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Development of Interactive IPAS Teaching Materials Using Wordwall Applications Based on Problem Based Learning (PBL) Models in Fourth Grade Elementary Schools

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Abstract: This research is motivated by the fact that teachers are not yet fully utilizing the available IT in schools. There is a lack of development of innovative, interactive, and enjoyable teaching materials for students. Therefore, teachers need to improve their ability to process technology-based teaching materials to encourage student enthusiasm for learning. Furthermore, the PBL model has never been used in learning. Based on these problems, this study aims to develop interactive IPAS teaching materials using a wordwall application based on the Problem Based Learning (PBL) model in grade IV elementary schools that are valid, practical, and effective. This type of research is research and development (R&D) using the ADDIE model. The ADDIE model consists of five steps: analysis, design, development, implementation, and evaluation. The designed teaching materials were then validated by a validator using a validation sheet in the form of a questionnaire. Product validation consisted of material experts, media experts, and language experts. For product practicality, it was carried out by filling out questionnaires of teacher responses and student responses. Then, for effectiveness, it was carried out by giving evaluation questions to students. The trial subjects were at SDN 01 Patamuan and the research subjects were at SDN 03 Patamuan and SDN 05 Patamuan. The results of the study obtained a validity level of 95% from the material aspect in the very valid category, 92.5% from the media aspect in the very valid category and 95% from the language aspect in the very valid category. Based on the results of teacher responses and student responses in the trial school, it is known that learning using interactive teaching materials is very practical with a percentage of practicality from teacher responses in the trial school of 92.5%, and from student responses of 93.9%. The percentage of teacher responses in the research school is 95% and the percentage of student responses is 96%. The effectiveness results show very effective results with a percentage increase in student learning outcomes from 74.5% to 97.3% with a N-gain test value of 0.925 or 92.5% in the effective category. Thus, it can be concluded that interactive science teaching materials using wordwall applications based on the Problem Based Learning (PBL) model in grade IV of elementary school are valid, practical and effective. to be used in the learning process.

Keywords: Interactive teaching materials; PBL model; Wordwall

Introduction

Law Number 20 of 2003 concerning the National Education System (Sisdiknas), Article 37, paragraph 1, states that the primary and secondary education curriculum must include Natural and Social Sciences as the basis for regulating the education curriculum, including those related to the integration of Natural Sciences and Social Sciences. Although the National Education System Law mandates Natural Sciences, in its

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implementation, particularly in the Independent Curriculum, Natural Sciences and Social Sciences are integrated into Natural Sciences and Social Sciences (IPAS) to provide a more comprehensive understanding of the surrounding environment.

Science is dynamic and is a continuous effort made by humans to reveal the truth and use it for life (Samuel, 2014). Emerging problems cannot be solved by looking at them from a single natural science or social science perspective, but rather a more holistic approach encompassing various disciplines is needed (Yanitsky, 2017). In the Independent Curriculum, Natural Sciences and Social Sciences learning in elementary schools are combined into a single subject called Natural Sciences and Social Sciences. This aims to make learning more holistic and enable students to understand the relationship between nature and society. Natural Sciences and Social Sciences aims to equip students with knowledge, understanding, and skills about nature and the surrounding environment, as well as social interactions within society.

The science subjects in the Independent Curriculum were developed to provide a comprehensive and meaningful learning experience, emphasizing the integration of science, the environment, technology, and social values. Science aims not only to equip students with factual knowledge but also to develop science process skills, critical thinking, problem-solving skills, and foster curiosity about the phenomena around them. Therefore, the learning approach used in science must foster active student engagement, provide space for exploration, and encourage independent learning.

However, in practice in various elementary education units, it is still found that science learning is not fully optimal. Learning often remains conventional, with the teacher serving as the center of information and students merely passive recipients. The teaching materials used are generally textbooks, structured textually and lacking in interactive features, thus not providing sufficient intellectual challenges for students. Yet, the characteristics of elementary school students demand an approach that is enjoyable, concrete, and able to accommodate diverse learning styles.

