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Development of Web-Based Learning Media Using Problem-Based Learning (PBL) Approach on Scratch Material to Enhance Learning Motivation of Seventh-grade Junior High School Students

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ABSTRACT

Students' low motivation to understand programming material at the junior high school level presents a challenge in informatics education. This study aims to develop web-based learning media using a Problem-Based Learning (PBL) approach to Scratch material to increase the learning motivation of seventh-grade junior high school students. The research and development (R&D) methodology used the ADDIE model, which encompasses five stages: analysis, design, development, implementation, and evaluation. Data were collected through observations, interviews, and questionnaires using a mixed-methods approach to obtain in-depth and measurable results. The analysis showed that the learning media was highly valid, with a 95.83% rating from content experts and 93.84% from media experts and received an excellent response from student trials. Motivation assessments revealed a significant increase in student learning motivation from 72.18% (high) before using the media to 87.85% (very high) after its implementation. This learning media was positively received by students, deemed engaging, and made it easier for them to grasp fundamental programming concepts. Therefore, web-based learning media using the PBL approach has proven effective in supporting increased student learning motivation and has contributed to advancing informatics education in junior high schools.

I. INTRODUCTION

Education in the 21st century has evolved rapidly alongside technological advancements that influence various aspects of life, including the education sector [1]. In junior high schools, particularly in seventh grade, introducing basic programming concepts presents unique challenges. As an intuitive tool for coding education, Scratch enables students to learn through a visual approach that is easier to comprehend, especially for those new to programming [2]. However, despite Scratch's user-friendly and interactive visual approach, many students still struggle to understand fundamental programming concepts [3]. This challenge is partly due to the abstract nature of topics such as looping, variables, and conditionals, which are unfamiliar to most students. Consequently, student motivation in learning algorithms tends to decrease, particularly when the teaching methods fail to capture their interest. Intrinsic motivation plays a crucial role in learning, especially in understanding abstract concepts like programming [4].

Today's technological advancements open new opportunities for educational innovation, including web-based learning media. Web-based media allow students to access materials flexibly inside

and outside the classroom, supporting independent learning [5]. Web-based media also offer advantages, such as the availability of accessible content anytime and the ability to tailor learning to each student's pace [6]. Unfortunately, the learning media available for Scratch at the junior high level remains limited. Many of these resources are insufficiently interactive and lack essential problem-solving elements for programming education. Therefore, it is necessary to develop learning media that help students understand the material and enhance their motivation through a more interactive and contextual approach.

The problem-based learning (PBL) approach is a method that can be applied to teach programming to junior high students. PBL emphasizes problem-based learning relevant to real-life situations, encouraging students to think critically and seek solutions actively [7]. PBL allows students to develop critical thinking skills independently as they engage directly in solving complex problems [8]. This is highly relevant in programming education, which requires logical and analytical thinking skills. In the context of Scratch, applying PBL provides a more meaningful learning experience as students are presented with concrete problems that they need to solve using programming logic. Therefore, developing web-based learning media with a PBL approach is expected to address the challenges in Scratch learning while promoting more active student engagement and enhancing their motivation. PBL also enables students to develop metacognitive skills, helping them understand how they learn and correct mistakes as they progress [9].

Student motivation is a critical factor in determining the success of the learning process [10]. Technology in education significantly enhances student motivation by providing easier access to learning materials and enabling personalized learning experiences [11]. When students are given access to interactive media that allows them to explore material independently, their motivation to learn tends to increase. Thus, developing web-based media explicitly designed to support Scratch learning through a PBL approach is essential to provide a better learning experience for students.

The main issue in teaching Scratch to seventh-grade students is the lack of effective and interactive learning media. Existing media tend to be one-way instructional tools that do not allow students to participate actively in problem-solving. However, active engagement is crucial for understanding abstract concepts, as emphasized by Vygotsky's social constructivist theory, which states that meaningful learning occurs through interaction and active exploration [12]. Moreover, most algorithmic learning media do not fully utilize technology, limiting students' flexible, independent learning opportunities. This condition affects student motivation, impacting their understanding of fundamental programming concepts.

This study aims to develop web-based learning media with a Problem-Based Learning (PBL) approach for seventh-grade Scratch material. Additionally, this research aims to evaluate the feasibility of the developed learning media and assess students' learning motivation after using the web-based media on Scratch material. This research is expected to contribute significantly to developing web-based learning media, specifically for Scratch education at the junior high school level. The main contribution anticipated from this study is an increase in student motivation through the use of more interactive and problem-based learning media. Therefore, this research provides solutions to the challenges in teaching algorithms educators face today while offering alternative media that supports more independent and flexible learning.

