PPD Profesi Pendidikan Dasar
p-ISSN: 2406-8012 | e-ISSN: 2503-3530
PROFESI PENDIDIKAN DASAR

STEM-Integrated Student Worksheets on Space Figure Using the Discovery Learning Model for Elementary School Students

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Submitted: 2022-07-25 DOI: 10.23917/ppd.v9i2.19319
Revised: 2022-11-10
Accepted: 2022-12-01

Keywords:	Abstract
research and development; student worksheet; discovery learning; STEM	*This study aimed to create student worksheets using the STEM approach for fifth-grade students of Bengkulu State Elementary School. The research used the ADDIE model and had two classes of 22 students as its sample population. The research tools were validation sheets, student assessment sheets, and learning outcome test sheets. Data was collected through multiple methods and analyzed using expert validation and reliability tests. The results showed that the STEM-based worksheets were highly feasible in terms of material, language, and presentation, and effective in improving student learning outcomes.*

INTRODUCTION

Background of the Study

The increasing pace of globalization has brought significant changes to the way science and technology evolve. According to Sutisna and Heysa (2019), globalization has led to the future of education being more interactive, hands-on, competitive, multidisciplinary, and high-productive. As we enter the 21st century, it is crucial that every country puts emphasis on enhancing the quality of education. The quality of education is deeply entwined with the quality of the teachers, as research has shown that effective teachers are better equipped to provide students with a superior learning experience as opposed to ineffective teachers(Cooper et al., 2011). Hence, teachers must strive to improve themselves, to become proficient educators, especially in the context of the elementary school where students receive their foundational education.

Enhancing the quality of education requires a focus on classroom learning. Teachers, as facilitators in developing students' abilities, need to implement innovative teaching methods (Susanta, Koto, & Susanto, 2022), particularly in the subject of mathematics at the elementary school level. Mathematics is a subject that is studied from early education through to higher education. Learning mathematics provides students with opportunities for the development of logical, systematic, critical, creative and careful reasoning abilities, as well as fostering self-confidence (Tandililing, 2012)

Teachers can utilize teaching materials in the form of student worksheets, designed using learning models that promote student engagement, to enhance student learning outcomes. To increase student knowledge, teachers must develop a series of learning designs that shift students from a passive role to an active one (Priatna, et, al., 2021). One effective method of supporting student engagement is the use of the discovery learning model. According to Divine (2012), the discovery learning model is an approach that enables students to actively participate in the learning process, utilizing their mental processes to uncover the concepts or theories being studied.

In creating these teaching materials, it is crucial to integrate approaches that connect concepts to the real world. One such approach is the Science, Technology, Engineering, and Mathematics (STEM) approach, which forms a relationship between classroom learning and the community environment (Kurniawan & Susanti, 2021). STEM-based learning is widely used in several countries as an effective method to support classroom learning. Incorporating teaching materials designed using the discovery learning model with STEM can serve as an effective learning solution in the classroom.

Problem of The Study

The current reality of classroom learning is that it is often not packaged in an engaging and attractive manner, which can result in students having less satisfaction and interest in the subject matter. A survey conducted at one of Bengkulu State's elementary schools found that 70% of fifth-grade students expressed less satisfaction and interest in mathematics. Additionally, document analysis of student assessments for fifth-grade building material at Bengkulu State's elementary school revealed an average score of 59.29 with a classical completeness percentage of only 44.82%. This highlights the need for a focus on improving student learning outcomes.

Interviews with fifth-grade teachers at Bengkulu State's elementary school revealed that the student worksheets currently in use are sourced from print/book agents. These worksheets provide only brief explanations of the material and some practice questions relevant to the material, failing to explain in detail the processes involved in obtaining a formula, theorem, or concept. Furthermore, by providing all the essentials of the material studied, these worksheets fail to increase students' curiosity and creativity, resulting in less active learning. These worksheets are expected to assist students in improving their mindset and way of learning in aspects including attitude (affective), knowledge (cognitive), and skills (psychomotor) as required by the Indonesian National Curriculum of 2013 and to support student activities in learning.

