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A Responsive Web Design Learning Media to Improve Students' Independent Learning Web Programming at Vocational High School

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ABSTRACT

The main objective of this learning media development is to develop responsive web design (RWD) based learning media with Pomodoro's learning technique for web programming. The learning media is used to create learning media that is not monotonous, and students can learn independently with features such as Pomodoro time management, monitoring material that has been learned, live coding to learn coding practices, and quizzes to monitor student understanding. This research and development use the Plomp development model reference, which consists of 5 stages, namely (1) preliminary investigation, (2) design phase, (3) realization/construction phase, (4) test, evaluation, and revision phase, and (5) implementation phase. Products are produced in the form of RWD learning media under the name WCode. The results of the material expert validation assessment were 78.87%, media validation was 92.71%, development trials (small groups) were 87.36%, field trials (large groups) were 90.02%, the level of student learning independence after using the media was 79.38% with an increase of 12.99% from the level of student learning independence before using the learning media made. The learning media can be considered feasible and used as student learning materials in class to support independent learning on web programming elements for vocational students majoring in Software Engineering.

I. INTRODUCTION

To achieve a good education, it is necessary to integrate technology into the learning process. [1], [2]. The use of technology in learning can expand access to education, improve learning effectiveness, and increase student engagement in the learning process. [3]. Students today have unlimited access to various educational resources, including e-books, learning videos, online courses, and app-based learning platforms. This allows for more dynamic and diverse learning, which can be tailored to individual needs. Learning media is needed to increase the effectiveness of achieving learning objectives in communicating in learning. [4]. When learning media are used effectively, teachers can create learning experiences that combine many different sensory elements, helping students understand concepts more deeply and remember information better.

Web programming is a material that Software Engineering Expertise Program students must learn in class XI in MPKK lessons. This is because web programming is a vocational foundation needed by the industrial sector. Therefore, students need to understand the material and apply their skills. In interviews conducted with teachers who teach web programming at SMKN 1 Purwosari, the teacher does hands-on practice in carrying out learning, and the material is presented using PowerPoint media without using other learning media. From the results of the questionnaire distributed to students, it is known that 96% of 49 students

stated that the learning media used was PowerPoint. From the interview results, it is also known that the material taught is HTML. The same thing is also done by teachers who teach web programming at SMKN 2 Singosari and SMKN 5 Malang.

From the observations made, it was found that the learning media used, on average, still did not utilize learning media in presenting the material. The use of PowerPoint to explain tends to be monotonous, with less interaction that can captivate students' attention and make students only passive recipients of information. In PowerPoint, the material presented is only in the form of points that cannot be detailed to improve student understanding. From interviews conducted with teachers, it was also found that students' independence in learning is still lacking; students still depend a lot on the teacher. This shows that efforts are needed to increase students' independence in managing and taking initiative in learning. One of the steps that can be taken is to develop learning strategies that encourage students to be more actively involved in their learning process. Here, there is a need to develop more interactive and creative learning media to overcome this problem to improve the quality of learning. In addition, using suitable learning media in modern education can help students acquire independent learning skills.

In the independent curriculum, one of the learning methods is the Student-Centered Learning (SCL) method. The independent curriculum uses a student-centered learning focus, which means that the teacher only functions as a facilitator and not the primary source of teaching. Instead, students are asked to participate more actively and independently in learning. There are many concepts related to SCL in the learning process, including agile learning, experiential learning, and independent learning. Through independent learning, students are given autonomy in managing their learning, which later leads to learning independence. [5]. Good time management skills are essential for a person to increase their independence. [6]. There are several techniques for students to improve their ability to manage time, one of which is the Time Management Technique. There are many ways to manage time that can make students more productive and efficient; the Pomodoro Technique is one of them. This technique is applied because a person focuses on studying for twenty-five minutes and then takes a short pause for five minutes. This technique helps a person avoid fatigue and improves their concentration.

