

# Development of Mobile Media Based on Problem-Based Learning in Basic Computer Network Engineering and Communication Subjects

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## ABSTRACT

This research aims to develop mobile learning media specifically designed for basic subjects in Computer Network Engineering and Telecommunications to enhance student motivation and learning outcomes. Utilizing the R&D (Research and Development) method, the ASSURE model was employed for development. This model includes analyzing learners, stating objectives, selecting instructional methods, media, and materials, utilizing media and materials, requiring learner participation, and evaluating and reinforcing. The mobile media was tested with 36 students from TJKT Vocational High School in Padang. Data collection instruments included validation sheets, practicality questionnaires, student evaluation questions, and student response questionnaires. Results showed a material expert validity of 0.89 and a media expert validity of 0.94, both indicating high validity. Teacher-assessed practicality scored 90.67, while student assessments scored 86.19, both in the very practical category. Effectiveness was determined by student evaluations, with 88.89% of students achieving competency, indicating high effectiveness. The increase in student learning outcomes was significant, with a gain score of 0.74% in the high category. The T-test revealed a significant difference in pretest and posttest learning outcomes ( $p$ -value  $< 0.005$ ). In conclusion, the problem-based learning mobile media developed for basic computer network engineering and telecommunications subjects has been validated, deemed practical, and proven effective for learning. Its implementation is expected to boost student engagement, creativity, and learning outcomes, thereby potentially improving the overall quality of education.

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## 1. INTRODUCTION

Learning media play a crucial role in education, significantly contributing to students' ability to achieve their learning objectives. Utilizing a variety of appropriate media in the educational process

can enhance student motivation and reduce apathy (Fajri et al., 2022). Previous studies have demonstrated the positive impact of multimedia tools on student engagement and learning outcomes (Smith & Jones, 2020; Anderson & Kumar, 2019). However, there is a notable gap in the integration of mobile learning media in vocational education, particularly in the context of basic Computer Network Engineering and Telecommunication subjects.

Observations and interviews conducted at SMKN 2 Padang with teachers specializing in TJKT revealed a critical issue: the vocational basics learning process has yet to incorporate mobile learning media. Teachers predominantly rely on blackboards and PowerPoint presentations, limiting learning opportunities outside the classroom. Consequently, students are unaccustomed to using technology for learning and often consider it taboo. Sudiarsa (2023) highlights that the traditional teacher-centered learning process, involving lectures and question-and-answer methods, adversely impacts students' learning outcomes.

Integrating the Problem-Based Learning (PBL) model with mobile learning media can address these challenges. PBL encourages student independence, enhances intellectual abilities, and promotes active engagement and freedom of expression throughout the learning process. PBL has been shown to improve students' critical thinking skills significantly (Johnson & Aragon, 2021). By actively engaging in problem-solving activities, students learn to apply theoretical knowledge to practical situations, fostering deeper understanding and retention of the material.

Moreover, mobile learning media provide flexibility and accessibility, allowing students to learn at their own pace and convenience, which can further enhance their motivation and engagement. Studies have shown that mobile learning can lead to higher student satisfaction and better academic performance due to its interactive and adaptive nature (Crompton, Burke, & Gregory, 2017). Additionally, the use of mobile devices for learning supports a more personalized learning experience, catering to individual student needs and learning styles.

In this model, teachers allow students to choose problem topics related to basic vocational learning, even though the lesson content is pre-prepared, thereby providing broader opportunities for problem-solving (Laksmi & Suniasih, 2021). This autonomy in learning not only fosters a sense of responsibility but also encourages students to explore topics of interest deeply, leading to a more engaged and motivated learning experience. Furthermore, integrating technology with PBL helps in bridging the gap between theoretical knowledge and real-world applications, preparing students for the demands of modern vocational fields. This holistic approach to learning ensures that students are not only academically proficient but also skilled in practical problem-solving and critical thinking, which are essential for their future careers.