Research's State of the Art

Several studies have demonstrated that the use of discovery-based and STEM (science, technology, engineering, and math) approaches can improve student success in the classroom. These approaches have been found to enhance critical thinking skills in elementary schools (Siregar et al., 2019), provide engaging and enjoyable experiences, and increase interest in deeper learning of mathematics (Kelana et al., 2020). Additionally, future research should focus on developing assessments for interdisciplinary STEM education programs, according to Gao et al. (2020).

Research by Majid and Majid (2018) also supports the effectiveness of STEM-based guided discovery learning in increasing student scores. Fadlina et al. (2021) found that applying a STEM-based discovery learning model can improve students' critical thinking skills. Similarly, a study by Subakti, Marzal, and Hsb (2021) found that using the STEM-based discovery learning model with a cultural focus on Jambi improved mathematical creative thinking skills. Furthermore, Maifi and Ahmad (2021) found that after applying the discovery learning model, students had better understanding of mathematical concepts and greater self-confidence.

Overall, these studies suggest that discovery-based and STEM-based approaches can improve learning outcomes. While these studies are similar in their use of discovery and STEM models, this specific research involves using interactive student worksheets with video media as support.

Gap Study & Objective

The problems of achieving mathematics learning outcomes in elementary schools that have been described show the importance of supporting materials in learning. The material applied can be students' worksheets integrated with STEM using the discovery learning model. Teaching materials in the form of STEM discovery model integrated worksheets can be used by students as learning support, and students will be active in discovering the concepts of the material being taught. Through the student's worksheet developed for students, it is easier to understand geometric material, so there will be an increase in the achievement of learning outcomes.

METHOD

Type and Design

The objective of this study was to design and develop a teaching product that incorporates principles of STEM education, specifically through the integration of discovery learning methodologies, with a focus on cube and rectangular prism materials. The research and development design was employed in this study, which is a structured process that involves steps for the development or improvement of a product, as described by Winarni (2018). The development process was guided by the ADDIE model, which is a systematic approach that encompasses five distinct stages: Analysis, Design, Development, Implementation, and Evaluation.

Data and Data Sources

This study utilized both qualitative and quantitative data to evaluate the development of the teaching product. Qualitative data was collected through the distribution of validity questionnaires to experts in the field of materials, language, presentation, and graphics, who served as validators for the product. Quantitative data was obtained from the students in the fifth grade of Bengkulu State Elementary School. The sample consisted of 22 students in the experimental class and 22 students in the control class. The collected data was analyzed to evaluate the effectiveness of the developed teaching product.

Data collection technique

In this study, various data collection methods were utilized to gather information related to the development of the teaching product. These methods include observation sheets, interviews, questionnaires, and tests. The observation sheets were used to collect data on the initial needs of the product development and the characteristics of the students. Interviews were conducted with teachers to gather information on the needs of product development. A questionnaire was used to assess the validity of the product development in terms of the material, language, and graphic presentation aspects. Participants were asked to rate a set of statements on a scale of 1-5. Additionally, a test was administered to measure students' understanding of the concepts through descriptions and evaluate the effectiveness of the teaching product.

Data analysis

The data analysis techniques consisted of qualitative descriptive and quantitative data analyses. The qualitative descriptive data analysis was conducted to process data from interviews with teachers to figure out teacher needs, a survey of student needs, and an analysis of experts' criticisms and suggestions on the STEM-integrated discovery-learning-based worksheets. The data were analyzed by grouping the information obtained according to the needs of each instrument used. The analysis of the data obtained from experts' responses, criticisms, and suggestions for improvement was used as a reference for improving the STEM-integrated discovery-learning-based worksheets developed. Meanwhile, the quantitative data analysis was conducted to analyze the data collected from the research instruments, including the validation instrument used by the content, language, presentation, and graphics experts, and to determine the effectiveness of the STEM-integrated discovery-learning-based worksheets developed. A t-test (paired sample t-test) was additionally performed.

