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Interactive Multimedia Based on Problem Based Learning Models on Material Changes in the form of Objects

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ABSTRAK

Pembelajaran IPA memerlukan media sebagai penunjang penyampaian materi yang umumnya bersifat abstrak menjadi konkret. Nyatanya penggunaan media masih terbatas dan kurang bervariasi sehingga minta dan hasil belajar siswa menurun. Penelitian ini bertujuan untuk mengembangkan multimedia interaktif berbasis problem based learning pada materi perubahan wujud benda kelas V sekolah dasar yang valid, praktis dan efektif. Penelitian ini tergolong dalam jenis penelitian pengembangan yang dikembangkan dengan model ADDIE. Metode pengumpulan data yang digunakan adalah kuesioner, observasi dan tes. Data yang diperoleh dalam penelitian kemudian dianalisis dengan teknik analisis data kualitatif dan kuantitatif. Hasil penelitian pengembangan melalui uji validitas dari ahli materi 96,67%, ahli desain pembelajaran 94,23%, ahli media 93,33%, uji coba perorangan 93,89% dan uji coba kelompok kecil 90,55%; uji kepraktisan dari respon siswa sebesar 89,12% dan observasi keterlaksanaan kegiatan pembelajaran sebesar 93,33%. Hasil uji efektivitas yaitu terdapat perbedaan yang signifikan hasil belajar kognitif IPA siswa antara sebelum dan sesudah menggunakan multimedia interaktif berbasis problem based learning, sehingga multimedia interaktif efektif digunakan untuk meningkatkan hasil belajar siswa. Disimpulkan multimedia interaktif berbasis problem based learning valid, praktis dan efektif diterapkan pada muatan IPA materi perubahan wujud benda untuk siswa kelas V sekolah dasar.

ABSTRACT

Science learning requires media to support the delivery of generally abstract material that becomes concrete. Media use is limited and less varied, so demand and student learning outcomes decrease. This study aims to develop interactive multimedia based on problem-based learning on material changes in the form of objects in grade V elementary schools that are valid, practical, and effective. This research belongs to the development research developed with the ADDIE model. The data collection methods used are questionnaires, observations, and tests. The data obtained in the study were then analyzed using qualitative and quantitative data analysis techniques. The results of development research through validity testing from material experts were 96.67%, learning design experts 94.23%, media experts 93.33%, individual trials 93.89%, and small group trials 90.55%; the practicality test of student responses was 89.12%, and the observation of the implementation of learning activities was 93.33%. The result of the effectiveness test is that there is a significant difference in students' science cognitive learning outcomes before and after using interactive multimedia based on problem-based learning, so interactive multimedia is effectively used to improve student learning outcomes. It was concluded that interactive multimedia based on problem-based learning is valid, practical, and effective when applied to natural science content material for changes in the shape of objects for fifth-grade elementary school students.

1. INTRODUCTION

Learning media refers to anything used to convey messages and stimulate the thoughts, feelings, attention, and will of learners, thereby promoting deliberate, purposeful, and controlled learning processes (Nurrita, 2018; Rahmawati et al., 2021). The use of learning media in teaching and learning facilitates students' mastery of subject matter, aiming to generate interest, motivation, and creativity, increase student activity, and make learning meaningful (Jundu et al., 2020; Masturah et al., 2018). Learning media also supports smooth learning processes, particularly in science content in elementary schools (Putra, 2021;

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Yanayanti et al., 2020). Basic science concepts are relevant materials for elementary school children to comprehend concepts (Agustiana et al., 2020; Antari, 2020). Science learning, which involves living things and their environment, requires real-life examples to optimize understanding beyond textbook content (Febriani, 2017; Winangun, 2020). The role of media, especially in science learning, is crucial for improving learning outcomes and enhancing student achievement (Nugrahaeni & Wulandari, 2022; Wicaksono et al., 2020). However, the optimal implementation of learning media for science materials in elementary schools is not yet a reality. Teachers still predominantly rely on conventional media, such as printed teaching materials, blackboards, and display media (Dwiqi et al., 2020; Riwanto & Budiarti, 2021). Additionally, most science learning activities conducted by teachers are limited to the lecture method, lacking the use of concrete learning media, which restricts students' opportunities to build learning experiences (Qistina et al., 2019) The main factor contributing to the limited use of learning media is teachers' lack of understanding regarding models, methods, approaches, and engaging teaching materials (Rahmadani & Taufina, 2020).

