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Implementation of the Problem-Based Learning Model Assisted by Interactive Multimedia in Database Learning to Improve Students' Computational Thinking

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ABSTRACT

Education is a crucial key in shaping individuals who are capable of competing and actively participating in an increasingly complex and dynamic environment. However, education today often remains focused on teacher-centered approaches, which can hinder students' problem-solving abilities, including computational thinking skills. This research aims to implement the Problem-Based Learning (PBL) model with the assistance of interactive multimedia in database learning to enhance students' Computational Thinking (CT) abilities. The research method used is the Research and Development (R&D) method with the ADDIE multimedia development model and a One Group Pretest post-test research design. The research findings indicate that: 1) The developed multimedia received expert validation with a validity level of 93.55% and categorized as "Very Good". 2) The implementation of the PBL model in database learning has a positive effect on improving students' computational thinking abilities, with an average n-gain of 0.478 categorized as "Moderate". 3) The average student response to the interactive multimedia is 93.45% with the category "Very Good".

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1. INTRODUCTION

The current era of the Fourth Industrial Revolution has significantly transformed the global landscape, presenting new challenges and unlimited technological development opportunities across various sectors of life. The advancement of digital technology and automation has impacted how humans work, communicate, and even learn (Tohari et al., 2019). With the increasingly widespread adoption of technology in various fields, the demand for individuals capable of adapting has also grown, emphasizing the importance of becoming high-quality and competitive human resources (Nuristiqomah et al., 2021).

High-quality and competitive human resources are characterized by their ability to adapt to the Industrial Revolution paradigm and upcoming challenges, supported by high-order thinking skills (Tahar et al., 2022). Possessing high-level thinking skills enables individuals to develop critical, methodical, and effective problem-solving mindsets. In Indonesia, despite the adoption of modern technology in various aspects of life, there are still significant challenges in meeting the need for high-quality human resources. This is proven by Indonesia's Human Development Index (HDI) results reported by the UNDP, which ranked Indonesia 122nd out of 193 countries in 2022, with a score of 0.713, indicating low compared to the global and ASEAN average scores. One of the main factors contributing to Indonesia's suboptimal human resources is the lack of quality education outcomes that align with the criteria of human resources in the Fourth Industrial Revolution era, particularly the lack of high-order thinking skills (Fatimah et al., 2022).

Therefore, education should not only produce students proficient in understanding theories but also skilled in solving practical problems encountered in the real world by habituating students to solve problems in the learning process. Quality education should focus not only on the results but also on the learning process itself, prioritizing problem-solving abilities, which can enhance the quality of education as students are directly confronted with challenges and thinking activities to provide solutions to problems, thus training their complex thinking abilities (Salay, 2019).

According to Wing (as cited in Yasin, 2020), Computational Thinking (CT) is a thinking skill that allows teachers to stimulate students to break down complex problems into smaller parts, identify patterns, create general information from problems, and devise problem-solving steps. Improving problem-solving abilities can be achieved by using problem-solving techniques within the realm of education, one of which is CT (Computational Thinking), which helps students think systematically and logically in addressing real-life problems.

In vocational schools (SMK), CT is already incorporated into learning, especially in early classes. However, in reality, the learning process in SMKs still does not sufficiently train CT skills, resulting in low problem-solving abilities among students (Diantary & Akbar, 2022). Based on these findings, CT skills need to be enhanced by habituating and training students to solve problems using CT techniques in the learning process. Training and habituation in problem-solving during the learning process can be supported by selecting the appropriate teaching models to produce effective learning.

Therefore, it is necessary to adopt a teaching model that can enhance student engagement and problem-solving abilities. In the process of problem-solving, students can actively acquire information and develop understanding related to the subject matter, construct problem frameworks, organize problems, gather data, and formulate solutions either individually or in groups. Thus, students are directly involved in the learning process and can train CT skills by regularly gathering, analyzing, and formulating information to solve problems.

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One of the learning models that can train students' CT skills is Problem-Based Learning (PBL). According to Moffit (as cited in Rafli, 2020), PBL is an approach to learning that utilizes real-life problems as contexts that students must solve to acquire new knowledge. Through PBL, students are stimulated to obtain their new knowledge and relate it to their daily lives, making learning outcomes more meaningful as students learn from their findings. The PBL model is expected to help students train their problem-solving skills, and they can apply CT indicators to the problem-solving process.