RESULTS

This research produces a teaching material product in the form of student worksheets on shape figures based on the discovery learning model and integrated with the science, technology, engineering, and mathematics (STEM) approach for the elementary school level. The development stages consisted of (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation. From the analysis stage, the following result was obtained: the curriculum used was Curriculum 2013, with a focus on developing basic competencies 3.6 *explaining and finding simple space figure nets* (the nets of cubes and rectangular prisms) and 4.6 *making simple nets of space figures* (the nets of cubes and rectangular prisms). At the design stage, the following elements were designed: (a) four student worksheets on cubes and rectangular prisms (including the nets of cubes and rectangular prisms); (b) basic instructions; (c) basic competencies and subjects; (d) supporting information and practice; (e) assignments and exercises; and (f) assessments. As an example, we present an example of the results of the product development design stage in Figure 1.

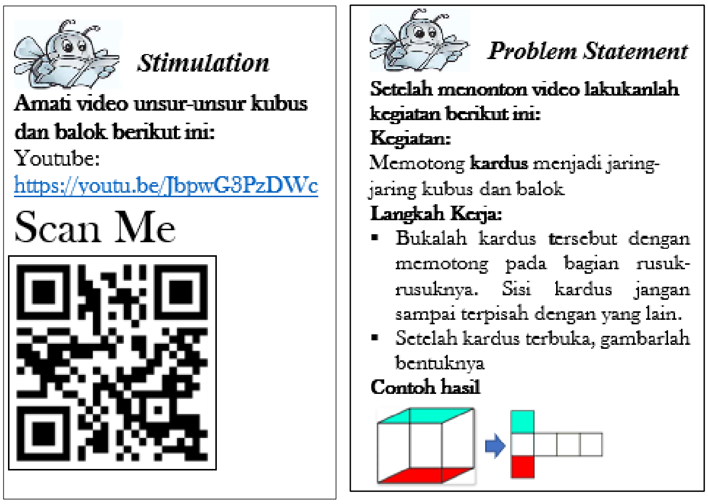


Figure 1. An example design of one of the student worksheets developed

Figure 1 is an example of the results of STEM-based LKPD-discovery learning product development in the stimulation and problem statement steps. The stimulation stage directed students to observe video elements of cubes and blocks via the YouTube link and barcodes. Stage the problem statement with the following translation.

After watching the video, do the following activities:

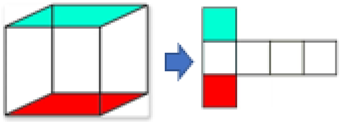
Activity:

Cuts cardboard into nets of cubes and blocks

Procedure:

- Open the cardboard by cutting the edges. Do not let the sides of the cardboard separate from the others.
- After the cardboard is opened, draw the shape.

Example



Validity test results

A validity test of the product draft was first carried out by experts with the aim of seeing the quality of the product in terms of content. The learning tools were validated by assessing the content, language, presentation, and graphics. The analysis of the validity of each component used the Aiken index analysis. The results of the validity analysis showed that, on average, each validator gave a value with a valid criterion for each component or aspect that was assessed. The results of the assessment and the analysis of the assessment data in the content aspect are shown in Table 1.

Indicators	Aiken Index	Criteria
Compatibility with the Basic Competencies	0.83	Very Valid
Suitability with students' abilities	0.67	Valid
Whether the student worksheets supported students' abilities	0.70	Valid
Compatibility with the discovery stage	0.63	Valid
Whether the student worksheets led to the science aspect of STEM	0.83	Very Valid
Whether the student worksheets led to the technology aspect of STEM	0.72	Very Valid
Whether the student worksheets led to the engineering aspect of STEM	0.68	Valid
Whether the student worksheets led to the mathematics aspect of STEM	0.83	Very Valid

Table 1. Validity testing results in the content aspect

An analysis of the Aiken index was conducted to evaluate the validity of each aspect of the materials. The results indicated that the materials met criteria for validity. To assess the agreement of experts in evaluating the content aspect, a reliability test was administered. The data analysis of the agreement test yielded a score of 0.92%, indicating a strong agreement between the two assessors. Additionally, an analysis of the Aiken index was conducted for the language aspect of the materials, as presented in Table 2.