Well-implemented learning objectives also require teaching materials to help provide meaningful learning to students. Meaningful learning can be achieved through engaging students during the learning process. Learning materials guide students to facilitate the learning process. The use of teaching materials can influence the effectiveness of the learning process. The use of teaching materials is a crucial element in achieving learning objectives. The development of teaching materials in this learning process is inseparable from technological developments. Various types of teaching materials can be developed using currently available technology. This is intended to ensure the learning process continues to meet students' needs.

The use of teaching materials is also accompanied by teachers' efforts in the classroom to understand the characteristics of students who, at their age, are curious, eager, and eager to try everything around them. Teaching materials serve as an intermediary between educators and students in delivering learning materials (Ridha et al., 2021). The importance of teaching materials is evident here, as they facilitate teachers and students in conducting a conducive learning process and provide meaningful learning experiences. When implementing learning using teaching materials, teachers are required to engage students in real-world situations to create more meaningful learning through the use of technology.

To support the development of innovative teaching materials, utilizing digital technology is a promising solution. The Industrial Revolution 4.0 era has brought about major changes in the way humans learn and interact with information. The current generation of students, known as digital natives, is highly familiar with technological devices and requires interactive, visual, and intellectually challenging learning approaches. Rapidly evolving technology is causing changes in the fabric of life. This also applies to education, including science and science lessons, requiring teachers to create interactive learning (Nuria et al., 2024).

According to Magdalena et al. (2020), teaching materials are a collection of teaching materials arranged systematically that represent concepts and direct students to achieve certain competencies. According to Wahyudi et al. (2022), teaching materials play a key role in teaching and learning activities. These materials can be in the form of text, images, audio, or video. Wordwall was chosen because teachers can create game-based learning activities such as quizzes, crosswords, match-the-pairs, and so on, which can be tailored to the lesson content. This application supports PBL-based learning because it can be used in the elaboration and evaluation phases as a tool to explore prior knowledge, test hypotheses, and reinforce concepts through educational games (Ariani, 2021). Furthermore, Wordwall offers flexibility in use, both online and offline, which greatly supports learning in the digital era and hybrid learning.

Using teaching materials alone is not enough; an appropriate learning model is needed. An appropriate learning model for the use of teaching materials can expand the teaching materials by providing meaningful learning to students. Students who enjoy using teaching materials will feel enthusiastic in every learning process. However, some students do not understand the learning instructions explained by the teacher. Therefore, it is necessary to use an appropriate model for students to

interpret learning using a problem-oriented learning model. The model used by educators is Problem-Based Learning (PBL). The Problem-Based Learning (PBL) model is a learning model that presents real-life problems in the learning process, thereby improving students' critical thinking skills. PBL presents a problem that has occurred, then students are asked to find information through other learning sources, involving thinking skills and other skills both individually and collaboratively. Thus, each student is actively involved in finding that information.

According to Barrows & Tamblyn (1980), "Problem-based learning is the learning that results from the process of working toward the understanding or resolution of a problem. The problem is encountered first in the learning process." According to Castle et al. (2008), problem based learning (PBL) is a learning model that presents various authentic and meaningful problem situations to students. The integration of PBL-based teaching materials and word wall applications in science learning is seen as a strategic approach to improving the quality of basic education. The collaboration between modern pedagogical approaches and digital technology can provide rich learning experiences, foster learning motivation, and equip students with skills relevant to future needs. Furthermore, this approach aligns with the policy direction of the Independent Curriculum (Kurikulum Merdeka), which emphasizes differentiated learning, project-based learning, and technology integration in education. A preliminary study was conducted at three schools: SDN 01 Patamuan, SDN 13 VII Koto Sei-Sarik, and SDN 05 Padang Sago.

Based on the results of a preliminary study at SDN 01 Patamuan, Patamuan District, Padang Pariaman Regency on Monday, April 14, 2025, researchers found that: the teaching modules created by teachers were not in accordance with the regulations of the Ministry of Education, Culture, Research and Technology where the module identity had not included the year, elements and time allocation, learning objectives were not specific and did not use measurable KKO, in terms of the learning process it was more teacher-centered because they explained a lot and students only listened to the information conveyed, teachers used teaching materials in the form of printed books and teaching aids had not used IT-based teaching materials, teachers had the ability to use IT-based teaching materials but were not optimal, schools had the availability of infrastructure that could support technology-based learning but were rarely used by teachers in learning because they were not yet proficient, had not used the PBL model, and had never used interactive Wordwall teaching materials in the learning process.