The novelty of this research lies in its focus on developing and implementing mobile learning media based on problem-based learning for Basic Computer and Telecommunication Engineering subjects, specifically targeting IoT material. This approach has not been extensively explored in previous studies, thus filling a significant gap in the current educational technology literature.

The main goals of this research are to create mobile learning media that aid student learning in Basic Computer and Telecommunication Engineering subjects and to assess the validity, practicality, and effectiveness of these tools. This study's outcomes will enrich both theoretical knowledge and practical application, particularly advancing academic efforts in the Computer Network Engineering and Telecommunications department at SMK Negeri 2 Padang. The developed product, Problem-Based Learning Mobile Media, is specifically crafted to boost student interest and enhance learning outcomes, revolutionizing the learning experience by incorporating modern technology and fostering a more engaging and effective educational environment.

## 2. METHODS

This study employs the Research and Development (R&D) approach, a widely used methodology for creating and testing the effectiveness of educational products. Specifically, the ASSURE model is utilized to develop mobile learning media. The ASSURE model encompasses analyzing learners,

stating objectives, selecting instructional methods, media, and materials, utilizing media and materials, requiring learner participation, and evaluating and revising.

The study focuses on the Computer Network Engineering & Telecommunications Department at SMK Negeri 2 Padang, where problem-based learning-based mobile media will be tested for class X students in the Fundamentals of Computer Network Engineering and Telecommunications course. The research design follows a One Group Pre-Post Test format, which involves administering a pre-test before the intervention and a post-test after the intervention within the same group of participants. This design helps measure the effectiveness of the mobile learning media by comparing student performance before and after its implementation.

Participants in this study are class X students of the Computer Network Engineering & Telecommunications Department at SMK Negeri 2 Padang, enrolled in the odd semester of the 2023/2024 school year. The data collection process includes the use of validation sheets to assess the media's content validity, practicality questionnaires to gauge user-friendliness from both teachers and students, and evaluation questions to measure student learning outcomes. Student response questionnaires will also be employed to gather feedback on their experiences with the mobile learning media.

The data analysis will be conducted using the interactive model by Miles, Huberman, and Saldana (2014), which involves data collection, data reduction, data display, and conclusion drawing/verification. This comprehensive approach ensures that the data are systematically analyzed to provide meaningful insights into the effectiveness and practicality of the mobile learning media developed for the course.

The ASSURE model is a systematic approach that comprises of 6 stages: Analyzing learners, stating objectives, selecting instructional methods, media, and materials, utilizing media and materials, requiring learner participation, and evaluating and revising. During the learner analysis stage, teachers observe students to identify gaps in their characteristics and needs, as well as to analyze student characteristics. The next step is the stage for stating state objectives, where standards and learning objectives are specified as precisely as possible. Learning goals can be derived from the curriculum, gathered from textbooks, or created by the instructional designer. Learning objectives are declarations that define the knowledge, abilities, and attitudes that students gain upon completing a learning experience. Selecting instructional methods, media, and materials involves choosing the specific methods, media, and teaching materials that will be utilized. When selecting methods, media, and teaching materials, there are several options available: using existing materials, modifying them, or creating new ones. The stage of media and material utilization involves testing to ensure that the media and teaching materials can function effectively. This includes product validation testing, limited trials, practicality assessment, and effectiveness assessment. The Aiken's V statistical formula was employed to establish the validity of the learning media, with the validity categories specified in Table 1.

**Table 1.** Validity Category of Problem Based Learning Mobile Media

Category	Score Range
Valid	>0,67
Invalid	≤0,67

<sup>1</sup>(Source: Irsyadunas dkk., (2021))

The evaluation involved assessing practicality through a questionnaire that gathered responses from both teachers and students, ensuring that the feedback reflected diverse perspectives on the usability and functionality of the mobile learning media. Additionally, the effectiveness was evaluated by comparing student learning outcomes through pretest and posttest scores, using the Gain Score as an indicator of learning effectiveness. This approach offered a quantitative measure of the media's impact on student performance. The classification of media practicality and media effectiveness is presented in Tables 2 and 3, respectively, offering a clear overview of the results. These tables highlight

the degree to which the mobile learning media met educational objectives and facilitated improved student engagement and learning outcomes.