Based on observation activities and questionnaire distribution conducted at SD Negeri 1 Sambangan, it was found that students experienced difficulties in understanding the subject matter using textbooks and some media such as real objects and visual media used by teachers, resulting in a lack of interest in the learning process. In addition, it was found that teachers more often applied a scientific approach with lecture methods in their teaching process. While the problem-based learning model has been implemented, it has not been maximized yet. There were statements from teachers in the questionnaire results stating that students' problem-solving abilities were still relatively low, indicating the need to improve the implementation of the problem-based learning model in teaching. Through questionnaires given to teachers, it was found that the use of learning media was still limited and lacked variation. Teachers mostly used real objects, visual media, and PowerPoint to assist students' learning process. The reasons for using these media were practicality and efficiency. Additionally, time constraints and limited understanding in creating varied media were also considerations for teachers. The science learning outcomes of fifth-grade students at SD Negeri 1 Sambangan are still relatively low, with 70.5% or 12 out of 17 students obtaining midterm assessment scores below the Minimum Completion Criteria (KKM), with a KKM for science subjects in elementary school being 72. The low learning outcomes of students are influenced by several factors such as passive students, the use of non-varied methods and media by teachers, and teachers not maximizing the use of science and technology.

To address these issues, the use of learning media that supports more engaging content delivery is necessary. One such media is interactive multimedia based on the problem-based learning model. Interactive multimedia is a learning medium that consists of two or more elements (text, audio, images, videos, and animations) supported by control tools to elicit active interaction from learners. The interactions referred to include learner-media interaction, learner-machine interaction (such as with computers and interactive videos), and the ability to regulate interactions between learners and the media (Deliany et al., 2019; Juniari & Putra, 2021; Mardiyah, 2021; Putra, 2021). Interactive multimedia based on the problem-based learning model is interactive multimedia that utilizes the syntax of the problem-based learning model as its instructional steps (Anggreni et al., 2021; Kadek et al., 2022). The problem-based learning model (PBL) is a learning model that uses real-world problems as a context for students to learn critical thinking and problem-solving skills (Hardiningrum & Agung, 2022; Ridwan et al., 2023). Problem-based learning is an effective approach to encouraging the development of students' critical thinking (Thorndahl & Stentoft, 2020). The problem-based learning model is used in the development of this media because it has advantages in developing students' critical thinking skills and their ability to adapt to new knowledge (Kenedi, 2019; Rosidah, 2018).

Several previous studies have revealed that interactive multimedia has excellent validity, making it suitable for use in the learning process (Dwiqi et al., 2020). Other research findings have shown that interactive multimedia based on problem-based learning is suitable for use in the learning process as it can improve students' learning outcomes (Tambunan et al., 2021). Further research has revealed that interactive multimedia based on problem-based learning is excellent and suitable for use in the science subject for fifth-grade elementary school students (Hardiningrum & Agung, 2022). Based on these research findings, it can be said that interactive multimedia based on PBL can enhance students' motivation and learning outcomes. However, previous studies have not specifically examined the development of interactive multimedia based on problem-based learning on the topic of changes in the state of matter for fifth-grade elementary school students. Therefore, this study focuses on this particular topic with the aim of developing valid, practical, and effective interactive multimedia based on problem-based learning for the topic of changes in the state of matter for fifth-grade elementary school students.