Based on the results of a preliminary study at SDN 13 VII Koto Sei-Sarik, VII Koto District, Padang Pariaman Regency on Wednesday, April 16, 2025, researchers found that in the teacher's teaching module, the learning objectives were still made only one, not described, some used KKO, in the learning process did not involve students to be more active, teachers used printed books and cards as teaching materials, used other models such as PjBL, Blended Learning, not all learning processes used the PBL model and wordwalls had never been used in learning.

The results of a preliminary study at SDN 05 Padang Sago, Padang Sago District, Padang Pariaman Regency on Monday, April 21, 2025, researchers found that in the CP and ATP teaching modules were not made, in the activity steps also not written the time allocation for each stage of the activity and did not use a learning model, teachers seemed more active than students, teachers used teaching materials in the form of printed books or videos taken from the internet, had not used the PBL model and had never used interactive wordwall teaching materials in the learning process.

Based on the results of the preliminary study and interviews, the researchers concluded that teachers were not maximizing the use of IT available in schools. The systematics of the teaching modules used by teachers did not comply with the regulations of the Ministry of Education, Culture, Research, and Technology. There was a lack of development of interactive, engaging, innovative, and enjoyable teaching materials for students, and no technology-based teaching materials designed independently. Therefore, teachers needed to improve their ability to process technology-based teaching materials to prevent student boredom. The PBL model had never been used for interactive teaching materials, especially technology-based ones.

Based on these issues, the researchers developed suitable online teaching materials, namely word walls using the Problem-Based Learning (PBL) model. This can provide more meaningful learning for students, with a variety of learning processes and templates, making learning more engaging. Maintaining student activeness in the classroom is crucial; the use of interactive teaching materials is significant. This can generate enthusiasm, interest, and diverse desires, stimulate motivation, and stimulate learning activities (Mujahidin et al., 2021).

From the background and problems obtained, the researcher is interested in conducting research to see how "Development of Interactive Science Teaching Materials Using Wordwall Applications Based on Problem Based Learning (PBL) Models in Grade IV Elementary Schools".

Method

The type of research used in this study is research and development (R&D). Research and development methods are used to produce a product and test its effectiveness. According to Sugiyono (2017), "R&D is a research method used to produce a specific product and test its effectiveness." Meanwhile, according to Saputro (2015), the research and development method is a research method used to produce a particular product and has the effectiveness of that product. Research and development are a process for developing a new product or refining an existing product, as well as testing its validity, practicality, and effectiveness.

The development model used in this writing is the EDDIE model. According to Branch in Batubara (2020) "The ADDIE model has five stages in its development, namely the first stage of Analysis, the second stage of Design, the third stage of Development, the fourth stage of Implementation, and the fifth stage of Evaluation." This model is used because it is in accordance with development writing and the stages of the ADDIE model are sequential according to the type of development writing to be carried out. The ADDIE model also provides a structured general framework and includes evaluation and revision at each stage (Angko & Mustanji, 2013).

According to Kuncahyono (2018), the ADDIE model has 5 stages, including: Analysis: This stage involves data collection through observations and initial interviews. Analysis is necessary to aid the design process and analyze the various needs and limitations in the field; Design: At this stage, the researcher creates a plan to be implemented after obtaining initial data from the needs analysis; Development: Development is the process of creating or developing teaching materials and validating them. The author created interactive teaching materials using a website, in this study, a word wall. The finished product was then validated by media, language, and materials experts. Focus Group Discussions (FGD) were conducted, followed by a trial at the designated elementary school; Implementation: This stage involves conducting field research at two subsequent schools with learning activities similar to those used in the trial. This research will also determine the practicality of the developed media. This practicality refers to the ease and appropriateness of the product when used in learning; Evaluation: This stage aims to determine the quality of the product. This stage is conducted to determine the qualitative and quantitative evaluation results. Qualitative data is obtained from expert validation questionnaires and student trial questionnaires. Quantitative data is obtained from the trial scores. The product development procedure using the ADDIE model according to Cahyadi (2019) is the ADDIE model (Analyze, design, development, implementation, and evaluation). As stated by Sugihartini & Yudiana (2018), the ADDIE model is often used because the stages of the ADDIE model describe a systematic approach to instructional development.