On the other hand, the learning model used should involve active student participation to prevent boredom and increase student motivation. Therefore, the selection of appropriate learning media is also crucial. One of the learning media that teachers can use, in line with current technological advancements, is interactive multimedia. Interactive multimedia consists of various media combinations in its learning content and involves student activity in the learning process by performing actions that can increase motivation and prevent boredom during learning.

The use of interactive multimedia can facilitate the PBL learning process with a CT approach. Through various media such as instructional videos, teaching modules, quizzes, and other interactive features, it is expected to assist in presenting problem-based learning that students can solve by applying CT. Moreover, the relevance of interactive multimedia in enhancing CT lies in providing students with opportunities to actively engage in the learning process, broaden their understanding of the material, and stimulate problem-solving abilities.

Furthermore, the PBL model assisted by interactive multimedia will implement database learning because, according to Herlambang (2021), databases have complex concepts involving understanding, analysis, and modeling in mastering database concepts and practices that address real-life problems. Therefore, CT abilities can be involved in database learning by training students to design and solve problems given in the PBL model using computational steps.

With these interconnected issues, this research titled "Implementation of Problem-Based Learning Assisted by Interactive Multimedia in Database Learning to Enhance Students' Computational Thinking" is proposed.

2. METHODS

To support the realization of this solution, the researcher will employ the Research and Development (R&D) method. R&D is a research and development method that is applied to create specific products and test their performance. In the context of education, the R&D method aims not to formulate theories but to create effective products for use in the learning process. The R&D method will be implemented alongside the ADDIE media development model and a one-group pretest-posttest design with a quantitative research approach, applying the ADDIE model for developing interactive multimedia (Analyzing, Designing, Developing, Implementing, and Evaluating). The one-group pretest-posttest design is a type of pre-experimental research design.

The ADDIE media development model consists of five stages that are used as a guide in development. The research steps to be outlined can be found in the flowchart below. The detailed explanation of the research stages illustrated in **Figure 1** is as follows:

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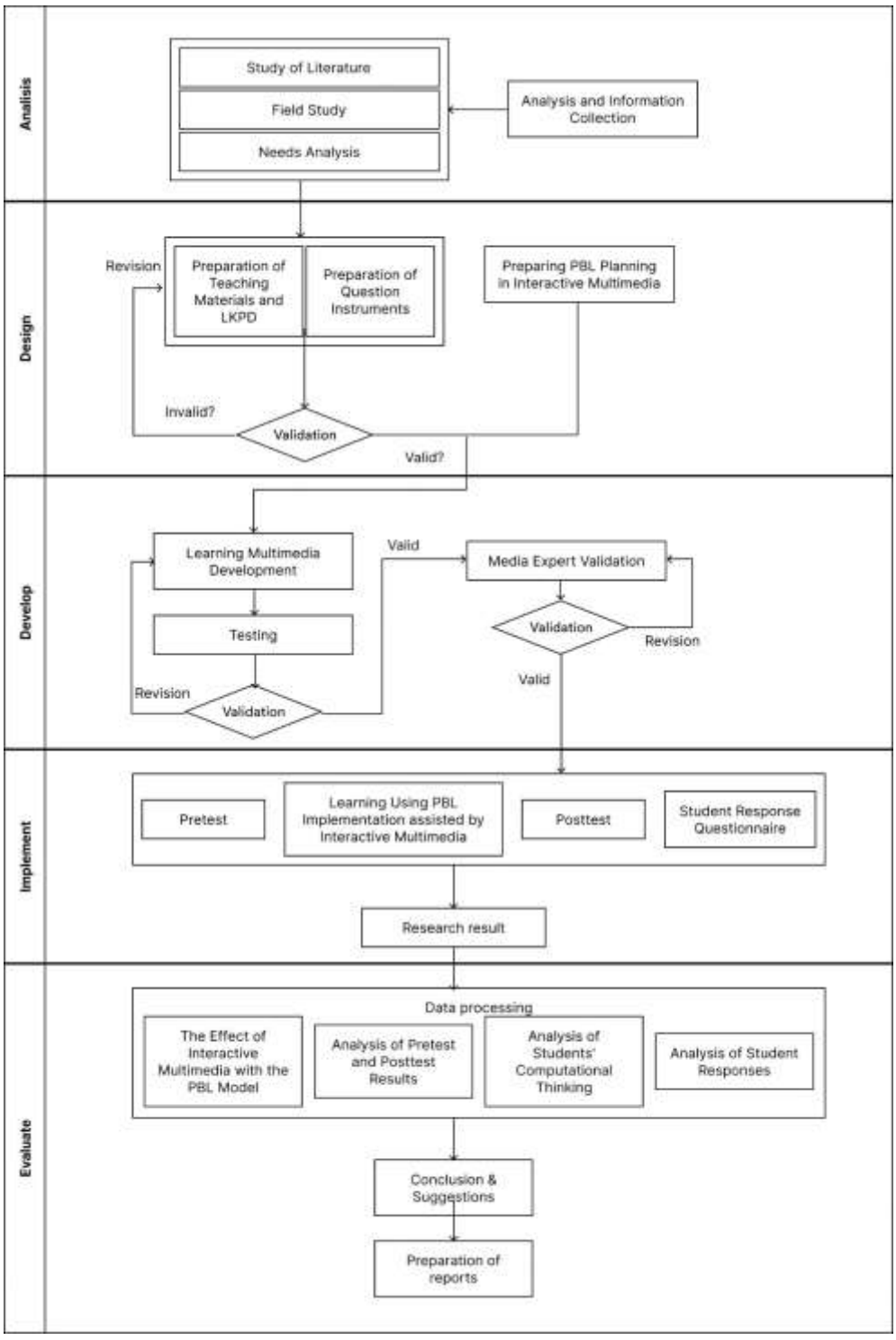