**Table 2.** Category of Practicality of Problem Based Learning Mobile Media

Category	Achievement Level
Not Practical	$\leq 54\%$
Less Practical	55% - 59%
Practical Enough	60% - 75%
Practical	76% - 85%
Very Practical	86% - 100%

<sup>2</sup>(Source: Purwanto, (2010))

**Table 3.** Category of Effectiveness of Problem-Based Learning Based Mobile Media from Gain Score Value

Category	Interpretation
High	$(\langle g \rangle) > 0,7$
Medium	$0,7 > (\langle g \rangle) > 0,3$
Low	$(\langle g \rangle) < 0,3$

<sup>3</sup>(Source: Hake (2002))

The whole research refers to systematic steps to ensure that Problem-Based Learning Mobile Media becomes a valid, practical, and effective learning media in improving learning outcomes, activities, and student motivation in Basic Computer Network Engineering and Telecommunications subjects.

### 3. FINDINGS AND DISCUSSION

After gathering the research data, a comprehensive description of the findings was compiled. The problem-based learning mobile media was created to improve students' skills, creativity, and independence in learning the Basics of Computer Network Engineering and Telecommunications. The development adhered to the ASSURE model, including evaluation stages for practicality and effectiveness. The media underwent thorough validity, practicality, and effectiveness testing by experts, teachers, and students. A modified instrument was subsequently employed to further assess the media's validity and practicality. The research results, which detail the development and evaluation of the problem-based learning mobile media, are presented in full, showcasing its positive impact on student learning outcomes.

#### 3.1. Stage Results Analyze Learner

An analysis of student characteristics was conducted to identify the fundamental issues they face in learning. The performance analysis revealed insights into the development of mobile learning media at SMK Negeri 2 Padang, specifically for the Computer Network Engineering and Telecommunications program. Interviews with teachers of Basic Vocational Engineering and Telecommunications subjects indicated that students often feel bored with the monotonous use of books and PowerPoints. It was discovered that teachers had not developed online learning media that could be accessed via Android phones. The analysis identified several student needs, including the desire for media that can be used both at school and at home to complement their learning. Additionally, students expressed a need for media that would increase their motivation to learn.

An analysis was also conducted to determine the ownership of android smartphones from each learner. All learners use android smartphones to support learning. Learners admitted that they prefer

to read material on android smartphones because it is more practical to carry around and can be read anywhere. Besides being easy to access, the material on android smartphones is also more attractive because of the more colorful design.

A needs analysis was conducted to determine the competencies that students need to acquire in learning. Researchers identified students' initial abilities in understanding the basics of computer network engineering and telecommunications. Observations revealed that the 36 students in class X TJKT at SMK Negeri 2 Padang were largely unfamiliar with recent technological developments in the field. Specifically, they lacked knowledge about advancements such as 5G, microwave links, IPV6, the latest fiber optic technology, sensor systems, IoT, smart devices, smart homes, smart cities, and cloud computing. This gap in knowledge highlights the critical need for updated and engaging learning media that can bridge this divide. Consequently, developing mobile learning media that addresses these areas is essential for equipping students with the necessary skills and knowledge to keep pace with rapid technological advancements. This approach will not only enhance their learning experience but also prepare them more effectively for future challenges in the field.

### **3.2. Stage Results State Objectives**

Planning involves developing learning media for computer network engineering and telecommunications basics using structured teaching modules. This stage includes a thorough analysis of the independent curriculum, focusing on the Teaching Module, Learning Outcomes (CP), and Learning Objectives (TP). After analyzing the Learning Outcomes, the next step is to formulate specific learning objectives for computer network engineering and telecommunications basics.