The subjects in the research on the development of interactive teaching materials using the wordwall application were fourth-grade students of SDN 01 Patamuan, SDN 03 Patamuan, and SDN 05 Patamuan, Cluster 1, Patamuan District, Padang Pariaman Regency. SDN 01 Patamuan served as a trial school, while SDN 03 Patamuan and SDN 05 Patamuan served as research schools. The number of students is as follows.

Table 1. Number of students as research subjects

School name	Amount		Total
	PA	PI	
SDN 01 Patamuan	13	15	28 Student
SDN 03 Patamuan	12	13	25 Student
SDN 05 Patamuan	10	15	25 Student

Instruments are needed in writing to obtain data. The data obtained serves to answer the formulation or writing questions (Lestari & Yudhanegara, 2017). The results of the writing data are highly dependent on the collection instrument. Valid data must have a level of trustworthiness and validity. According to Prastowo (2011), in compiling teaching materials, clear language, clear and concise sentences, and easy to read should be used. Sitepu (2012) also explains that in compiling textbooks, standard grammar from official sources such as the Indonesian Spelling System (EBI) should be used. Nerita et al. (2018) also said that teaching materials are said to be valid if they are in accordance with the curriculum, learning outcomes and the truth of the substance of the learning material.

A validity instrument is a validity sheet used to collect data on the validity of the developed teaching materials. The validity instrument provided to experts is a teaching materials validation sheet. This validation sheet is used to instill concepts and assist in the implementation of the learning process. This sheet includes material validation, language validation, and media validation. The practicality instrument for teaching materials is useful for collecting data on the practicality of the developed teaching materials. The instruments used were teacher response scores, student response questionnaires, and interview sheets. After using the developed interactive teaching materials, students and teachers were given questionnaires. The questionnaires aimed to determine the practicality of the products the author had developed.

Akbar (2016) stated that teaching materials can be considered practical if students have no difficulty using them. The use of technology in learning will be an additional factor in increasing the effectiveness of the learning process. Hasanah et al. (2017) stated that teaching materials designed with an attractive appearance can stimulate students' interest in learning and use them as learning resources.

The instrument for the effectiveness of interactive learning materials is a test. The test aims to determine whether student learning outcomes have improved and whether the learning materials used are effective. Test questions are given to obtain data on students' ability to master the learning material.

In this study, the author used statistical data analysis techniques because the data obtained through validity and practicality tests are in numerical form (Setyosari, 2016a). The data obtained were then analyzed and presented in tabular form using a Likert scale. (Suriasih, 2019). A teaching material can be considered effective if it can achieve the set learning targets or if there is an increase in learning outcomes.

From the results of the validity of the interactive teaching materials obtained, all aspects were analyzed which were presented in table form using a Likert scale.

In this study, the author used statistical data analysis techniques, because the data obtained through validity tests and practicality tests are data in the form of numbers (Setyosari, 2016b).

Table 2. Validity questionnaire assessment scale

Information	Weight
Very good	4
Good	3
Not Good	2
Very Not Good	1

From the table, it is known that if you get a score of 4, it is included in the very good category, if you get a score of 3, it is included in the good category, if you get a score of 2, it is included in the less good category, and if you get a score of 1, it is included in the very bad category. Furthermore, to calculate the final value data, the validity results use a formula modified by Purwanto in Sapuri (2015) using the formula:

$$V = \frac{x}{y} \times 100\% \quad (1)$$

Description:
V = Validity Value
x = Score Obtained
y = Maximum Score

Table 3. Categories of validity of teaching materials

Percentage (%)	Criteria
86–100	Very Valid
76–85	Valid
60–75	Quite Valid
55–59	Less Valid
0–54	Not Valid

The practicality analysis technique is useful for analyzing data from observations of the implementation of teacher and student response questionnaires. Data on teacher and student responses to the learning process are analyzed using the provisions in the following table.