Indicators	Aiken Index Ranges	Criteria
Readability	0.68–0.83	Valid–Very Valid
Information clarity	0.70–0.83	Valid–Very Valid
Language compatibility	0.83–1.00	Very Valid
Suitability with the development of students	0.65–1.00	Valid–Very Valid

Table 2. Validity testing results in the language aspect

The Aiken index was utilized to evaluate the validity of various indicators in the materials. The results indicated that the criteria for validity were met, with scores ranging from valid to very valid. Additionally, a reliability test was conducted to assess the agreement of experts in evaluating the language aspect of the materials. The average score obtained from the test was 0.86%, which met the criterion for good agreement. Furthermore, the results of the validity analysis for the presentation and graphics aspect, as determined by the Aiken index, are presented in Table 3.

Indicators	Aiken Index Ranges	Criteria
Presentation	0.68–0.83	Valid–Very Valid
Graphics	0.70–0.83	Valid–Very Valid

Table 3. Validity testing results in the presentation and graphic aspects

The results of the agreement testing for the presentation and graphics aspect of the materials, as conducted by the validators, revealed an average score of 0.90%. This score met the criterion for strong agreement. Based on the results of the validity analysis, it was concluded that each aspect of the materials met the criteria for validity. However, the results were accompanied by notes and revisions suggested by the validators. A summary of these suggestions for each aspect of the assessment of the student activity worksheets, as offered by the experts, is presented in Table 4.

Expert Validators	Suggestions/Feedback
Content Expert 1	1. The Basic Competencies and indicators were not appropriate.
	2. Highlight the STEM elements in the student worksheets.
	3. Explain the characteristics of discovery learning in the student worksheets.
	4. STEM in the student worksheets was not appropriate.
	5. The tools and materials in concept discovery were not appropriate.
Content Expert 2	1. Pay attention to the consistency of the indicators up to the evaluation.
	2. The contents of the materials did not lead to STEM.
	3. The tools and materials in the student worksheets were not clear.

Linguist 1	1. Similar elements needed to be clarified. 2. The use of spelling must be more careful. 3. The product was not very interactive. 4. There were some grammatical errors. 5. The language was not suitable for elementary school students.
Linguist 1	1. The use of spelling must be more careful; some letters were missing. 2. The sentences used should not be too long. 3. Pay attention to the grammatical accuracy in the use of interrogative words.
Presentation and Graphics Expert	1. The presentation of the student worksheets was not coherently ordered. 2. The general appearance was not yet attractive. 3. The pictures were not clear. 4. The presentation and graphics were not attractive. 5. The layout was untidy.

Table 4. The summary of validator suggestions/feedback for each aspect

The suggestions given by the validators were used as the basis for product revision. The following is an example of the correction provided by the validators to the student worksheets developed.

Figure 2. Before revision

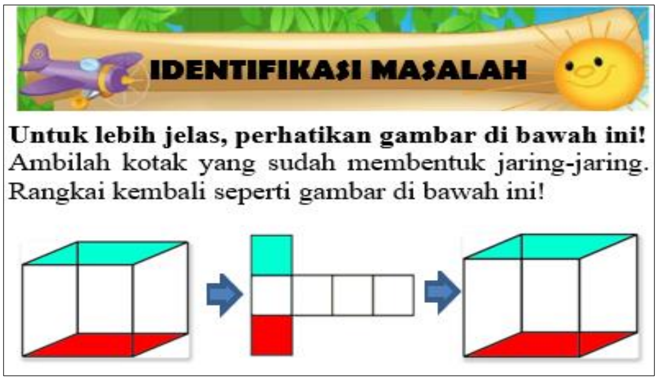


Figure 3. The product after revision

The focus of the student worksheet improvement was on images and the presentation of additional information.

Effectiveness test results

In order to determine the effectiveness of the STEM-integrated, discovery-learning-based worksheets on cube and rectangular prism materials developed in this study, a field trial was conducted. The trial was carried out on fifth-grade students of Bengkulu State Elementary School, with an experimental group consisting of 22 students and a control group consisting of another 22 students. The experimental group received instruction utilizing the developed worksheets, while the control group received conventional instruction. Both groups were administered a pretest and posttest with identical questions.

