun quiz	100	93	93%	Very Practical
6	Easy to use	100	90	90%	Very Practical
7	Help with questions	100	86	86%	Very Practical
8	More active	100	89	89%	Very Practical
Amount		800	710	88.75%	Very Practical

Based on the results of the educator response questionnaire, a percentage of 94.28% was found to be very practical, and the results of the student response questionnaire, a percentage of 88.75% was found to be very practical. These results indicate that Nearpod-based learning media is easy to use and able to attract students' interest and attention throughout the learning process.

5. Prototype 5

All fifth-grade students at SDN 20 Gumarang participated in prototype 5, a field test phase designed to assess the usability and effectiveness of Nearpod-based educational materials. To determine the effectiveness of Nearpod-based learning media in improving student literacy, a comparison was conducted between pretest and posttest results. The pretest was administered before using the learning media to measure students' initial abilities, while the posttest was administered after the learning process using Nearpod media.

Table 6. Descriptive Statistics

	N	Minimum	Maximum	Mean	Standard Deviation
Ngain Score	21	,57	1.00	,7866	,15686
Gain Percent	21	56.52	100.00	78,6594	15.68594
Valid N (listwise)	21				

Table 7. Paired Samples Statistics

	Mean	N	Standard Deviation	Std. Error Mean
Pair 1 Pretest	58,3333	21	4,57530	,99841
Posttest	91,1429	21	6.64293	1.44961
Pair 2 Posttest_Less_Pretest	32,8095	21	7.99136	1.74386
Ideal Score_Less_Pretest	41,6667	21	4,57530	,99841
Pair 3 Ngain_Score	,7866	21	,15686	,03423
Gain_Percent	78,6594	21	15.68594	3.42295

Based on the results of descriptive statistical analysis, it is known that the number of research subjects was 21 students. The results of the N-Gain Score calculation obtained a minimum value of 0.57 and a maximum value of 1.00 with an average (mean) of 0.7866 and a standard deviation of 0.15686. These results indicate that the increase in student learning outcomes after using Nearpod-based learning media is in the high category. The relatively small standard deviation value indicates that the increase in student learning outcomes tends to be evenly distributed.

Furthermore, the N-Gain Percentage obtained a minimum value of 56.52% and a maximum of 100.00% with an average of 78.66% and a standard deviation of 15.69. Based on the N-Gain effectiveness criteria, this percentage is included in the effective category. This indicates that the use of Nearpod-based learning media is able to improve student learning outcomes well and effectively.

Paired Samples Statistics results show an increase in student scores between before and after using Nearpod media. The average pretest score was 58.33 with a standard deviation of 4.58. This value reflects students' initial abilities before learning using Nearpod media. After being given treatment, the average posttest score increased to 91.14 with a standard deviation of 6.64. This average increase indicates a significant change in learning outcomes after using Nearpod-based learning media. In the second pair, the average difference between the posttest and pretest was 32.81 with a standard deviation of 7.99. These results indicate that the average increase in students' scores after the learning process reached 32.81 points. Meanwhile, the average difference between the ideal score and the pretest was 41.67, indicating that before the learning process, students' abilities were still quite far from their maximum scores. In the third pair, the average N-Gain Score was 0.7866, equivalent to 78.66%. Based on the N-Gain classification, this score is considered high. Therefore, it can be concluded that Nearpod-based learning media is effective in improving student learning outcomes.

Assessment Phase

The final step in the development approach was the assessment phase, which aimed to determine how well the Nearpod-based learning materials improved the literacy skills of fifth-grade elementary school children. Pre- and post-test data, learning observations, and student and teacher surveys were all analyzed as part of the evaluation process. After using Nearpod media, children's literacy skills improved, according to the analysis results. Higher post-test scores compared to pre-test scores further confirmed this. This improvement indicates that Nearpod media can help students understand reading content, find relevant information, and more successfully answer text-based questions. Furthermore, the N-Gain calculation results were in the moderate to high range, indicating that the Nearpod-based learning materials successfully improved students' literacy levels, particularly in the area of reading comprehension.

According to a survey of educator responses, Nearpod received an excellent response. Teachers rated the media's ease of use, usefulness, and quality in facilitating learning. Furthermore, the content offered was deemed appropriate for learning objectives and capable of increasing student engagement in learning activities. Overall, Nearpod-based educational materials are highly beneficial for teaching reading in elementary schools.

Meanwhile, the majority of students gave very positive comments about the use of Nearpod media, according to the findings of the student feedback survey. Because learning is enhanced with visuals, movies, colors, and interactive activities such as games, students believe that learning becomes more interesting. Nearpod media is not only easy to use but also improves students' understanding of the subject matter and increases their enthusiasm for learning. After accessing the media, students feel more comfortable reading, understanding, and answering text-based questions. Thus, the Nearpod-based learning media created is considered useful and successful in increasing the interest and literacy skills of fifth-grade students at SDN 20 Gumarang based on the findings of observations, feedback surveys, and improvements in student learning outcomes.