Figure 1. Procedure of Multimedia Development

Here is the explanation of the multimedia development procedure:

a. Analysis: The initial phase of pre-production aimed at identifying the needs and causes of ineffective learning by conducting a literature review and field studies. The researcher conducts a review of literature and field research to explore issues related to the research topic.
b. Design: Involves detailed and clear planning related to the teaching materials, database-related questions, and the planning of multimedia learning. The overall planning of materials and questions is aligned with the Learning Objectives Flow from

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the Learning Outcomes present, as well as the Competency Achievement Indicators desired during the learning process. Additionally, the planning includes software planning comprising the creation of flowcharts, storyboards, and multimedia data flow diagrams to facilitate the researcher during the development process later on.

c. Development: The researcher begins the process of preparing teaching materials, worksheets, and database question instruments, creating interactive multimedia that will be accessible to students through a website, and conducting black box testing to ensure the compatibility between input, output, and various features such as buttons, images, videos, and other features within the multimedia.
d. Implementation: The researcher implements the developed multimedia to the experimental group during the learning process in the classroom. Before this, the researcher administers a pretest to the students to evaluate their initial abilities related to the material to be tested. Subsequently, students will be guided to use the interactive multimedia with specific steps. Afterward, the researcher will guide the students to undergo a posttest to evaluate the improvement of students' understanding of the material and their computational thinking abilities. Students are then asked to provide feedback or assessment of their experience using the interactive multimedia they have undergone.
e. Evaluation: The researcher processes and analyzes the data collected during the previous implementation stage, which will then be compiled into conclusions and recommendations related to the application of the interactive multimedia designed and developed by the researcher.

The advantage of this research design is that the researcher can measure the treatment effect more accurately because they can compare the conditions before the treatment with the conditions after the treatment is given. Here in **Table 1** is the research pattern of the one-group pretest-posttest:

Table 1. Design One-Group-Pretest-Posttest

Pretest	Treatment	Posttest
O_1	X	O_2

Explanation:
O1 : Pre-test Results (before treatment)
X : Administration of Experimental Treatment
O2 : Post-test Results (after treatment)

2.1. Population and Research Sample

In a research study, it is necessary to select a sample that can represent the population with criteria and qualities relevant to the research objectives. The research object refers to a subset of the criteria within the population, and this is known as the sample. The population in this research is the vocational high school (SMK) students in the SIJA program, specifically those in Grade XI. The researcher selects Grade XI because the initial database material is taught at this level. To determine the sample, the researcher uses the purposive sampling method, where the sample is chosen based on specific criteria. 35 students in SIJA SMK Negeri 1 Cimahi were suitable to be research samples.

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2.2. Research Instrument

In the conducted research, several instruments were utilized, including field instruments, questions, media validation, and instruments for feedback from the experimental group or students. The field instrument consisted of interviews with teachers and questionnaires in the form of surveys given to students, containing opinions, challenges, and suggestions related to the database subject. To assess students' comprehension abilities regarding the taught material, a database question instrument in the form of multiple-choice questions was employed. Before being administered to the students, these questions were validated by subject matter experts and educational experts. Next, the development of a media validation instrument utilized the Multimedia Mania Judge's Rubric 2004 from North Carolina State University. This rubric was employed to assess whether the created multimedia met the appropriate standards for use. Subsequently, the development of validation instruments for computational thinking (CT) and Problem-Based Learning (PBL) within the multimedia was tailored to the needs of the students and the multimedia itself. Additionally, the creation of a student feedback instrument was conducted to gather assessments and feedback from students regarding various aspects of the media, conveyed through a questionnaire. The instrument utilized by the researcher was the Multimedia Mania Student Checklist 2004 from North Carolina State University.