Based on the results of the explanation of the background of the problem above, to implement SCL in the independent curriculum, student learning independence is needed. Learning independence requires good time management; the Pomodoro technique can be applied. Pomodoro is a time management technique that helps students manage their study time to avoid fatigue and maintain concentration. Learning independence requires learning media that is not monotonous and has interaction in it to attract students' attention. Responsive Web Design (RWD) can be used to create learning media attractive to students learning. Using this RWD, students can access the learning media using their devices, one of which is a device that cannot be far from students today, namely cell phones or smartphones. The primary purpose of this learning media development is to develop RWD-based learning media with Pomodoro learning techniques in web programming material. The learning media is used to create learning media that is not monotonous, and students can learn independently with time management techniques.

II. METHODS

This research and development used Plomp's development model reference, which consists of 5 stages. Previous studies revealed that whatever the purpose of design and development research, the process always incorporates a systematic design process. [7]. Plomp's research model was chosen because its development is more flexible than other development models; each phase in this model can also be adjusted to the characteristics of the research. The application of the Plomp model uses five phases, with each flexible stage's details: preliminary investigation, design phase, realization/construction phase, test, evaluation, revision phase, and implementation phase. Plomp's development model is shown in Figure 1.

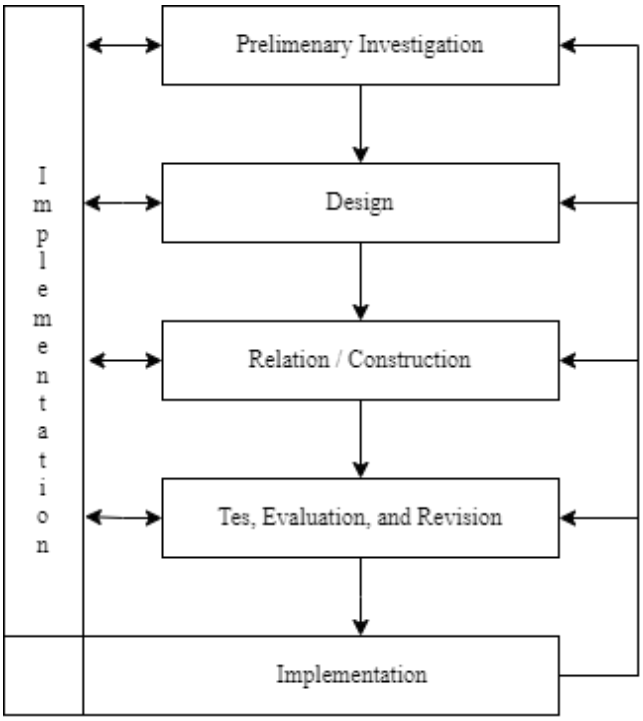

Fig. 1. Plomp Development Model

A. Preliminary Investigation

Analyzing the problem is done by observing learning activities at school, distributing initial questionnaires to students, and interviewing teachers who teach web programming elements of HTML material. From the questionnaire and interview, it is known that the learning media used by the teacher to explain the material is only using PowerPoint. The use of this learning media has shortcomings, namely the lack of interactivity that students can engage in when accessing the learning media; besides that, the use of

PowerPoint also cannot support students' learning independence.

1) Needs Analysis

From the interview results, the teacher also mentioned that students' learning independence is still lacking, and they are still very dependent on the teacher. Hence, the learning is still more inclined towards teacher-centered learning (TCL). Based on the questionnaire distributed, it is known that 46 (94%) of 49 students need learning media that can be used to manage study time. Good time management skills are essential to increase one's learning independence.

From the questionnaire distributed to students, it is also known that 84% of students need learning media that can be used to practice (live coding). With the live coding feature in the learning media, it is expected that students will not only understand the theory but also get an understanding of it in practice.

2) Infrastructure Analysis

The analysis of infrastructure facilities carried out by observation shows that the PPLG lab at SMKN 5 Malang has three labs, and the RPL lab at SMKN 2 Purwosari also has three labs. At SMKN 2 Singosari, there is a problem with the number of RPL labs, whereas in this school, there is only 1 lab. The analysis of infrastructure facilities through questionnaires shows that 98% of students have smartphones.