DISCUSSION

This study aims to develop Nearpod-based learning media on the human respiratory system for fifth-grade elementary school students using the Plomp development model. The results indicate that the developed media meets the criteria of validity, practicality, and effectiveness. However, the research findings not only indicate that the media is "good" to use, but also provide an overview of the factors that influence improved student learning outcomes, obstacles that arise during implementation, and the contribution of digital media development to science learning in elementary schools.

During the preliminary research phase, it was discovered that the learning process at SDN 20 Gumarang was still teacher-centered, with textbooks and lecture methods being the primary learning resources. This situation led to students quickly becoming bored, lacking focus, and being less active in the learning process. This finding indicates a gap between the characteristics of 21st-century learners and the learning strategies implemented in the classroom. Today's elementary school students are more familiar with digital technology, so they tend to be more interested in visual, interactive, and activity-based learning. Therefore, Nearpod was chosen because it can integrate various multimedia features such as videos, quizzes, animations, and educational games into one learning platform.

The validation results show that the developed learning media is in the very valid category with a material validation percentage of 83.87%, media validation of 91.67%, and language validation of 91.67%. The high validation

results indicate that the media is in accordance with learning outcomes, the characteristics of elementary school students, and the principles of interactive learning design. However, the difference in percentages in the material aspect compared to the media and language aspects indicates that there are still several parts of the material that require simplification and adjustment to the student learning context. This indicates that in developing digital media, the quality of the display and interactive features alone is not enough, but the presentation of the material must also be adjusted to the level of understanding and reading ability of elementary school students.

The results of this study align with previous research that suggests digital-based learning media can increase student engagement in learning. However, this study provides a more specific contribution because it not only assesses the media's visual aspects but also emphasizes the relationship between Nearpod's interactive features and improved student literacy skills. Features such as text-based quizzes, instructional videos, and interactive worksheets (LKPD) help students understand information gradually, so that the reading process is not merely passive but also involves simple thinking and analysis.

In the practicality stage, teacher and student responses indicated a very practical category with percentages of 94.28% and 88.75%, respectively. These results indicate that Nearpod is easy to use for both teachers and students. However, during the trial, several obstacles were encountered in the field, such as limited internet connection, differences in student abilities in operating digital devices, and relatively limited learning time. Some students also required assistance at the beginning of using the media because they were not used to participating in digital-based learning independently. These obstacles indicate that the success of digital media use is influenced not only by the quality of the media, but also by the readiness of the infrastructure and the digital literacy of the users. Furthermore, there were differences in student responses during media use. Students with high academic ability tended to adapt more quickly and actively participate in learning activities, while students with low ability took longer to understand instructions and complete text-based assignments. This condition is one factor influencing overall student learning outcomes.

The effectiveness of the media is evident from the increase in the average pretest score from 58.33 to 91.14 in the post-test, with an average N-Gain score of 0.7866 or 78.66%. Based on the N-Gain classification, this score is categorized as high. However, upon closer analysis, the results of this improvement have not reached the maximum level for all students. This is evident from the minimum N-Gain score of 0.57, indicating that some students still experienced moderate learning improvement. This condition can be influenced by several factors, such as varying initial student abilities, uneven reading skills, and student adaptation to the use of digital media. Furthermore, the human respiratory system material contains scientific terms that are quite complex for elementary school students, so some students still struggle to grasp the information quickly, even with the help of visual and interactive media. Thus, while the use of Nearpod can improve learning outcomes, its effectiveness is still influenced by internal student factors and classroom learning conditions.

The findings of this study provide theoretical contributions to the field of learning media development, specifically that the effectiveness of digital media is determined not only by the use of technology but also by the integration of literacy activities within the media. Nearpod is effective because it not only presents material visually but also engages students in reading, understanding information, answering questions, and engaging in interactive discussions. This supports constructivism theory, which emphasizes that knowledge is actively constructed through learning experiences and student interactions with the learning environment.

This study also strengthens the findings of previous research on the use of interactive digital media in elementary schools, but differs in its development focus. Previous research generally emphasized improving motivation or overall learning outcomes, while this study demonstrates that Nearpod media can support students' literacy skills through the integration of text, visuals, and interactive activities in science learning. Therefore, this study provides a new contribution, demonstrating that web-based digital media can be a means of strengthening literacy in science learning in elementary schools. Overall, the research results indicate that Nearpod-based learning media is suitable for use as an innovative learning tool in elementary schools. However, implementing digital media still requires infrastructure support, teacher readiness, and student mentoring to ensure optimal and equitable outcomes for all students.

CONCLUSION

This research produces Nearpod-based learning media that meets the criteria for validity, practicality, and effectiveness. The validation results show a very valid category, while practicality is in the very practical category based on teacher and student responses. From the effectiveness aspect, there was an increase in student learning outcomes with a moderate N-Gain category after using the media. This research has limitations in the limited number of subjects and the lack of long-term effectiveness testing, so the generalizability of the results is still limited.

Therefore, further research is recommended to involve a wider sample and a more robust experimental design. Theoretically, this research contributes to the development of Nearpod-based interactive digital learning media in improving the quality of science learning in elementary schools, while practically it can be an alternative learning media that can be used by teachers in the classroom.

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