2. METHOD

This study falls under the category of development research, or research and development (R&D), which is a method used to create a product and test its effectiveness. This research was developed using the ADDIE model, where ADDIE is an instructional design that focuses on individual learning, has direct and long-term phases, is systematic, and uses a systemic approach to human knowledge and learning. The ADDIE model was chosen because it is relevant and adaptable to various conditions, allowing it to be used effectively. The level of flexibility of the ADDIE model in addressing problems is quite high. The ADDIE model provides a structured framework and includes revision and evaluation at each stage, resulting in a product that is suitable and effective for use. The ADDIE model consists of five stages: analysis, design, development, implementation, and evaluation.

The product testing phase is conducted through a media review system by experts and students to evaluate the developed media. The testing is carried out to determine the level of media validity. The testing involves media experts, design experts, content experts, and individual and small group testing with students. Once the media is deemed valid, the next step is to conduct practicality and effectiveness testing by implementing the media. Practicality testing is done through student response tests and assessments of the observance of learning activities. Effectiveness testing involves assessing student learning outcomes. The subjects in this study consist of 1 media expert, 1 design expert, 1 content expert, 3 students for individual testing, 9 students for small group testing, and 17 students. The object of this study is interactive multimedia based on the problem-based learning model on the topic of changes in the state of matter for fifth-grade elementary school students.

The data in this study is divided into quantitative and qualitative categories. Quantitative data is obtained from the assessments of content experts, instructional design experts, media experts, individual testing, small group testing, student response tests, observation sheets on the implementation of learning activities, and effectiveness testing. On the other hand, qualitative data is obtained from input, criticism, and suggestions from experts. The data collection methods used are questionnaires/ surveys, observation, and testing methods. The data collection instrument grids can be seen in Table 1, Table 2, Table 3, Table 4, Table 5, Table 6, and Table 7.

Table 1. Interactive Multimedia Validation Instrument Grid for Material Experts

No.	Aspect	Indicator	Item Number	Number of Items
1	Curriculum	1. Compatibility of material with KD.	1	1
		2. Conformity of material with GPA.	2	1
2	Content/Material	1. Material truth.	3	1
		2. Material accuracy	4	1
		3. The importance of material.	5	1
		4. Depth of material.	6	1
		5. Material attractiveness.	7	1
		6. Suitability of material to student characteristics.	8	1
		7. Material is easy to understand.	9	1
		8. The material helps students solve problems.	10	1
		9. The concept of matter can be logically explained clearly.	11	1
3	Grammar	1. Use of appropriate and consistent language.	12	1
		2. Language according to student characteristics.	13	1
		3. The language used is easy to understand.	14	1
		4. Sentence effectiveness.	15	1
Amount				**15**

Table2. Interactive Multimedia Validation Instrument Grid for Learning Design Experts

No.	Aspect	Indicator	Item Number	Number of Items
1	Competence	1. Clarity of basic competencies and indicators of competency achievement.	1	1
		2. Alignment of basic competencies and indicators of competency achievement with the material.	2	1
2	Strategy	1. Systematic delivery of material.	3,4	2

No.	Aspect	Indicator	Item Number	Number of Items
		2. Learning activities can motivate students.	5	1
		3. Provide students with opportunities for independent learning.	6	1
		4. The explanation of the material is interesting and appropriate to the characteristics of the students.	7.8	2
		5. Delivery of material according to learning steps.	9	1
3	Evaluation	1. Contains evaluation questions to test student understanding.	10	1
		2. The questions presented are in accordance with basic competencies and learning indicators.	11,12	2
		3. Clarity of instructions for working on questions.	13	1
Amount				**13**