II. METHODS

This research adopts a Research and Development (R&D) design, utilizing the ADDIE development model, which comprises five stages: Analysis, Design, Development, Implementation, and Evaluation [13].

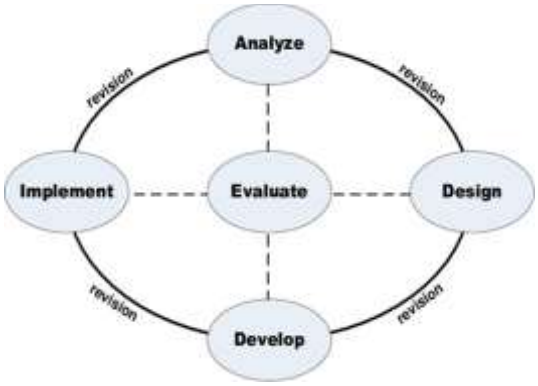

Fig. 1. ADDIE Stages [13]

The ADDIE model was chosen for its systematic and structured development process, which is well-suited for learning media development [14]. A mixed methods approach was applied, with qualitative methods used for needs analysis and initial evaluation and quantitative methods employed to assess the media's effectiveness. This mixed methods approach was selected to combine qualitative and quantitative data, providing a comprehensive and in-depth perspective on the development and effectiveness of the learning media [15]..

The research subjects consist of three primary groups: (1) Subject matter experts, responsible for ensuring that the content within the learning media aligns with curriculum standards and is accessible to students. Validation focused on aligning the Scratch learning concepts with the Problem-Based Learning (PBL) approach. The subject matter experts included Informatics experts from Universitas Negeri Malang and an Informatics teacher from SMP Negeri 24 Malang; (2) Media experts, who validated the web-based learning media from several perspectives, including software engineering, instructional design, and visual communication. The media experts also included Informatics experts from Universitas Negeri Malang and the Informatics teacher at SMP Negeri 24 Malang; (3) Seventh-grade students who had completed the Scratch module and are the target users of this learning media. A total of 33 students participated in the implementation phase, which took place at SMP Negeri 24 Malang, to test the media's effectiveness and its impact on their learning motivation.

The questionnaire was given to experts, including media experts and material experts, which contained closed questions using a Likert scale that had been modified from Sugiyono [16]. This scale is used to assess media quality from various aspects. The material expert questionnaire has assessment aspects such as

content feasibility and presentation feasibility [17]. while the questionnaire for media experts has assessment aspects such as software engineering, learning design, and visual communication [18]. Meanwhile, to determine the feasibility of learning media based on student responses, the User Experience Questionnaire (UEQ) criteria from Pratama are used [19]

The data obtained after product trials were analyzed to determine whether the product was feasible. Quantitative data derived from the questionnaire scores of the trial subjects were converted into percentage form. The formula used to calculate the validity of the questionnaire score follows the validity formula from Akbar [20] as follows.

$$V = \frac{TSe}{TSh} \times 100\%$$

Description:
V =Validity
TSe =Total empirical scores of validators
TSh =Total expected maximum score

The validity of the product obtained from this calculation will be measured using the scale listed in Table I.

TABLE I. VALIDITY CRITERIA

Percentage (%)	Validity Level
85.01 - 100.00	Very Valid
70.01 - 85.00	Fairly Valid
50.01 - 70.00	Less Valid
01.01 - 50.00	Not Valid

[a.] (Source: Akbar, 2017)

Furthermore, the data obtained from the six UEQ categories were analyzed using Excel. The questionnaire consists of 26 questions divided into six aspects, namely attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty. The calculation results of the six categories were used as a reference in each evaluation, with the benchmark scale shown in Table II from Schrepp [21]. Then, the level of student learning motivation is analyzed using percentages based on the specified indicators. The percentage criteria for student learning motivation are shown in Table III from Syachtiyani and Trisnawati [22] .