Prior to conducting the trial, the research instruments were thoroughly analyzed to ensure they met the necessary measurement and assessment criteria. The instruments were standardized through various tests, including expert validity and instrument reliability tests. The results of the validity test for the instruments used to measure the effectiveness of the worksheets are provided as part of the study findings.

Item	Question Indicators	r Count	Conclusion
1	Explaining cube nets (C2)	0.921**	Valid
2	Finding solid objects; for example, a cube (C3)	0.891**	Valid
3	Choosing cube nets (C4)	0.812**	Valid
4	Proving the net of a cube (C5)	0.953**	Valid
5	Making 11 cube nets (C2)	0.872**	Valid
6	Explaining the nets of rectangular prisms (C2)	0.848**	Valid
7	Finding rectangular prism nets (C3)	0.882**	Valid
8	Choosing rectangular prism nets (C4)	0.758*	Valid
9	Proving rectangular prism nets (C5)	0.804*	Valid
10	Making 5 cube nets (C2)	0.865**	Valid

Table 5. The results of the validity test of the test instruments

Table 5 shows that the calculated R-value ranges from 0.58 to 0.953 with valid criteria. Based on this, it can be concluded that the questions to measure product effectiveness meet the validity aspect. Next, we tested the reliability of the questions using Cronbach's alpha test. This calculation yielded a Cronbach's alpha (r11) of 0.927, meaning that the items were reliable with a very high criterion.

Student learning outcomes were tested through the effectiveness test of the student worksheets in the two research classes, the results of which are presented in the following table:

Statistics	Control	Experimental
Mean	60.23	83.18
Maximum	60.00	95.00
Minimum	20.00	70.00
Standard deviation	4.321	5.132

Table 6. Posttest data statistics

Based on Table 6, it is shown that there is an average difference in students' conceptual comprehension ability between the control class, where learning without using STEM-based worksheets and experiments with STEM-based worksheets. The control class has an average ability of 60.23, while the experimental class is 83.18..The test results data were analyzed to test the effectiveness of the student worksheets. It was performed using a t-test, and data analysis prerequisite tests were carried out. The first test was a normality test to determine whether the classes under study were normally distributed or not. The summary of the results of the posttest data normality test using the Kolmogorov-Smirnov test can be seen in table 7.

Class	Statistics	df	Sig.
Experimental	0.154	22	0.190
Control	0.121	22	0.200*

Table 7. Normality Test Results of Posttest Data Variants

As demonstrated in Table 7, the significance value was greater than 0.05, indicating that the test data on student learning outcomes were normally distributed. Subsequently, the test results of the students in the experimental and control groups were analyzed for data homogeneity. A summary of the results of this analysis can be found in Table 8.

Statistics	Levene Statistic	df1	df2	Sig.
Based on mean	0.269	1	42	0.607
Based on median	0.287	1	42	0.595
Based on median and with adjusted df	0.287	1	41.57	0.595
Based on trimmed mean	0.326	1	42	0.571

Table 8. Results of Homogeneity Test of Posttest Data Variants

As indicated in Table 8, the significance value was greater than 0.05, indicating that the data from the experimental and control groups were from a homogeneous population. Having confirmed that the test data on student learning outcomes were normally distributed and homogeneous, hypothesis testing was conducted using an independent t-test.

H_0: There is no difference in average learning outcomes between students who take part in learning with STEM-integrated, discovery-learning-based worksheets on the nets of cubes and rectangular prisms and students who do not use STEM-integrated, discovery-learning-based worksheets on the nets of cubes and rectangular prisms.

H_a: There is a difference in average learning outcomes between students who take part in learning with STEM-integrated, discovery-learning-based worksheets on the nets of cubes and rectangular prisms and students who do not use STEM-integrated, discovery-learning-based worksheets on the nets of cubes and rectangular prisms.