Table3. Interactive Multimedia Validation Instrument Grid for Media Experts

No.	Aspect	Indicator	Item Number	Number of Items
1	Technical	1. Ease of using media.	1	1
		2. Media can help students understand the material.	2	1
		3. Media can arouse student motivation.	3	1
2	Appearance	1. Attractive appearance (colors, background and animation).	4	1
		2. The layout of media components is precise and appropriate.	5	1
3	Text	1. Text readability.	6	1
		2. Accurate use of type and size of letters.	7	1
		3. Accurate use of text spacing.	8	1
4	Videos	1. The use of videos can support understanding of the material.	9	1
		2. Video quality	10	1
5	Picture	1. The use of images supports understanding of the material.	11	1
		2. Standard image quality or resolution	12,13	2
6	Audio	1. Background suitability.	14	1
		2. Use appropriate sound effects.	15	1
Amount				**15**

Table4. Multimedia Validation Instrument Grid for Individual and Small Group Trials

No.	Aspect	Indicator	Item Number	Number of Items
1	Media	The attractiveness of learning with interactive multimedia.	1	1
		Ease of use of interactive multimedia.	2	1
		The attractiveness of interactive multimedia displays (background, color and animation).	3	1
		The effectiveness of interactive multimedia.	4	1
		Clarity of instructions for using interactive multimedia.	5	1
2	Material	Ease of learning material.	6	1
		Usefulness of the material.	7	1
		Clarity of the material displayed.	8	1
		Clarity of evaluation questions.	9	1
3	Learning	Fun learning activities with interactive multimedia.	10	1
		Multimedia interactivity.	11	1
		Students have the opportunity to study independently.	12	1
		Increase interest in learning.	13	1
		Giving examples.	14,15	1
Amount				**15**

Table5. Interactive Multimedia Practical Instrument Grid for Student Response

No.	Aspect	Indicator	Item Number	Number of Items
1	Material	Clarity of material content.	1	1
		Ease of learning material.	2	1
		Clarity of evaluation questions.	3	1
2	Convenience	Media is easy to use.	4	1
		Use simple language.	5	1
		The menus in the media are easy to understand	6	1
		The selected menu can display pages quickly.	7	1
3	Attractiveness	Learning media attracts students' interest.	8.9	2
		Media makes students more enthusiastic.	10	1
		Media helps students understand the material.	11	1
4	Appearance	Attractive media display.	12	1
		Interesting media to use.	13	1
		Image and video compatibility.	14	1
		Audio is clear and appropriate	15	1
		Amount		**15**

Table6. Practical Instrument Grid for Observing the Implementation of Learning Activities

No.	Learning Activities	Indicator	Item Number	Number of Items
1	Opening Activities	Delivery of greetings and prayers together.	1,2	2
		Delivery of competencies and learning objectives.	3	1
		Motivate students to be actively involved in learning activities.	4	1
		Implementation of the pretest.	5	1
2	**Core activities**			
	Problem orientation	Explore students' initial abilities.	6	1
		Raise the problem to be analyzed.	7	1
		Application of learning media.	8	1
	Organizing students to study	Form heterogeneous groups.	9	1
		Divide tasks and discuss problem solving.	10	1
	Guide individual or group investigations	Doing experiments.	11	1
		Conduct investigations and hold discussions.	12,13	2
		Utilize data/sources as discussion material.	14,15	2
		Checking student learning activities.	16	1
		Discuss problem solving solutions.	17	1
	Develop and present work results	Guiding the creation of work or reports.	18	1
		Prepare the results of the discussion to be presented.	19	1
		Presenting the results of discussions or problem solving solutions.	20	1
	Analyze and evaluate the problem solving process	Stimulate active student interaction during discussions.	21	1
		Provide feedback on presentations.	22	1
		Provide clarification on the issues that have been discussed.	23	1
		Review the material.	24	1
3	Closing	Asking students' impressions regarding media use.	25	1
		Carry out the posttest.	26,27	2
		Make conclusions.	28	1
		Pray together.	29	1
		Closing the lesson activity with greetings.	30	1
		Amount		**30**