TABLE II. UEQ BENCHMARK SCALE

Aspect	Category				
	Excellent >	Good >	Average >	Below Average >	Bad <
Attractiveness	>1.75	>1.52	>1.17	>0.7	<0.7
Perspicuity	>1.90	>1.56	>1.08	>0.64	<0.64
Efficiency	>1.78	>1.47	>0.98	>0.54	<0.54
Dependability	>1.65	>1.48	>1.14	>0.78	<0.78
Stimulation	>1.55	>1.31	>0.99	>0.5	<0.5
Novelty	>1.40	>1.05	>0.71	>0.3	<0.3

[b.] (Source: Schrepp et al., 2017)

TABLE III. LEARNING MOTIVATION CRITERIA

Percentage (%)	Motivation Criteria
85 - 100	Very High
69 - 84	High
53 - 68	Medium
37 - 52	Low
20 - 36	Very Low

[c.] (Source: Syachtiyani and Trisnawati, 2021)

III. RESULTS

This research develops a website-based learning media named "AlproSkill" using the ADDIE development model. The final product produced is learning media for Scratch subjects for seventh-grade students. This media can be accessed through browser applications on laptops, computers, and smartphones. The material presented includes (1) Introduction to Scratch algorithms and programming, (2) Conditions and looping, and (3) Sensing. The results of this development include five main menu pages, namely (1) Home, (2) Guide, (3) Material, (4) Evaluation, and (5) About.

Fig. 2. Home page

Fig. 3. Guide Page

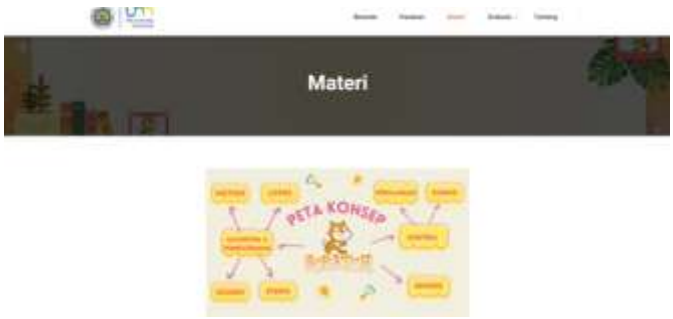

Fig. 4. Materials Page

Fig. 5. Evaluation Page

Fig. 6. About Page

After the learning media is developed, the next step is to test the product as described in the research method. The first trial was the material validity test, whose results can be seen in Fig.7. Next is the media validity test, whose results can be seen in Fig.8.

Based on Figure 7, the results of the material expert validation show that the aspect of the feasibility of learning media content obtained a score of 94.79%, which is included in the very valid category, and the aspect of the feasibility of presentation obtained a score of 96.88%, also included in the very valid category. The average of the two aspects is 95.83%, which is also in the very valid category. With the results of this material validity test, the "AlproSkill" website learning media is declared suitable for use because the material is in accordance with curriculum standards and student needs and can support the learning process well.

Based on Figure 8, the results of media expert validation show that in the software engineering aspect, the learning media scored 92.97%, which is included in the very valid category. The learning design aspect scored 96.88%, and the visual communication aspect scored 91.67%, both of which were also included in the highly valid category. The average of the three aspects is 93.84%, which is included in the very valid criteria. With the results of this media validity test, the "AlproSkill" website learning media is declared suitable for use because it meets the standards of good software engineering, effective learning design, and clear visual communication so that it can facilitate students in the learning process more optimally.

After the material and media validity tests were carried out, the next stage was implementation, namely product trials on seventh-grade students at SMP Negeri 24 Malang. Students' responses to the learning media were measured using UEQ, with data obtained from assessments conducted by 33 students. This assessment consisted of 26 questions grouped into 6 aspects, namely attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty. Each question was answered using a 1-7 scale presented to students. The measurement results of the UEQ scale can be seen in Table IV.