Table 4. Teacher and student questionnaire assessment scale

Range	Conversion
4	Strongly Agree
3	Agree
2	Disagree
1	Very Much Disagree

The final value of the calculation and questionnaire was analyzed using the formula from Permana & Kasriman (2022), namely:

$$NP = \frac{R}{SM} \times 100\% \quad (2)$$

Description:
NP = practicality value
R = score obtained
SM = maximum score

Then, for the practicality category of teaching materials based on the calculation of the final value, it can be seen in the following table.

Table 5. Categories of practicality of teaching materials

Percentage (%)	Criteria
86–100	Very Practical
76–85	Practical
60–75	Quite Practical
55–59	Less Practical
0–54	Not Practical

The effectiveness test is obtained from student learning outcomes through completed evaluation tests. Student learning outcomes will later be used as a benchmark to measure student satisfaction. Students are considered satisfied if their learning outcomes exceed their pre-learning scores using interactive learning materials. Student satisfaction with learning materials can be measured using Purwanto's formula in Marhadi & Witri (2017):

$$S = \frac{R}{N} \times 100\% \quad (3)$$

Description:
S = Expected Value
R = Total Score
N = Maximum Score

In this study, data obtained before and after implementing learning with interactive teaching materials from both the pilot and research schools were reflected in pretest-posttest scores. Learning outcomes were obtained using a gain-normalization (N-gain) analysis. The N-gain score aims to measure the effectiveness of the treatment in the study. The N-gain score test is conducted by calculating the difference between the pretest and posttest scores (Meltzer, 2002). By calculating the difference between the pretest and posttest scores, or the gain score, we can determine whether the use or implementation of a particular method is effective or not.

The steps for analyzing normalized gain (Meltzer, 2002) are as follows: Calculate the normalized gain score using the formula:

$$< g >= \frac{\text{Posttest score} - \text{Pretest score}}{\text{Maximum score} - \text{Pretest score}} \quad (4)$$

Description:
<g> = Normalized Gain
TF = Posttest Score
Ti = Pretest Score
SI = Ideal Score

Table 6. Distribution of gain scores

N-Gain Value	Criteria
g < 0.3	Low
0.3 < g ≤ 0.70	Medium
0.70 < g ≤ 100	High

Table 7. Category N-gain percent (%)

Percentage (%)	Interpretation
< 40	Ineffective
40–55	Less Effective
56–75	Quite Effective
> 76	Effective

This research was conducted in Semester 1 from July 21 to July 25. SDN 01 Patamuan served as the trial school. SDN 03 Patamuan and SDN 05 Patmuan served as research schools.

Result and Discussion

This chapter presents the results of research on the development of interactive science teaching materials using a wordwall application based on the Problem Based Learning (PBL) Model in grade IV of elementary school. The development model used is the ADDIE development model with five stages, namely: the analysis stage, the design stage, the development stage, the implementation stage, and the evaluation stage.

Analysis Stage
Curriculum Analysis and Teaching Modules

The curriculum used in developing these teaching materials is the Merdeka Curriculum. The purpose of the curriculum analysis was to obtain an overview of the learning materials developed in accordance with the Merdeka Curriculum. The researcher conducted the curriculum analysis on the subjects included in Chapter 6 of the Natural Sciences (IPAS) book, "My Indonesia is Rich in Culture," with the topic of Cultural Diversity in Indonesia.

The learning objectives formulated for the topic of cultural diversity in Indonesia are: By observing pictures, students can identify various cultural diversities in Indonesia; By observing learning videos, students can examine the factors of cultural diversity in Indonesia; By playing games on the wordwall, students can determine the forms of diversity in Indonesia; and with the wordwall, students can reconstruct cultural diversity in Indonesia.