Table7. Interactive Multimedia Effectiveness Instrument Grid

GPA	Question Indicator	Cognitive Level	Question Form	Question Number	Number of Questions
3.7.1 Describe the properties of solids, liquids and gases.	Students are able to determine the type of object according to its shape based on short text.	C3	Objective	1	1
	Presented with pictures, students are able to analyze examples of solid, liquid or gaseous objects	C4	Objective	2	1
	Students are able to analyze examples of objects in everyday life.	C4	Objective	4.5	2
	Students are able to analyze the properties of solid, liquid and gas objects.	C4	Objective	3.6	2
	Presented with images, students are able to make decisions regarding the properties of liquid objects.	C5	Objective	7	1
3.7.2 Analyze the differences between solid, liquid and gas objects.	Students are able to conclude the equations of liquids and gases.	C5	Objective	8	1
	Students are able to analyze the differences between solid and liquid objects.	C4	Objective	9	1
3.7.3 Detail the types of changes in the form of objects.	Presented with pictures, students are able to determine the type of change in the shape of an object.	C3	Objective	10,11	2
	Students are able to analyze types of changes in the form of objects.	C3	Objective	17	1
	Students are able to analyze charts of changes in the form of objects.	C4	Objective	24	1
3.7.4 Analyze examples of changes in the form of objects in everyday life.	Students are able to determine the changes in the shape of objects that occur in the examples presented	C3	Objective	14.21	2
	Students are able to determine examples of changes in the form of objects	C3	Objective	15	1
	Students are able to analyze examples of changes in the form of objects in everyday life	C4	Objective	13,16, 18,19	4
3.7.5 Examining that heat can change the shape of objects	Students are able to understand that heat can change the shape of objects.	C2	Objective	12	1
	Students are able to determine how heat can change the shape of an object.	C3	Objective	20.25	2
	Students are able to explain that heat can change the form of objects	C4	Objective	22,23	2
	Amount				**25**

The data obtained in this study was analyzed using qualitative and quantitative descriptive data analysis techniques. Qualitative descriptive data analysis is used to process data in the form of suggestions, criticisms, and comments from experts in content, design, and media, as well as from students through product testing. Meanwhile, quantitative descriptive data analysis is used to process numerical data to describe the average scores of each subject. Then, the overall subject percentage is calculated. The results obtained are then converted into a conversion guide for a five-point scale to determine the validity and practicality of the developed multimedia. The effectiveness analysis of the media is conducted using the correlated t-test formula. Data is collected by administering pretests and posttests to the target group of

students. Before hypothesis testing, it is necessary to conduct prerequisite tests, including testing the normality of data distribution and the homogeneity of variances.

3. RESULT AND DISCUSSION

Result

The design of this study is an interactive multimedia presentation based on the problem-based learning model on the topic of changes in the state of matter for fifth-grade elementary school students. The development is conducted based on the stages of the ADDIE model. The results of each stage of the ADDIE model are as follows: The first stage is the analysis stage. The analysis stage includes the analysis of learning needs, infrastructure analysis, media analysis, and content analysis. The needs analysis is conducted by direct observation and by providing questionnaires to teachers at SD Negeri 1 Sambangan in fifth-grade classrooms to obtain information about the problems faced by students and teachers during the learning process and the use of media to support the learning process. The observation activities revealed that students have difficulties understanding science subjects using textbooks and some media, such as real objects and pictures used by teachers, which results in a lack of interest and enthusiasm for learning. In addition, the problem-based learning model has not been fully implemented by teachers, as indicated by statements from the questionnaires stating that students' problem-solving abilities are still low; therefore, the implementation of the problem-based learning model needs to be improved in the teaching process. The infrastructure analysis is conducted to determine the completeness of the learning facilities available at the research site so that the developed media can be used effectively. The school already has complete learning facilities. The media analysis is based on the problems faced by students and teachers at SD Negeri 1 Sambangan, namely the limited use of concrete media and PowerPoint, which leads to the development of interactive multimedia based on the problem-based learning model. The content used in the development of interactive multimedia is the content of science subjects, specifically the topic of changes in the state of matter. The science subject is chosen based on the low cognitive learning outcomes in science subjects, thus requiring media support to make the learning process more interesting and less monotonous. The specific competencies and indicators used can be seen in Table 8.