3) Media Analysis

The media analysis found that many students have the opportunity to have smartphones. This opportunity can be utilized to overcome the problem of limited labs, as occurs in SMKN 2, by creating learning media that has practical features and can be accessed using smartphones owned by students. In addition to overcoming the problem of limited labs, using learning media that can be accessed using smartphones will also make it easier and faster for students to access learning media.

From this analysis, the learning media developed is based on responsive web design, which makes learning media run well on PCs, laptops, smartphones, and other devices so that this learning media can be utilized in the school lab, on student laptops, and student smartphones.

B. Design

Architectural design drafting technique: this phase aims to solve the problems found from the initial research by making an initial design. At this stage, the design of web programming learning media based on RWD is carried out.

1) Material Design

The first step in designing this learning media is compiling learning materials. From the observations, the material that will be applied to this learning media is HTML.

2) Media Design

After knowing what material content will be made, the next step is to prepare media designs by applying RWD. In this media design, student flowcharts, teacher flowcharts, use cases, initial designs (students), and initial designs (teachers) are designed.

C. Realization/Construction

In this stage, the initial prototype is made, which is the realization of the implementation of the design phase. The learning media is developed by the design that has been designed at the design stage and tested at the next stage.

D. Test, Evaluation, and Revision

Before the media is implemented in students, material validation is needed to assess the feasibility of the material as media or teaching materials. This material validation was carried out by a material expert who is a web programming element teacher at SMKN 2 Singosari.

In addition to validation by material experts, validation from media experts is also needed as a validator of learning media research products developed to assess the weaknesses and advantages of the media developed. This material expert is a Malang State University lecturer experienced in learning media development.

After validation by material experts and media experts, learning media products will go through a trial stage for students. At this stage, the trial is a small group trial that is carried out to a small number of students who can represent class XI RPL students at SMKN 2 Singosari. Students will be given the developed learning media. Then, students will test the media products developed, and after that, they will be given an assessment questionnaire to be able to provide feedback on the media that has been developed.

Based on the data collected, it can be decided which types of solutions meet the standards and which types of solutions still need to be developed. This shows that improvements may still need to be made in the previous phases. This is called the feedback cycle and is repeated until the desired solution is achieved.

E. Implementation

After going through the test, evaluation, and revision stages, a valid and practical product is obtained, and then the next stage is a large group trial, which is carried out to a more significant number of students than the small group trial. XI RPL class students conducted this large group trial at SMKN 2 Singosari. In its implementation, students will be given the media that has been developed to study and test the media. After that, students will be given an assessment questionnaire to provide feedback on the media that has been developed. The developed media continues to be evaluated for further improvement in its application.

The instruments used in research and development include material expert validation, media expert, trial respondent, and learning independence instruments. This instrument is made with a Likert scale. The Likert scale criteria are shown in Table I.

TABLE I. LIKERT SCALE

Score	Description
4	Strongly Agree / Very Suitable / Very Appropriate / Very Good / Very Clear / Very Easy / Very Good
3	Agree / Appropriate / Appropriate / Good / Clear / Easy /

	Complete
2	Less Agree / Less Suitable / Less Appropriate / Less Good / Less Clear / Less Easy / Less Complete
1	Disagree / Not appropriate / Not appropriate / Not good / Not clear / Not easy / Not complete.

The material expert validation instrument will be given to one teacher who teaches MPKK web programming elements. The material and media validation expert uses a questionnaire grid to assess learning aspects and material content. Lecturers in the Informatics Engineering Education Department will carry out media validation. The aspects evaluated for media expert validation are display and programming aspects. SMKN 2 Singosari Class XI RPL students will carry out the test respondent instrument. The test respondent instrument uses a questionnaire grid with the aspects assessed on the instrument as aspects of appearance, material, and usefulness.

Data on the feasibility of learning media developed is taken using quantitative data; this data is obtained from the results of questionnaires given to media experts, material experts, and students. This data analysis technique was obtained from [8] using the following formula:

$$V = \frac{TSe}{TSh} \times 100\% \qquad (1)$$

Information:
V = Validation percentage
TSe = Total empirical score (total score achieved)
TSh = Total maximum score (expected total score)

It was developed using assessment criteria as a basis for decision-making regarding the feasibility of learning media. The validity criteria can be seen in Table II below.