The criterion for concluding the independent t-test results is that H_0 would be accepted and H_a would be rejected if the significance level was < 0.05, meaning that there was no difference in average learning outcomes between those who took part in learning with the STEM-integrated, discovery-learning-based worksheets on the materials of the nets of cubes and rectangular prisms and those who did not. On the other hand, if the significance level was > 0.05, H_0 was rejected and H_a was accepted, meaning that there was a difference in average learning outcomes between those who took part in learning with the STEM-integrated, discovery-learning-based student worksheets on the geometrical nets material and those who did not. The summary of the independent t-test results can be seen in Table 9.

	Levene's Test for Equality of Variances		**T-Test for Equality of Means**		
	F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**
Equal variances assumed	0.269	0.607	5.549	42	0.000
Equal variances not assumed			5.549	41.243	0.000

Table 9. Independent T-Test Results

Table 9 shown the significance value in each group was 0.000. Because 0.000 < 0.05, then H_0 was rejected, and H_a was accepted. There was a difference in average learning outcomes between those who took part in learning with the STEM-integrated, discovery-learning-based worksheets on cube and rectangular prism nets and students who did not. These results were obtained from both the control class and the experimental class.

To measure the magnitude of the effect of one variable on another variable, the magnitude of the difference and relationship must be free from the influence of the sample size. The effect size value obtained from the t-test was 1.79. The results of the effect size calculation were interpreted using the classification according to Cohen (Becker & Kleinsmith LJ, 2000), as shown in Table 10.

Interval	Interpretation
0.8 ≤ d < 2.0	High
0.5 ≤ d < 0.8	Moderate
0.2 ≤ d < 0.5	Low

Table 10. The Criteria for the Interpretation of Effect Size Values

According to Table 10, the effect size value of 1.79 met the significant criterion. This means that using the STEM-integrated, discovery-learning-based worksheets had an effect on students' learning outcomes on the cube and rectangular prism material for the fifth grade of elementary school. To see the increase in learning outcomes, a gain test was conducted. The pretest and posttest scores are shown in Table 11.

Class	Average value		Gain	df	Criteria
	Pretest	***Postest***			
Control	42.05	64.55	0.38	11.86	Low
Experimental	40.23	83.18	0.59	10.31	Moderate

Table 11. The Summary of Pretest and Posttest Scores

Based on Table 11, the average pretest score of the control class was 42.05, increasing to 64.55 in the posttest. Based on the pretest and posttest results, a gain score of 0.38 was obtained, which was in the medium category. Meanwhile, in the experimental class, the average pretest score was 60.23, increasing to 83.19. Based on the pretest and posttest results, a gain score of 0.59 was obtained, which was in the medium category.

Based on these results, it can be concluded that students' learning outcomes in both control and experimental classes increased after learning. However, in the control class, the increase amounted to only 0.38, while in the experimental class, there was an increase of 0.59.

DISCUSSIONS

The outcome of this research and development project was the creation of teaching materials in the form of STEM-integrated, discovery-learning-based student worksheets that have been deemed valid through expert evaluations. The effectiveness of the student worksheets was evaluated through a field trial in experimental and control classes. The results revealed that the class that utilized the student worksheets had a higher average learning outcome compared to the class that did not use the student worksheets. These findings indicate that the use of STEM-integrated, discovery-learning-based student worksheets improves student learning outcomes. These results are consistent with previous studies, such as Sutama and Mayasri's (2016)), who found that the use of worksheets positively impacted learning, fostered student independence, and enhanced students' learning achievements. Similarly, Utami et al (2016) reported that student worksheets can improve students' learning outcomes. Furthermore, the utilization of activity sheets by teachers is deemed beneficial as it simplifies the learning process while promoting independent learning and written task performance, as stated by Anissa (2018).

The STEM-integrated student worksheet with the problem-solving model includes the following stages:

1. Stimulation - In this stage, students are presented with visual aids such as pictures and videos and are encouraged to ask questions based on their observations.
2. Problem Statement - At this stage, students identify relevant problems from the material presented and form hypotheses.
3. Data Collection - Students collect data to test and validate their hypotheses.
4. Data Processing - The data collected is analyzed and interpreted.
5. Verification - Students carefully examine and evaluate the hypothesis to determine its accuracy, in light of the results of data processing.
6. Generalization - Students draw conclusions from the information gathered and analyzed throughout the process.