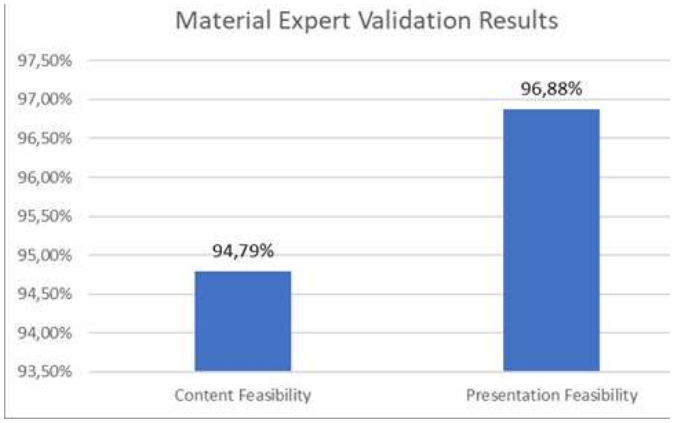

Fig. 7. Material Expert Validation Results

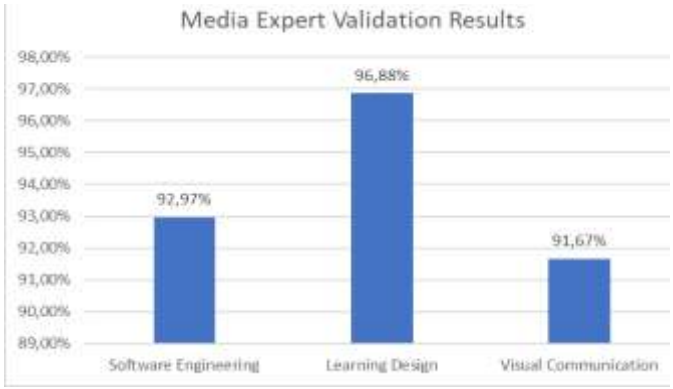

Fig. 8. Media Expert Validation Results

TABLE IV. UEQ GROUP MEASUREMENT RESULTS

Pragmatic and Hedonic Quality Scale	UEQ Scale	Score
Attractiveness	Pragmatic	2.19
Perspicuity	Pragmatic	2.16
Efficiency	Pragmatic	2.05
Dependability	Pragmatic	2.31
Stimulation	Hedonic	2.17
Novelty	Hedonic	2.29

Based on Table IV, the measurement results of the UEQ scale show that the attractiveness aspect is at a positive value of 2.19, perspicuity 2.16, efficiency 2.05, dependability 2.31, stimulation 2.17, and novelty 2.29. This UEQ scale is categorized into Pragmatic Quality (which includes perspicuity, efficiency, and dependability) and Hedonic Quality (which includes stimulation and novelty). The average score for Pragmatic Quality was 2.17, and Hedonic Quality was 2.23. Based on the measurement results, it was found that all aspects have positive values, which are above 0.8. Values between -0.8 and 0.8 are considered normal, while values >0.8 indicate positive results, and values <-0.8 indicate negative results. Further analysis was conducted by comparing the

UEQ results using the benchmark scales in Table II, the results of which can be seen in Fig. 9.

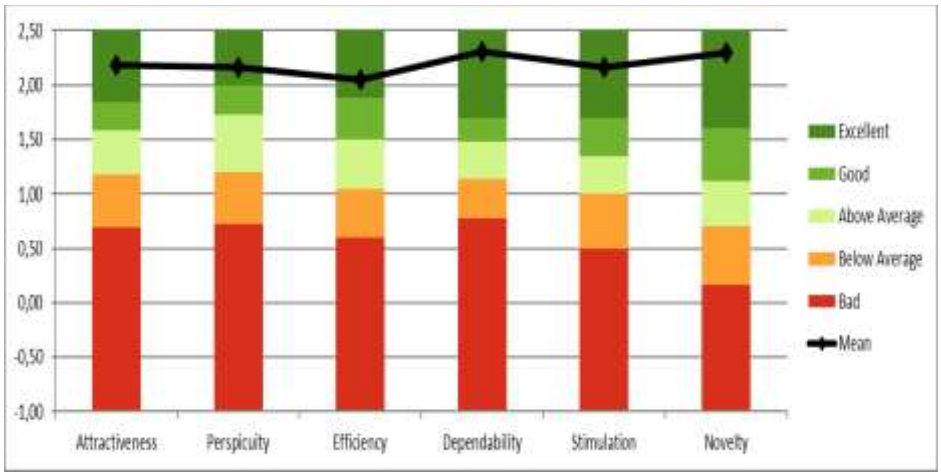

Fig. 9. UEQ Graph with Benchmark

Based on the UEQ results with the benchmark in Figure 9, it can be seen that the UEQ scale for AlproSkill developed is included in the excellent category. This is because all aspects ranging from aspects of attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty are in the excellent category, which indicates that AlproSkill has an attractive appearance, is easy to use, supports effective learning and provides a pleasant learning experience, and offers innovative features that increase its attractiveness as a learning medium so that it can provide a maximum learning experience for students. This finding is in line with the statement of [23], which states that educational website design that pays attention to aspects of interactivity and personalization can support learning effectiveness. Websites that are easy to use and have an attractive appearance tend to increase student engagement and interest, which in turn supports the achievement of learning objectives.