The formulated learning objectives aim to provide students with foundational knowledge, skills, and attitudes—encompassing both hard skills and soft skills—that are essential for their development. These objectives are designed to enhance students' abilities and broaden their understanding of advancements in the field of computer network engineering and telecommunications. By focusing on these key areas, the planning process ensures that the learning media will be comprehensive and aligned with current technological trends. The learning modules are intended to equip students with practical skills such as configuring network devices, understanding network protocols, and implementing telecommunications systems. Additionally, the modules aim to foster critical soft skills, including problem-solving, teamwork, and effective communication, which are vital for success in the technology sector.

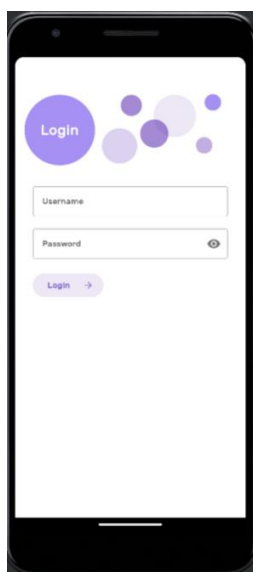
This comprehensive approach to planning and curriculum design is crucial for developing an educational framework that meets current educational standards and prepares students for the dynamic and ever-evolving field of computer network engineering and telecommunications. By integrating both theoretical knowledge and practical applications, the learning media will provide a robust foundation for students, enabling them to navigate and excel in their future careers.

### **3.3. Stage Results Select Instructional Methods, Media and Materials**

At this stage, researchers implement the Problem-Based Learning (PBL) method for mobile learning media. This problem-solving approach encourages students to learn and work cooperatively in groups to find solutions, think critically and analytically, and identify and use appropriate learning resources. PBL involves training students to address various problems, both personal and group-related, fostering independent and collaborative problem-solving skills. Known as the brainstorming method, PBL stimulates student insights regardless of the initial quality of their opinions. Teachers are advised to focus on students' thought processes and diverse opinions, motivating them to express their ideas freely. By prioritizing the way students think and communicate, educators can foster a more dynamic and engaging learning environment. In

conclusion, the use of PBL in mobile learning media effectively enhances students' collaborative, critical thinking, and problem-solving abilities, preparing them to tackle real-world challenges with confidence and creativity.

This learning media is designed to provide students with comprehensive learning materials, enabling them to study at home or anywhere. It includes learning videos to help students quickly grasp the basics of Computer Network Engineering and Telecommunications. The media was developed using XAMPP, Visual Studio Code, and Android Studio, and is intended for use on Android-based smartphones in online mode. It features several display pages, beginning with an initial page shown in Figure 1, which appears briefly before directing users to the login page. On the login page, students are prompted to enter their username and password, as illustrated in Figure 2 below.



**Figure 1.** Page Login

Students will be taken to the main menu page after completing the information and clicking the login button. The instructional menu, material menu, video menu, assessment menu, and value menu are the five menus that are present on the main menu page. You may see this primary menu in Figure 3 below.



Figure 2. Main Menu Page

Teachers and students can get instructions on how to use and understand the functionalities of the buttons on this produced media by clicking the instruction button on the main menu page.



Figure 3. Instructions Page

For the material button after clicking it, the next page will appear which contains six sub-chapters of material that can be studied in this media as shown in Figure 4.



Figure 4. Subject Matter Page

For the learning video button, if clicked, a page will appear containing the title of the video that can be watched by students as shown in Figure 5.



Figure 5. Video Title Page

### 3.4 Stage Results Utilize Media and Materials

This research involves multiple stages of assessment, specifically validating the media and materials integrated into the problem-based learning mobile media. A media validation questionnaire was administered to two media expert validators and two material experts, who evaluated several components, including real-world learning, comprehensive learning, stand-alone functionality, adaptability, user-friendliness, mobile learning elements, and aspects of the PBL-based approach. The results from each evaluated aspect were analyzed using Aiken's V formula. These findings contribute to the overall validation value of the developed problem-based learning mobile media, with a summary of the validation results from various aspects presented in Table 4.