Each of these stages is designed to guide students through a structured process of problem-solving, that allows them to gather, understand and apply their knowledge, to solve the problem presented to them.

The impact of student worksheets on learning outcomes in this study was attributed to the application of the discovery learning model. This model emphasizes students' active engagement with concepts and principles through their own experiences, leading to the discovery of the key ideas of the material. The discovery learning model worksheets trained students in the independent acquisition of concepts and improved their skills in conducting experiments, leading to enhanced learning outcomes.

Research by Junina et al (2020) has also found that discovery learning worksheets can guide students in conducting experiments independently and in gaining excellent learning outcomes. Additionally, Hosnan (2014) emphasized that the discovery model is focused on the understanding of the structure or important ideas of the discipline through active student involvement in learning. Similarly, Andayani (2020) reported that discovery-learning-based worksheets can improve students' cognitive skills and processes in understanding learning materials. Illahi (2012) also noted that the discovery learning model allows students to be directly involved in the learning process, using their mental processes to understand the studied concept. Furthermore, Winarni (2012) suggested that the discovery learning model is a type of learning process that does not present the material in a final form. Instead, students are encouraged to identify what they want to know and seek information on their own, and then organize the information to form what is known and understood.

Based on a review of literature, it was determined that the development of student worksheets that incorporate discovery learning activities and technology integration can be beneficial for teachers. This study resulted in the creation of a teaching material that integrates STEM principles. The STEM approach, which integrates science, technology, engineering, and mathematics, is considered to be important for fostering 21st-century skills (Beers, 2011). Effective implementation of STEM is crucial for the future success of learners, and thus integrated STEM teacher preparation and support are vital (Stohlmann et al., 2012). Therefore, in this study, the researcher developed STEM-integrated, discovery-learning-based student worksheets for fifth-grade elementary school students. The final product was specifically focused on the nets of cubes and rectangular prisms.

The research conducted by Fitri et al. (2021) showed that learning through the STEM approach has a significant impact on students' scientific reasoning abilities, with an effect size of 1.89. These findings are consistent with the results of the effectiveness test on the developed STEM-integrated, discovery-learning-based worksheets, which showed high effectiveness and feasibility for use (Fri & Risfendra, 2021). Moreover, the research conducted by Haifaturrahmah et al. (2020) found that the

STEM-integrated student worksheets developed are feasible to be used as a supportive learning resource within the context of integrated thematic learning, as outlined in the Curriculum 2013.

CONCLUSION

Novelty and Contribution

The outcome of this research and development study was the creation of teaching materials in the form of student worksheets that incorporate the discovery learning model and the STEM (science, technology, engineering, and mathematics) approach. Previous similar developments have been conducted, but these were limited to model-based worksheets and did not integrate STEM. The integration of technology with teaching materials can provide a more convenient learning experience for students. The results of the product validity analysis by experts indicate that the teaching materials meet the criteria of "very valid" in terms of content, language aspects, presentation, and graphics. The developed worksheets that integrate STEM and discovery learning have been found to be effective in improving students' conceptual abilities. This study makes a valuable contribution to the field of teaching materials by providing materials that integrate STEM, making it easier for students to understand and engage with learning concepts.

Limitations and Future Study

This research has several limitations, particularly in the implementation phase. One limitation is that the sample population of this research and development study was limited to students from Bengkulu State Elementary School 3. This affects the diversity of data used to evaluate the effectiveness of the teaching materials. Future studies should consider using a more diverse sample population, drawn from a variety of schools and regions, to improve the generalizability of the findings. Another limitation is that the materials were only focused on space figures, leading to a lack of diversity in terms of the subjects covered. Future research is recommended to include a broader range of materials and to extend the research time in order to address this limitation.

Suggestions

In light of the research findings, it is suggested that teachers incorporate the use of teaching materials that integrate technology in their instruction. Furthermore, it is recommended that schools provide specialized training for teachers in the use of technology in classroom learning to ensure that they are able to effectively utilize these materials in their instruction. Furthermore, future research should aim to develop teaching materials on more varied topics and materials and to use more diverse samples from more schools and regions to make the research result more generalizable.

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