2.3. Data Analysis Techniques

After the multimedia and materials have been validated by experts, the results are analyzed using a rating scale. Meanwhile, the question instruments deemed appropriate by experts must undergo a series of analyses before being used in the pre-test and post-test. These analyses include validity testing, reliability testing, difficulty level testing, and discrimination testing. Once the results of these analyses are obtained, the items/questions to be used by students during the research process are determined. To analyze the data from the pre-test and post-test, paired t-test and n-gain test will be utilized. The objective is to draw conclusions from this research and analyze the improvement in students' learning outcomes and their feedback on the learning media associated with students' CT abilities. The paired t-test will be conducted using the SPSS application, with the requirement that the data used must have a normal distribution. After confirming the normal distribution, the following hypotheses can be formulated:

$H0$: There is no significant improvement in students' learning outcomes between before and after the learning when implementing the PBL model with multimedia assistance.

$H1$: There is a significant improvement in students' learning outcomes between before and after the learning when implementing the PBL model with multimedia assistance.

Given the conditions:

If the p-value > 0.05, then H0 is accepted and H1 is rejected. If the p-value < 0.05, then H1 is accepted and H0 is rejected.

The formula for the N-Gain test, according to Hake (2008), will be used as described in the following **Equation 1**.

$$g = \frac{T_2 - T_1}{T_3 - T_1}$$

Equation 1. Calculation of N-Gain Value

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3. RESULTS AND DISCUSSION

3.1. Analysis Phase

In this phase, a preliminary analysis is conducted, including a literature review and field study, the results of which will be used as a reference for analyzing user needs and learning multimedia.

3.1.1. Identification of Problems

In this stage, the researcher distributed questionnaires to students in the SIJA vocational program who have undergone database learning. The results indicated the level of satisfaction among students during database learning. It was found that 50% (17 students) and 38.2% (13 students) rated their satisfaction as 3 and 2 points, respectively. Additionally, 8.8% (3 students) rated their satisfaction as 4 points, while 2.9% (1 student) gave the highest rating of 5 points for their database learning experience. Based on this, it can be concluded that students' satisfaction during database learning is still very low.

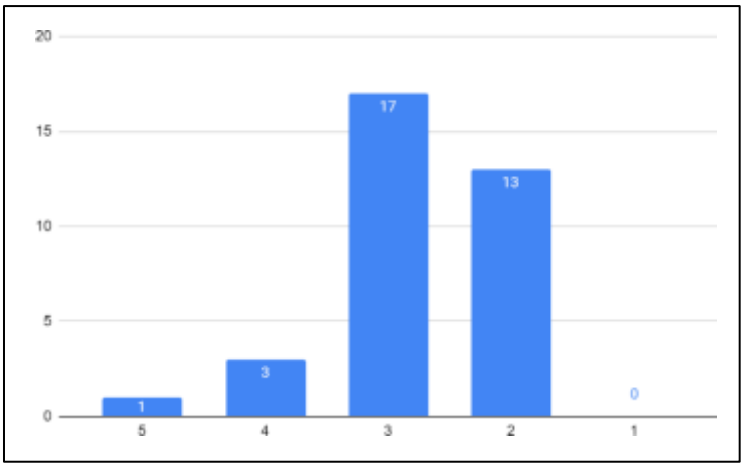

Figure 2. Student Responses Regarding Learning Experience Satisfaction

Student satisfaction with this learning experience can result from various factors such as the difficulty of the database material, learning methods, and teaching media. Supported by student responses, 70% of students stated that the influence of media or technology in overcoming obstacles during database learning is highly significant, and 97% of students agreed to use more engaging and interactive learning media for the database subject.

In addition to analyzing based on student questionnaire responses, interviews conducted with database teachers revealed that during theoretical material, teachers typically conduct lectures by presenting and explaining the material through modules and demonstrations. The enthusiasm of students, especially in the SIJA program, is low in learning the database subject. Students perceive that databases are not extensively used in their field of study. Furthermore, teachers never provide CT-based learning, assignments, or questions.