In the analysis of teacher teaching modules, several categories were observed and assessed. Data from SDN 01 Patamuan, SDN 13 VII Koto Sei-Sarik, and SDN 05 Padang Sago indicate that the teaching modules developed do not yet meet the standards for development in accordance with the Independent Curriculum. Common deficiencies found include incomplete module identities, the use of learning outcomes that do not refer to the latest CP, and learning objectives that are still general and do not use measurable operational verbs. Furthermore, most modules do not include a Learning Objective Flow (ATP), and the steps of learning activities do not follow a specific model, particularly the recommended Problem-Based Learning (PBL) model. The teaching materials used are still limited to conventional formats, without the integration of educational applications such as word walls. In terms of assessment, there are still shortcomings in the types of assessments used and the clarity of the rubrics and assessment criteria. The learning resources included are also limited, and Student Worksheets (LKS) are generally still paper-based, not digital or interactive.

Analysis of Teaching Materials

The results of interviews with three teachers from SDN 01 Patamuan, SDN 13 VII Koto Sei-Sarik, and SDN 05 Padang Sago as well as the results of observations during teacher implementation of learning indicate that the teaching materials used in learning are still dominated by conventional forms and have not fully utilized interactive technology. The teaching materials

used include printed books, images from the internet, handmade teaching aids, and simple learning videos downloaded from the internet. The three teachers stated that the teaching materials are quite effective, but still have limitations in maintaining student enthusiasm, especially when the learning is textual and not varied.

Analysis of Student Characteristics

Based on interviews and observations during teacher instruction, it was discovered that student characteristics exhibit a unique dynamic for elementary school age, particularly in phase B (grade IV). Students generally exhibit a high level of curiosity, are easily attracted to visual elements, and enjoy learning that involves hands-on activities or is fun. However, the conventional and unvaried teaching materials used by teachers tend to make them easily bored, especially if the material is delivered monotonously or relies solely on textbooks.

Analysis of Teacher and Student Needs

Based on the results of the teacher and student needs questionnaires administered, it was discovered that both teachers and students have a strong need for the development of interactive science teaching materials. Wordwalls as learning materials are considered to have great potential to address this need, particularly in increasing interest, motivation, and understanding of the material.

The teacher needs questionnaire results indicated that the current science teaching materials are still monotonous and uninteresting for students. Teachers feel that textbooks alone are insufficient to support optimal understanding of the material. Teachers stated that wordwalls are highly suitable for use in science teaching because they are easy to create, can be tailored to the material, and can capture students' attention through engaging visuals and quiz formats. Teachers also assessed that wordwall-based teaching materials support active, collaborative learning and increase student engagement throughout the learning process.

The student questionnaire data revealed that most students feel bored when learning science using only textbooks. Students stated that they prefer learning with games, engaging visuals, or quizzes. They also reported that they understand the material more easily when presented through interactive media, such as educational games.

Design Stage

At this stage, researchers designed digital-based science teaching materials. The interactive teaching materials were necessary for both delivering the material and assessing students. During this planning stage, researchers prepared the materials, created teaching modules, videos, games, and evaluation questions, which were added to the word wall.

According to Gagné (1985) "Instruction is a set of events that affect learners in such a way that learning is facilitated" which shows that teaching materials are part of instructional events designed to facilitate learning. According to Yuberti (2014), teaching materials can be interpreted as all forms of materials that are systematically arranged that enable students to learn by being designed according to the applicable curriculum. Supardi (2020), states that in addition to being systematic, meaning that teaching materials must be arranged sequentially and coherently.

According to Sherianto in Nissa & Renoningtyas (2021), a wordwall is a learning media application, a learning resource, and an assessment tool for teachers and students. Meanwhile, Halik & Rustan (2021) argues that wordwall learning media can also be managed as a web application that can be used to create fun quiz-based games with various templates.

According to Rahayu & Isnawati (2022), Wordwall is defined as a web-based digital platform that allows teachers to create interactive learning media. According to Zulaikha & Maftukhin (2021), Wordwall is a game-based learning application that aims to directly engage students in the learning process. According to Rofiah & Widodo (2023), Wordwall is a tool to help teachers create interactive web-based learning media. Meanwhile, Fitriani & Yusro (2022) state that Wordwall is a digital learning platform designed to present game-based activities that can be tailored to the subject matter and students' learning styles.