Table 4. Media Validation Results

Indicator	Validation Result	Category
Media Expert Validation	0,94	Valid
Material Expert Validation	0,89	Valid

The validity test study conducted by media professionals resulted in an average score of 0.94, as presented in Table 4, demonstrating that mobile media for problem-based learning falls within the acceptable category. Additionally, the validation by material experts yielded an average score of 0.89, indicating that the problem-based learning mobile media content is legitimate. These findings are consistent with the research by Weci Kurnia Sari (2018), which involved the design and creation of mobile learning media for ICT Class X at SMK N 1 Padang, where media experts showed an 85.02 percent validity in their test results. Similarly, Siti Aisyah's (2019) research on the development of Android-based mobile learning media for Product Knowledge subjects at SMK Negeri 1 Surabaya supports these results, demonstrating a media expert validation validity test proportion of 89.45%.

In conclusion, the evaluations from subject-matter specialists and learning media experts confirm the accuracy and appropriateness of the developed mobile media for problem-based learning. This implies that the Problem-Based Learning Mobile Media meets the criteria for self-learning,

comprehensive learning, stand-alone functionality, adaptability, user-friendliness, and mobile learning components, making it suitable for achieving learning objectives. The practicality of this mobile media as a learning medium in the Fundamentals of Computer Network Engineering and Telecommunications course was also assessed through a questionnaire administered to two subject professors and 36 students. The findings from this practicality test are summarized in Table 5, indicating the effective application of problem-based learning mobile media in educational settings.

**Table 5.** Media Practicality result data

Respondents	Practicality Result	Category
Teacher	91,11	Very Practical
Student	86,19	Very Practical

The practicality test results for the problem-based learning mobile media, based on data from teachers and students, yielded scores of 91.11 and 86.19, respectively. These scores are classified as "very practical" for use in learning, as depicted in Table 5. Therefore, the integration of problem-based learning mobile media into the educational process is deemed highly practical.

In conclusion, evaluations from both educators and learners indicate that the developed mobile problem-based learning curriculum is effective for teaching the fundamentals of computer network engineering and telecommunications. This validation confirms that the mobile learning approach meets three critical requirements for practicality, demonstrating its utility in aiding both teachers and students in the learning process.

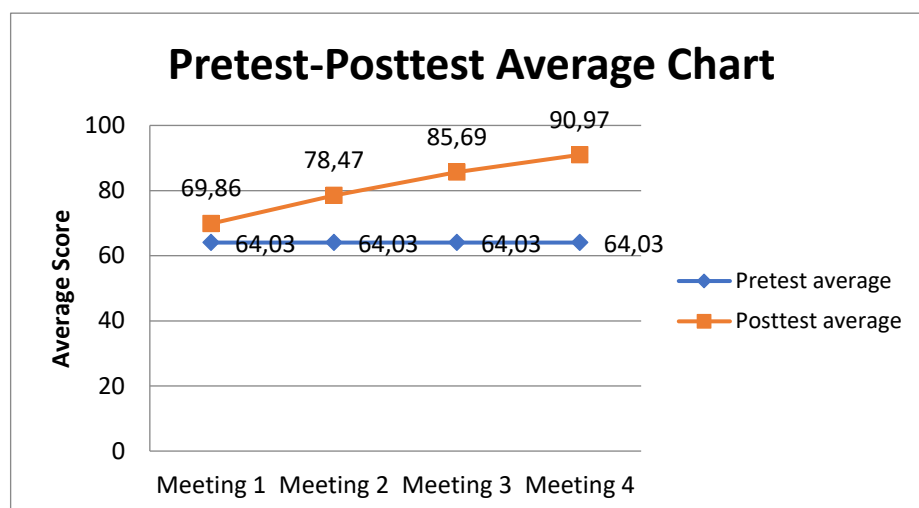
### 3.5. Stage Results Require Learner Participation

Students are currently engaged in educational activities and will use the produced media, specifically mobile media for problem-based learning. The ability of mobile media based problem-based learning to increase student learning outcomes, comprehension of the learning materials, and student involvement in the learning process is evidence of its efficacy. Table 6 presents the findings of the gain score analysis. The effectiveness evaluation was carried out four times by computing pretest and posttest data. Each meeting was assessed.