3.1.2. Validation of Performance Gaps

Based on the results of the previous problem identification, it was found that the current learning model applied in the classroom is still lacking in innovation and attractiveness, thus necessitating innovation in the application of learning models that can motivate students to develop computational thinking abilities. One proposed approach is the implementation of the PBL model. The material considered difficult by most students is the ERD material. The difficulty in understanding this material is related to the lack of attractiveness in its

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presentation, which ultimately can affect students' level of engagement and their ability to understand the material. Therefore, appropriate learning strategies need to be implemented involving the use of interactive learning multimedia and the development of students' computational thinking skills.

3.1.3. Formulating Instructional Objectives

The next stage after identifying the initial problems in the learning process is to determine instructional objectives. These instructional objectives are useful for researchers in developing test instruments and learning media, as this research aims to improve students' CT abilities. The specific instructional goal of this study is to enhance students' computational thinking skills through learning activities that apply the PBL model. The general instructional goal refers to the learning outcomes of the Information Systems, Networks, and Applications subject in Phase F of the SIJA vocational program, with elements of platform as a service. The learning outcomes in this element include "Teaching the concepts and implementation of platforms for activating information technology services within the scope of cloud computing and implementing services as well as configuring Web Server, Database Server, DNS Server, and Mail Server".

3.1.4. Analysis of Resources

The availability of learning tools such as computers has been well facilitated, particularly in the computer lab. Additionally, students who do not have personal computers can borrow them from the vocational program's facilities for use during learning sessions.

3.1.5. Needs Analysis

The product developed in this research is a web-based learning media. Before entering the media creation process, a needs analysis is conducted, including the needs of users such as students and teachers, as well as the minimum software and hardware requirements that users must have to access the media. In the media creation stage, both internal and external supporting components are required. The software components used include XAMPP Control Panel, Visual Studio Code, Codeigniter, Bootstrap, Figma, Draw.io, Canva, and Capcut. Meanwhile, the hardware components used have specifications of 8 GB RAM, AMD Ryzen 3 Processor, and 1 Terabyte internal storage.

3.2. Design Phase

In the design phase, the design of the learning media is conceptual and serves as the basis for further development stages. The procedures conducted in the design phase include several steps, as follows:

3.2.1. Development of Learning Materials and Student Worksheets (LKPD)

The learning materials and LKPD are developed based on the curriculum used in the school, namely the Merdeka Curriculum, taking into account the CP (Learning Objectives) in the database subject of the SIJA vocational program, and applying CT indicators and the PBL model.

3.2.2. Development of Database Subject Question Instruments

The development of pretest and post-test question instruments. The question instruments are tailored to the material, cognitive level, and CT indicators. After drafting the question instruments, they are validated by experts.

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3.2.3. Planning for Interactive Multimedia

In this stage, the researcher creates a flowchart, storyboard, and DFD to facilitate the coding process in the subsequent stages.

3.3. Development Stage

3.3.1. Development of SBDVerse Multimedia Learning

The development phase involves creating the multimedia interface, ERD, and proceeding to multimedia coding using the PHP programming language with the utilization of Codeigniter 3. The creation of the multimedia interface refers to the previously created storyboard and multimedia flow adapted from the designed flowchart. The multimedia being developed is named SBDVerse (Universe Data Base System). Below in **Figure 3** is the interface view resulting from the multimedia development:

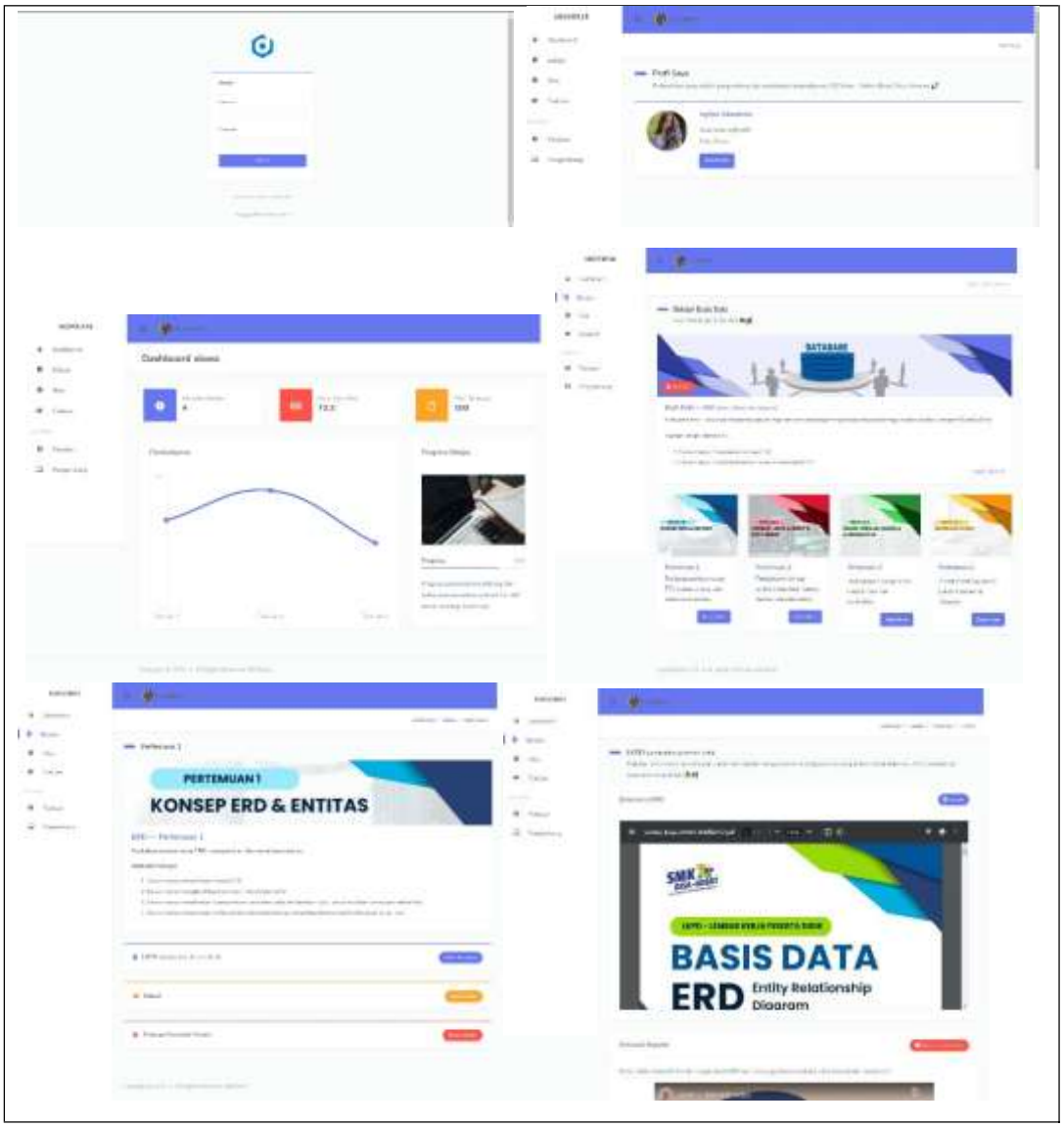

Figure 3. Multimedia Interface Display

For further clarity, here's an explanation of each user interface in Figure 3 above:

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1) Login Page: The initial page and login page of the SBDVerse multimedia. On this page, users, both students and teachers, are required to enter their usernames and password.
2) Profile Page: Users can view their account information, such as full name, username, and profile picture. There is also an Edit Profile button that directs users to the Edit Profile Data page.
3) Dashboard Page: Users can view their account information, such as full name, username, and profile picture. There is also an Edit Profile button that directs users to the Edit Profile Data page.
4) Detail Learning Page: Contains information on the title of the material and the learning achievement indicators of the meeting material, as well as access cards to the LKPD, Material, and Formative Evaluation pages.
5) Learning Page: Information on subjects, learning achievements, and a list of meetings. When a student accessed one of the meetings, they will be directed to the Meeting Detail page.
6) Learning Detail Page: Students can access LKPD documents, download the documents, watch orientation problem explanation videos, and information on learning organization instructions they need to follow, and students can also submit completed LKPDs.

3.3.2. Multimedia Testing

The testing phase of the SBDVerse multimedia learning is conducted using the black-box testing method. Testing is performed by examining whether the inputs and outputs match the expected outcomes or not.