Development Stage

The development stage of interactive science teaching materials using the wordwall application includes validation testing, FGD (Focus Group Discussion) activities and product trials. At this stage, the designed teaching materials are tested by validators consisting of material experts, media experts, and language experts. After being validated by the validators, revisions are made based on the input provided and the validation results from all validators.

The results of the validity test of the teaching materials using wordwalls were obtained from the material validator with a final result of 95% in the very valid category. The validity test was conducted by filling out a questionnaire by the validator and providing suggestions for improving the media developed by the researcher. Aspects assessed in the material validity test include the appropriateness of the content/material, suitability with learning outcomes and the flow of learning objectives, presentation of the material that is interesting, clear and fosters students' curiosity.

The media expert validity test data obtained a result of 92.5% with a very valid category. Aspects assessed in the media expert validation questionnaire included the suitability of the wordwall media to the material, clear and attractive media displays, appropriate and attractive backgrounds on the wordwall media, and the templates used were appropriate for the learning material.

The results of the language expert analysis data were 95%, with a very valid category. Aspects assessed in the language validation questionnaire included the wordwall learning media using language that conforms to Indonesian language rules and EBI, being communicative, easy to understand, precise, and using the correct sentence structure.

Table 8. Summary of validation test results

Validation Test	Score (%)
Validity Test of Material Aspects	95
Media Aspect Validity Test	92.5
Language Aspect Validity Test	95

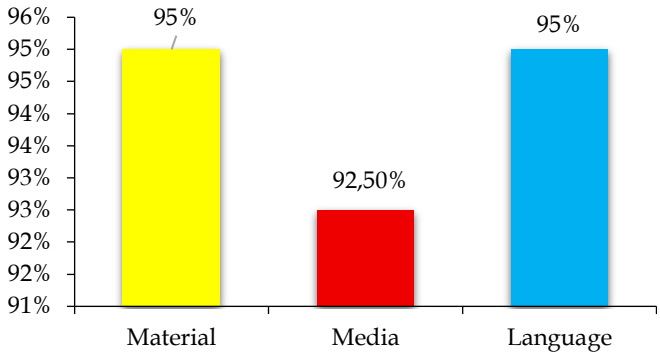

Figure 1. Validation test results

Implementation Stage

The use of teaching materials in the learning process at the pilot school received excellent reviews, as evidenced by the results of the teacher and student response questionnaires. The teacher's practicality test yielded a score of 92.5%, categorized as very practical, and the student's score of 93.9%, categorized as very practical. Therefore, it can be concluded that the practicality of the teaching materials falls into the very practical category.

The implementation of learning using wordwall learning media at the research school received an excellent response, as evidenced by student enthusiasm for the learning process using the wordwall. The results of the teacher and student response questionnaires showed that the teacher questionnaire received a score of 95%, categorized as very practical, and the student questionnaire received a score of 96%, categorized as very practical.

Table 9. Summary of practicality test results

School Name	Score (%)	
	Teacher	Students
Trial School	92.5	93.9
Research School	95	96

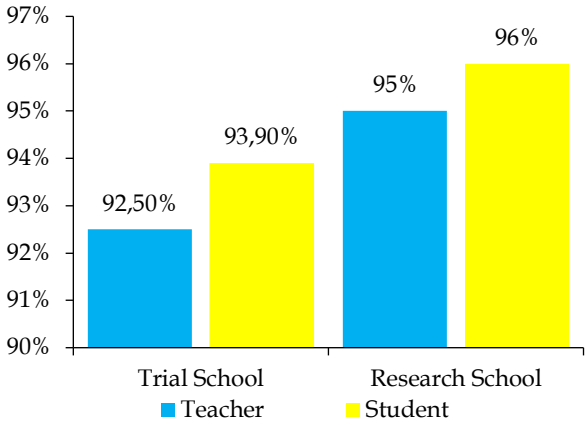

Figure 2. Practicality test results

The results of the effectiveness test at the trial school, the results of the effectiveness sheet calculation showed that student learning outcomes increased from 76.4 to 95.5% and at the research school from 74.15 to 97.3%. The results of the N-Gain test at the trial school were 83% and the results of the N-Gain test at the research school were 92.5%, so it can be concluded that the teaching materials using the wordwall application developed by the researcher are effective in the learning process.