Table8. Basic Competencies and Indicators

Basic competencies	Indicators of Competence Achievement
3.7 Analyze the effect of heat on changes in temperature and shape of objects in everyday life.	3.7.1 Describe the properties of solids, liquids and gases. 3.7.2 Analyze the differences between solid, liquid and gas objects. 3.7.3 Detailing the types of changes in the form of objects. 3.7.4 Analyze examples of changes in the form of objects in everyday life. 3.7.5 Examining that heat can change the shape of an object.

The second stage is the design stage, where interactive multimedia based on problem-based learning is designed. This stage involves creating a flowchart and storyboard, designing the media interface, and developing teaching materials and assessment instruments. The flowchart is created to help organize the content flow of the interactive multimedia. The storyboard, created using Adobe Animate, represents the visual design of the interactive multimedia. The media interface design includes a green and white color scheme with ornaments that represent the topic of changes in the state of matter. In this stage, teaching materials such as lesson plans and media assessment instruments are also developed.

The third stage is the development stage, where the product is created based on the media design. The product is organized in a specific order, including a cover page, main menu, button usage instructions, reference list, competency and objectives, problem orientation, content, problem-based learning activities, evaluation, and developer profile. Other buttons such as home, exit, back, and sound on/off are also included. The developed media interface can be seen in Figure 1.

Figure 1. Interactive Multimedia Display

The previously prepared assessment instruments underwent content validity testing by two competent judges. The testing was conducted using the Gregory formula, with the results showing that the content validity coefficient of the subject matter expert instrument obtained a score of 1.00, which falls into the category of very high content validity. The content validity coefficient of the design expert instrument obtained a score of 0.92, also falling into the category of very high content validity. The media expert instrument obtained a content validity coefficient of 1.00, indicating very high content validity. The individual trial and small group trial instruments obtained a content validity coefficient of 1.00, also falling into the category of very high content validity. The student response practicality test instrument obtained a content validity coefficient of 0.93, indicating very high content validity. The observation instrument for learning implementation obtained a content validity coefficient of 1.00, indicating very high content validity. Lastly, the test instrument obtained a content validity coefficient of 1.00, also indicating very high content validity. The test instrument underwent further testing to determine its validity, reliability, discrimination power, and difficulty level. Based on these results, the instrument can be used with minor revisions.Next, the product was validated by experts and tested through individual and small-group trials. The product was revised based on the input provided by the experts.

The fourth stage is the implementation stage. The developed media is used in classroom learning with the help of a lesson implementation plan to make the learning process more systematic and directed. The learning is carried out by teachers and students using interactive multimedia based on problem-based learning. Meanwhile, students assess the implementation of the learning activities using an observation sheet, accompanied by another teacher at the school.The fifth stage is the evaluation stage, which is done by assessing the product through formative and summative evaluations. Formative evaluation is conducted by analyzing the validity data from subject matter experts, media experts, design experts, and student trials, which are then used as input for product revisions. Summative evaluation is conducted by analyzing the practicality and effectiveness data to draw conclusions. The analysis of the validity data of the interactive multimedia showed that the subject matter expert obtained a score of 96.67%, the design expert obtained a score of 94.23%, the media expert obtained a score of 93.33%, the individual trial obtained a score of 93.89%, and the small group trial obtained a score of 90.55%. The validity results indicate excellent ratings from both experts and students, indicating that the interactive multimedia is valid for use in the learning process. Furthermore, based on the analysis of the practicality data of the interactive multimedia, the practicality assessment from student response obtained a score of 89.12% with a good qualification, and the observation of learning implementation obtained a score of 93.33% with a very good qualification, indicating that the interactive multimedia is practical for both teachers and students.