Furthermore, the learning media was tested on student learning motivation by giving motivation questionnaires before and after the use of AlproSkill media. The results of student learning motivation can be seen in Figure 10.

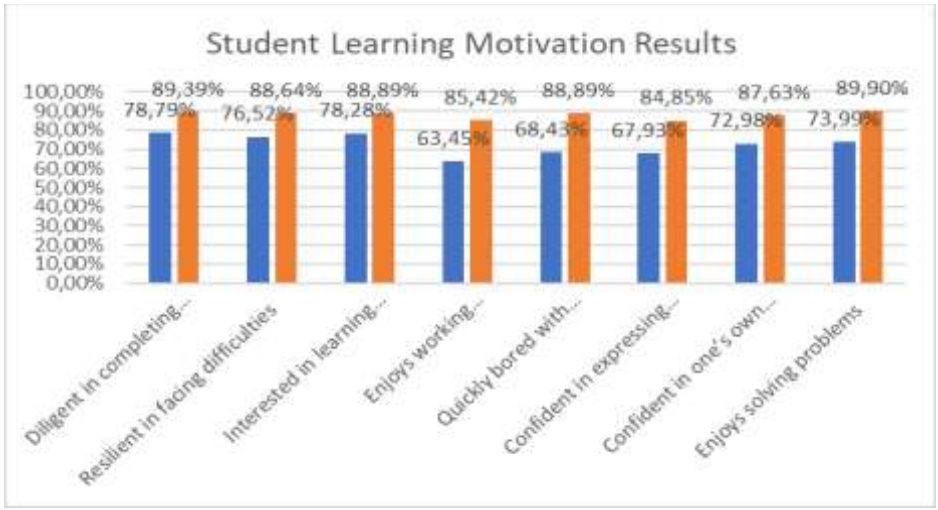

Fig. 10. Student Learning Motivation Results

Based on Figure 10, overall student motivation has significantly increased after using AlproSkill media, with the total percentage of motivation rising from 72.18% (pre) to 87.85% (post), an increase of 15.67%. The aspect of diligence in completing tasks improved from 78.79% to 83.39%. Resilience in facing difficulties rose from 76.52% to 88.64%, while interest in learning materials grew from 78.28% to 88.89%. Student motivation regarding enjoyment of independent work also increased from 63.45% to 85.42%. In contrast, motivation related to quickly getting bored with assignments rose from 68.43% to 88.89%. The aspect of confidence in expressing opinions increased from 67.93% to 84.85%, while confidence in one's work improved from 72.98% to 87.63%. Lastly, the aspect of enjoying problem-solving rose from 73.99% to 89.90%.

Thus, it can be concluded that overall, AlproSkill provides an innovative and interactive learning experience that helps students overcome learning challenges. This media is designed to be visually appealing and user-friendly, combined with the Problem-Based Learning model, creating a more engaging learning environment that supports the development of student motivation. This aligns with studies indicating that interactive learning media can enhance student engagement by presenting information in a more captivating and understandable manner. Through the incorporation of multimedia elements, students become more involved and can enjoy their learning experience more. Therefore, the combination of engaging learning media and the Problem-Based Learning (PBL) model can significantly enhance the learning experience and support the growth of student motivation [24].

IV. CONCLUSION

This research has developed a web-based learning media called AlproSkill, designed using a Problem-Based Learning (PBL) approach for the Scratch programming module to help seventh-grade students increase their learning motivation. The subject matter expert validation results indicated that AlproSkill falls into the "very valid" category, with content feasibility scoring 94.79% and presentation feasibility scoring 96.88%, giving an average of 95.83%. Media expert validation also placed AlproSkill in the "very valid" category, with software engineering scoring 92.97%, instructional design scoring 96.88%, and visual communication scoring 91.67%, resulting in an average of 93.84% across these three aspects. Field implementation further demonstrated that this media received positive feedback from students, as shown by the UEQ scores, which placed all aspects in the "excellent" category. Additionally, measurements of students' learning motivation before and after using AlproSkill showed a significant increase from 72.18% to 87.85%, an improvement of 15.67%. This indicates that web-based learning media effectively fosters students' motivation, especially in programming education. AlproSkill is expected to serve as an alternative interactive and contextual learning media to support Scratch learning while also facilitating flexible and independent learning for students.

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