Table 10. Summary of effectiveness test results

School Name	Pretest (%)	Posttest (%)	N-Gain Score	N-Gain Percentage (%)
Trial School	76.4	95.5	0.83	83
Research School	74.15	97.3	0.925	92.5

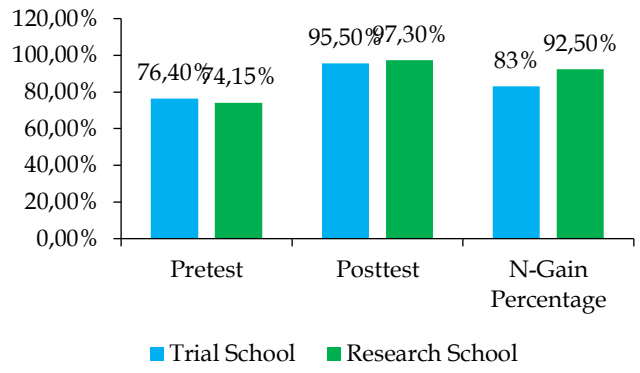

Figure 3. Effectiveness test results

Based on the results of the study, it shows that the use of teaching materials using the wordwall application has a very good impact on the process of learning science in grade IV. The learning process using this teaching material can help meet the needs of students, this is because the materials summarized in the teaching material are quoted from various sources that are relevant to initial competencies, learning outcomes and the flow of learning objectives and also the use of interactive teaching materials using the wordwall application increases students' enthusiasm and enthusiasm in learning because it has an interesting and attractive appearance so that it provides a new experience for students to not be bored and bored during learning in class.

Evaluation Stage

The evaluation phase is the final stage of the research process. The evaluation phase is conducted to provide feedback to product users, and revisions are made based on the evaluation results or any needs that the product has not yet met. Evaluation and improvements are carried out in accordance with the direction and input from the validator, as well as comments and suggestions from teachers and students.

After the researcher develops the teaching materials, the researcher then conducts validity tests with several validators who are experts in the fields of materials, media, and language. The product validation test process is conducted to determine whether the product the researcher has developed can be declared valid and suitable for field testing. After discussions regarding the product and completing the questionnaire, several aspects need to be improved or revised before the product can be considered suitable for use in the learning process. Revisions are made to perfect the developed media.

After this, analyze the results of each test conducted, both from the validity test, practicality test and effectiveness test in using this teaching material.

Conclusion

From the presentation of the research data and discussion above, the conclusions that can be drawn from this research are: The results of the validity test of the research entitled "Development of Interactive Science Teaching Materials Using Wordwall Applications Based on Problem Based Learning (PBL) Models in Grade IV Elementary Schools" have been developed with a very valid category and are suitable for use in the field. The results of the material expert validation obtained results of 95%, media validation obtained results of 92.5% with a very valid category and language validation obtained results of 95% with a very valid category. Based on the final results of the validity test, the development of teaching materials using wordwalls is valid and suitable for testing in the field; The results of the practicality test of the teaching materials using the wordwall that the researcher developed have been declared practical by teachers and fourth-grade elementary school students both at the trial school and at the research school. The percentage of the practicality level in the trial school was 92.5% for teacher responses and 93.9% for student responses. Meanwhile, the percentage of the practicality level in the research school was 95% for teacher responses and 96% for student responses. Thus, it can be concluded that the teaching materials using the wordwall application are practical and suitable for use in the field; The results of the effectiveness test of teaching materials using the wordwall application in science learning in elementary schools are effective for use in classroom learning. This can be seen from the results of student evaluations using the wordwall which show an improvement in the learning process. With the description, in the trial school the pretest percentage was 76.4%, increasing to 95.5% in the posttest. In the research school the pretest percentage was 74.15%, increasing to 97.3% in the posttest. Thus, it can be concluded that interactive teaching materials using the wordwall application are effective and suitable for use in the field.

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Author Contributions

Conceptualization, methodology, formal analysis, investigation, resources, E.R.P. and D.; data curation, preparation of the initial draft of the manuscript, validation, review and editing of the manuscript, visualization, L.Z. and M.F.A. All authors have read and approved the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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