Furthermore, the analysis includes effectiveness testing of the media product. The effectiveness testing is done by comparing the students' test results through pretests and posttests using the correlated t-test formula. Prior to that, normality testing and variance homogeneity testing were conducted, with the results showing that the pretest and posttest data were normally distributed and had homogeneous variances. The calculation of the correlated t-test obtained a t-value of 8.75. This result indicates that the calculated t-value is greater than the tabulated t-value (8.75 > 2.04), thus rejecting the null hypothesis (H0) and accepting the alternative hypothesis (H1). This means that there is a significant difference in students' cognitive learning outcomes in science before and after using the interactive multimedia based on problem-based learning, indicating that the interactive multimedia is effective in improving students' learning outcomes.

Discussion

Based on the results of the analysis conducted, three main findings were obtained in this study. The first finding indicates that interactive multimedia based on problem-based learning is valid for use in the learning process. This is because several factors, such as the ability of interactive multimedia to translate abstract science materials into concrete ones, make the material easier to understand. Science is generally difficult to learn using only books as learning resources (Febriani, 2017; Qistina et al., 2019). The

presentation of materials in interactive multimedia can increase students' interest in learning and their understanding (Nuraini et al., 2021). The use of examples in learning can build students' prior knowledge (Maharani et al., 2021; Mardiyah, 2021). The developed interactive multimedia also provides opportunities for independent learning for students (Deliany et al., 2019; Putra, 2021). Multimedia-based learning media can facilitate students in independent learning to develop their understanding and problem-solving skills. The interactive multimedia is designed with clear navigation buttons and usage instructions to facilitate students use of the media (Panjaitan et al., 2020; Utami, 2021). Another factor is that the developed media has an attractive appearance, which motivates students to learn. The appearance of a media can include audio, images, and colors used; the more attractive the presentation, the higher the motivation and desire of students to learn from the media (Hardianti & Asri, 2017; Supriyono, 2018; Tambunan et al., 2021).

Second findingshows that interactive multimedia based on problem based learning also obtains practical results for use in the learning process. Interactive multimedia can be utilized and used easily by students in learning, because it presentsdesigned navigation buttonsas simple as possible and describes the contents of the button (Egok & Hajani, 2018; Hardiningrum & Agung, 2022).The use of interactive multimedia also allows teachers to organize classes to be more enjoyable through clear learning steps available in interactive multimedia(Ridwan et al., 2023; Ulfa et al., 2022). The third finding shows that the effectiveness of interactive multimedia development products based on problem based learning in this study obtained effective results where it was found that there was a significant difference in students' cognitive learning outcomes in the science content material on changes in the shape of objects between before and after using interactive multimedia.(Kenedi, 2019; Rosidah, 2018). Interactive multimedia which contains elements of text, images, animation, music and video is an attraction for students in gaining meaningful learning experiences, because generally attractive media displays can motivate students to learn.(Thorndahl & Stentoft, 2020). Increasing student learning outcomes is also influenced by student interest in learning, where there is a high relationship between student interest in learning and student learning outcomes(Kahfi et al., 2021).The combination of using digital media such as interactive multimedia in learning will be very beneficial in bridging the process of delivering material to students, because this media is able to foster enthusiasm, creativity, imagination, critical thinking skills and improve student learning outcomes.(Hardiningrum & Agung, 2022).

The results obtained in this study are in line with the results of previous research, which also revealed thatInteractive multimedia has a very good validity value so it is suitable for use in the learning process(Dwiqi et al., 2020). Other research results show that interactive multimedia based on problem based learning is suitable for use in the learning process because it can improve student learning outcomes(Tambunan et al., 2021).Further research revealed that interactive multimedia based on problem based learning was very good and suitable for use in science content in grade V elementary schools(Hardiningrum & Agung, 2022). So based on several research results, it can be said that PBL-based interactive multimedia is able to increase student enthusiasm and learning outcomes.

4. CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that interactive multimedia is problem-based *learning.* In the material on changing the shape of objects, we obtained very valid, practical, and effective results for use in learning. Thus, the product developed can be used as a medium to support the learning process in elementary school and can be used to improve student learning outcomes.

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