3.3.3. Expert Validation

Validation is conducted by Computer Science Education lecturers and database subject teachers at SMK Negeri 1 Cimahi. The media validation results obtained a "Very Good" rating with an average score of 93.55%. Below is the representation of the validation results scale:

Figure 4. Media Validation Representation

3.4. Implementation Phase

After completing the development and expert validation stages, the researcher proceeded with the implementation of the SBDVerse multimedia to the students at the school. During this implementation phase, data will be collected, and the results from the use of the designed and validated instruments will be analyzed. The results obtained from this phase will be the basis for evaluating and assessing the effectiveness of the instruments and multimedia created. Data collection activities are conducted over 4 sessions, with all students divided into 5 groups for completing the prepared LKPD in each session.

3.4.1. Pretest Questionnaire

The pretest is administered at the beginning before the implementation of interactive multimedia learning using the PBL approach.

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3.4.2. Learning Activities

The learning process is conducted based on the previous analysis stages with adjustments made for learning using the SBDVerse multimedia. In each session, students will learn about various topics related to ERD material, successively covering:

1) Basic ERD concepts, notations in ERD, entity concepts, types of entities, and determining entities from everyday problem illustrations.
2) Attribute concepts, determining attributes of an entity, as well as determining the type of attribute and the relational key of each attribute.
3) Concepts of relationships between entities, determining relationships in databases and determining the degree of relationships and cardinality of relationships that occur in each related entity.
4) Compiling and combining ERD components they have learned into a complete ERD based on illustrations of everyday life problems.

3.4.3. Post-test Questionnaire

After completing the learning sessions, students are given a post-test to assess the final outcome of the learning they have undergone.

3.4.4. Student Feedback

Students are asked to provide feedback on the learning multimedia used during the learning process.

3.5. Evaluation Stage

3.5.1. Evaluation of the Media

Based on the assessment and validation by experts, including 2 lecturers and 1 teacher, on the SBDVerse multimedia, several recommendations for improvements in the development of the learning multimedia were identified.

3.5.2. Evaluation of Students' CT Abilities

3.5.2.1. Normality Test

A normality test was conducted to determine if the data follows a normal distribution. The Shapiro-Wilk test was employed for this purpose. If the significance value is greater than 0.05, the data is considered to be normally distributed. Below in Table 3 are the results of the normality test for the pre-test and post-test:

Table 3. Normality Test Result

Type Test	Statistic	Df	Sig.
Pretest	0.950	35	.111
Postest	0.946	35	0.087

Based on the **table 3**, the pretest instrument has a significance value of 0.111, and the post-test instrument has a significance value of 0.087. Therefore, H0 is accepted, and H1 is rejected because the Sig. Value> 0.05, indicating that both the pre-test and post-test instruments have a normal distribution.

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3.5.2.2. Paired T-Test

The Paired T-test is conducted because there are two paired data samples with the same subjects but experiencing different treatments, i.e., before and after undergoing the learning treatment. **Table 4** shows the results of the T-Test calculation:

Table 4. Paired T-Test Result

N	t	Df	Sig. (2-tailed)
35	0.950	35	.000

This test helps determine whether there is a significant difference between the means of the paired data samples (pre-test and post-test) after the learning treatment.

3.5.2.3. Pre-test Post-test Gain Test

Based on the data obtained in the previous implementation phase, there are two tests: pre-test and post-test, from 35 students, with each test consisting of 30 items covering ATP and CT indicators. Below are the average scores of the pre-test and post-test:

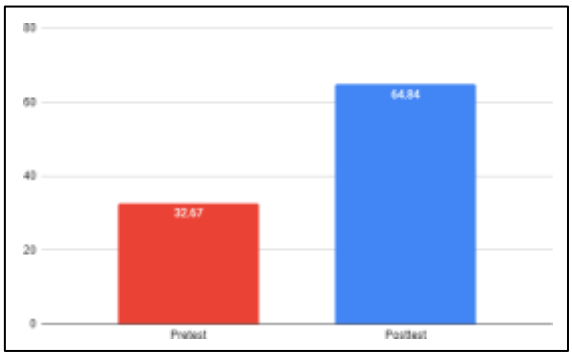

Figure 5. Pre-test and Post-test Results

In **Figure 5**, there is an observed increase in students' scores before and after the implementation of the intervention or treatment. This can be seen from the average pre-test score of students at 32.67, while the average post-test score reached 65.84. Therefore, it can be said that students' understanding of database problem-solving in ERD material presented through multimedia learning experienced improvement after implementing the database learning action with the support of multimedia-assisted PBL. From the pre-test and post-test results, the overall n-gain obtained is 0.478 or 47.78%, interpreted as "Moderate" according to the criteria. The gain test based on the top, middle, and bottom groups of students is as follows:

Table 5. Gain Test Based on Top – Middle – Bottom Groups

Group	Description	*Pre-test*	*Post-test*	Gain Score	Criteria
Above	Maximum Value	53,33	93,33	0,441	Medium
	Minimum Value	40	53,33		
	Average	46,33	70		
	Maximum Value	36.67	90		

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Middle	Minimum Value	20.00	30		
	Average	31,05	65,97	0,506	Medium
Below	Maximum Value	16,67	90		
	Minimum Value	13,33	36,67	0,419	Medium
	Average	14	50		

Based on the data from the gain test for each group, it can be concluded that all groups have gain values classified as "Medium." For the top group, the n-gain score obtained is 0.441, for the middle group, the n-gain score is 0.506, and for the bottom group, the n-gain score is 0.419.

3.5.2.4. CT Indicator Gain Test

To further examine the improvement in students' CT abilities in learning using interactive multimedia, here is the gain test for each CT indicator:

Table 6. Gain Test Based on CT Indicators

Indicator	Average Pre-test	Average Post-test	Gain Score	Criteria
Decomposition	37,35	66,94	0,472	Medium
Pattern recognition	32,38	78,10	0,676	Medium
Abstraction	25,71	50	0,327	Medium
Algorithmic Thinking	28,57	76	0,664	Medium

The results in **Table 6** indicate that all CT indicators have experienced a moderate increase, with the highest increase, or rather moderately effective, observed in the pattern recognition indicator. Meanwhile, the abstraction indicator shows a low difference in average post-test and pre-test scores. The algorithmic thinking indicator ranks second in terms of effectiveness, followed by the decomposition indicator in third place. Following is the complete explanation:

1. Decomposition
   The average pretest score for questions with decomposition indicators is 37.35. This score can be interpreted as indicating low decomposition thinking ability. After the treatment and post-test evaluation, students' decomposition indicators experienced an improvement with an average score of 66.94 and a gain of 0.472, which falls into the criteria of moderate improvement.
2. Pattern Recognition:
   The pattern recognition indicator received an average pretest score of 32.38, indicating that students' pattern recognition abilities were still relatively low. After the treatment and completion of the post-test, the pattern recognition indicator significantly improved with moderate improvement criteria, reaching an average post-test score of 78.10. The pattern recognition indicator showed the highest improvement compared to other indicators, with a gain of 0.676.
3. Abstraction:
   The average pretest score for abstraction indicator questions reached 25.71. This score

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indicates that students' abstraction abilities are relatively low and rank lowest compared to the pretest scores of other indicators. Students' abstraction abilities improved after the treatment, with the implementation of PBL with interactive multimedia assistance. The average post-test score for students increased to 50.00. This increase can be categorized as moderate improvement as it has a gain score of 0.327.

4. Algorithmic Thinking:
   It can be observed that students' algorithmic thinking abilities received an average score of 28.57, indicating that students' algorithmic thinking abilities were still low. Students' algorithmic thinking abilities improved after the treatment. Based on the graph above, there was an increase in the average post-test score of students to 76 with a gain score of 0.664. The algorithmic thinking indicator showed the second-highest improvement after the pattern recognition indicator.

3.5.3. Results of Student Responses to Multimedia

Student responses regarding SBDVerse multimedia were assessed by administering the Multimedia Mania Student Checklist 2004 response questionnaire. Based on these calculations, the average value of student responses was 93.45%. The following is a representation of the average student responses in scale form:

Figure 6 Representation of Student Response Interval Scale

4. CONCLUSION

Based on the conducted research, it can be concluded that there is an influence of learning with the PBL model assisted by interactive multimedia on the improvement of students' CT in the subject of database with ERD material. This influence can be seen based on the analysis of the gain test and paired t-test on the pre-test and post-test of students, who obtained an overall average gain of 0.478 or 47.78%, interpreted as "Moderate".

The development of interactive multimedia learning using the ADDIE model resulted in a validation score of 93.55% from experts, classified as "Excellent." Additionally, student feedback on the SBDVerse interactive multimedia yielded a criteria rating of "Excellent" with an average score of 93.45%. The design and development of this interactive multimedia learning for database basics were carried out through a series of ADDIE interactive multimedia development models.

5. ACKNOWLEDGMENT

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granting permission to conduct the research, and to all students who volunteered their time to participate as subjects in this study.

6. AUTHOR'S NOTE

The author declares no conflicts of interest related to the publication of this research report. It is affirmed that this research report is free from plagiarism.

7. REFERENCES

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