**Table 6.** Gain Score Recapitulation

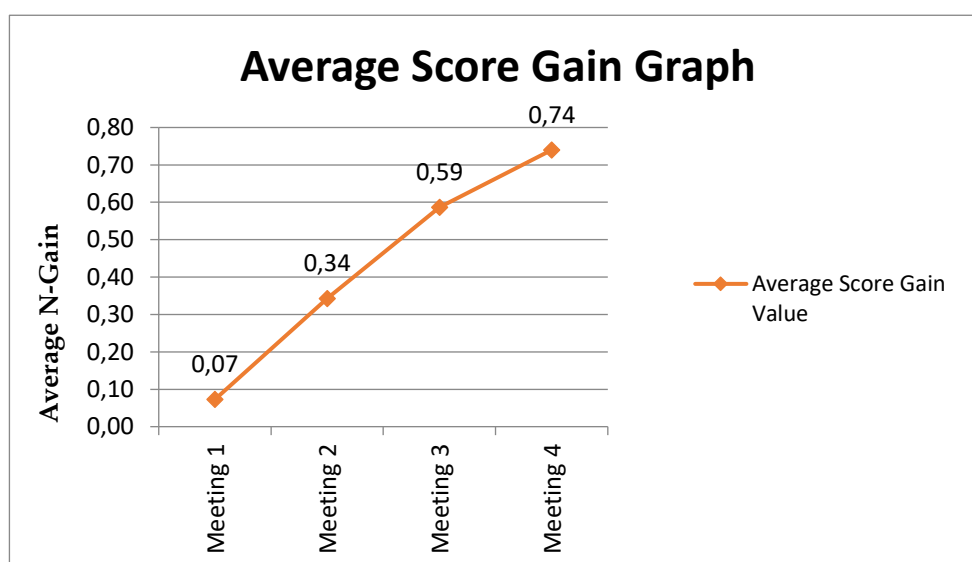
N	Minimum Value	Maximum Value	Average G Score
36	0,14	1,00	0,74
Category			High

Based on the percentage of classical completeness which reached 88.89% with a very high effectiveness category and the percentage of gain score value of 0.74 with a high category, it can be concluded that problem-based learning-based mobile media is declared very effective to be used as learning media.



**Figure 1.** Average Pretest-Posttest

Based on the graph data above, it shows the results of the pretest-posttest average test of Problem Based Learning-based Mobile media in the basic subjects of Computer Network Engineering and Telecommunications for Class X TJKT students have conducted 4 meetings by evaluating each meeting by obtaining the first meeting of the average posttest value of 69.86 the second meeting with the average posttest value of 78.47 the third meeting with the average posttest value of 85.69 and the fourth meeting with the average posttest value of 90.97 so that each meeting has increased and is categorized as High.



**Figure 2.** Average Gain Score Chart

Based on the graph data above, it shows the results of the Problem Based Learning-based Mobile Media Score Gain test in the basic subjects of Computer Network Engineering and Telecommunications for Class X TJKT students have conducted 4 meetings by evaluating each meeting by obtaining the first meeting the average value of the gain score of 0.07, the second meeting with an average gain score of 0.35, the third meeting with an average gain score

of 0.59 and the fourth meeting with an average gain score of 0.74 so that each meeting has increased and the fourth meeting is categorized as High.

**Table 7.** T-Test Results (*Paired Samples Test*)

➔ **T-Test**

[DataSet1]

Paired Samples Statistics					
	Mean	N	Std. Deviation	Std. Error Mean	
Pair 1 Pretest	64.03	36	11.072	1.845	
Posttest	90.97	36	9.009	1.502	

Paired Samples Correlations				
	N	Correlation	Sig.	
Pair 1 Pretest & Posttest	36	.210	.218	

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-26.944	12.721	2.120	-31.249	-22.640	-12.709	35	.000

Table 7 above indicates that the significant value (2-tailed) is 0.000 < 0.005, indicating that the use of problem-based learning-based mobile media by students results in a significant difference in learning outcomes between the pretest and posttest, indicating the effectiveness of the method.

### 3.6. Stage Results Evaluate and Revise

This is the final step in the ASSURE approach. Recommendations and critiques from knowledgeable examiners will be utilized to assess and enhance the learning media to make it more qualified, depending on the findings of the evaluation by media specialists. Learning materials are helpful, but be mindful of typos and EYD. The SMK Negeri 2 Padang logo should be included, and the instructions menu must be fully functional and clearly explained. The material indicates that the testers used in this development are suitable. Experts in learning design have provided feedback and recommendations, such as the addition of learning objectives (TP) and the organization of learning resources in a methodical manner.

Problem-based learning mobile media is designed to improve student learning outcomes by providing clear directions for independent learning. The media is developed in accordance with the subject material for Basic Computer Network Engineering and Telecommunications for Class X TJKT at SMK Negeri 2 Padang. The development process follows the ASSURE model, which includes stages such as analyzing learners, stating objectives, selecting methods, Media or Materials, Utilize Media and Materials, Require Learner Participation, and Evaluating and Revising. This structured approach ensures that the media is tailored to meet educational goals and is practical for classroom use.

Based on this approach, it can be concluded that the Problem-Based Learning mobile media developed for the Basic Computer Network Engineering and Telecommunications subject in Class X TJKT is feasible for use in the learning process. Validity and practicality tests involving teachers and students confirm the qualifications of the media. The validity analysis indicates that the media meets the criteria for good learning tools, including effective presentation, functionality, and appropriate language use. The media's design aligns with learning objectives and needs, ensures the accuracy of the learning material, and enhances student motivation and knowledge.

These findings are corroborated by similar research, such as Weci Kurnia Sari's (2018) study on mobile learning media for ICT Class X at SMK N 1 Padang, which reported an 85.02% validity rating

from media experts. Additionally, Siti Aisyah's (2019) research on Android-based mobile learning media for Product Knowledge at SMK Negeri 1 Surabaya indicated a media expert validation rating of 89.45% and a material expert validation rating of 91%, both reflecting high feasibility. The practicality test results are further supported by Syukron Hamid Siregar et al. (2022), whose study showed an average practicality rating of 92.21%.

From these assessments, it can be concluded that the developed learning media is effective for student use. The learning outcomes for students using mobile media in the Basic Computer Network Engineering and Telecommunications course indicate that the media is effective in improving learning outcomes. This aligns with Wina's (2012) assertion that effective learning media must consider usability and its impact on student performance.

#### 4. CONCLUSION

This research has successfully developed Problem-Based Learning Mobile Media for Basic Computer Network Engineering and Telecommunications subjects, aligning with the goal of educational development to create effective academic products. The analysis of validation, practicality, and effectiveness data confirms that the media is valid, with significant mean percentages indicating that all essential components—presentation, use, functionality, and language—meet the criteria for effective learning media. The product and usage trials revealed that the media is very practical, scoring high in ease of use, time efficiency, and overall media functionality. Moreover, the effectiveness of the media was demonstrated by the significant gain in student knowledge during trials, confirming its suitability as an effective learning tool. The mobile learning media enhances the learning process by increasing efficiency and understanding, making it possible for students to grasp the material anywhere and anytime, which in turn improves their learning outcomes. Additionally, it fosters creativity and offers teachers an innovative way to create an engaging and effective learning environment.

However, this research has certain limitations. The study was conducted within a specific educational context, and the sample size was limited to a particular group of students and teachers. Future research should consider a broader and more diverse sample to generalize the findings. Additionally, long-term studies are needed to evaluate the sustained impact of the mobile learning media on student outcomes. Further research could also explore the integration of advanced interactive features and adaptive learning technologies to enhance the effectiveness of problem-based learning mobile media.

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