TABLE II. MEDIA FEASIBILITY ASSESSMENT CRITERIA

Score	Description
85,01% - 100,00%	Very valid, or can be used without revision
70,01% - 85,01%	Moderately valid, or can be used but needs minor revisions
50,01% - 70,01%	Less valid, or recommended not to be used because it needs significant revisions
01,00% - 50,01%	Invalid, should not be used

The learning independence questionnaire determines how students can learn independently using the developed learning media. XII RPL students of SMKN 2 Singosari became respondents in this study. The learning independence questionnaire aspects assessed in the instrument are aspects of initiative and intrinsic learning motivation, habits of diagnosing learning needs and usefulness, setting learning goals/targets, monitoring, regulating and controlling learning, viewing difficulties as challenges, utilizing relevant sources, applying learning strategies, evaluating learning processes and results, and self-ability.

Learning independence is measured by distributing questionnaires to respondents and analyzing them based on the class average. Therefore, the acquisition of respondents' scores and the average overall score of students are calculated using the following formula:

$$V = \frac{TSe}{TSh} \times 100\% \qquad (2)$$

Information:
K = Percentage of independence
TSe = Total empirical score (total score achieved)
TSh = Total maximum score (expected total score)

Based on the results of obtaining the percentage value (K) of the respondent's score, it will be re-categorized based on Table III below.

TABLE IIII. MEDIA FEASIBILITY ASSESSMENT CRITERIA

Score	Description
80,01% - 100,00%	Very High
65,01% - 80,01%	High
55,01% - 65,01%	Moderately High
01,00% - 55,01%	Low

III. RESULTS AND DISCUSSION

The experts validated the learning media by filling out a questionnaire. Two experts were involved in this process: material and media experts. The results of this validation were then used as a reference to continue the trial with the respondents or actual targets, namely students. This trial was conducted in two stages. The first stage was a development test conducted on a small group of 10 students. The goal is to determine whether the learning media is accessible for students to understand and use. The second stage was a field trial conducted on a large group of 30 students. The results of the feasibility trial of learning media are described as follows:

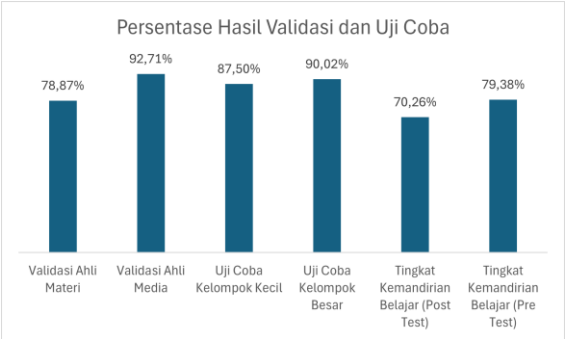

Fig. 2. Example of a figure caption. (figure caption)

A. *Material Expert Validation Results*

Based on the assessment of the material expert validator described in Figure 2, the results of the assessment calculation of 78.87% are pretty valid but need minor revisions according to the eligibility level category shown in Table 1. From the assessment presented, it is obtained that the material presented in the learning media is based on the learning objectives,

clarity of discussion, and examples; the media can help support student learning independence and can be used as a supporting learning media. The criteria for this material expert's response, as from the results of previous research, show that this application can be validly tested, which can guarantee the scope of the material by learning objectives and support its usefulness by the plan. [8].

B. Media Expert Validation Results

Based on the assessment of media expert validators described in Figure 2, the results of the assessment calculation were 92.71% with very valid criteria according to the eligibility level category shown in Table 1. The assessment shows that the size of the text, fonts, and images presented are good, learning media can run without errors, and the display can be adjusted with various devices. The criteria for this media expert's response, as from the results of previous research, show that this learning media can be validly tested, ensuring that this learning media, by learning objectives, can support the plan's usefulness. [9].

C. Development Test Results (Small Group)

Based on the development test assessment described in Figure 2, the results of the assessment calculation were 87.50% with very valid criteria. The assessment found that two of the three aspects received very valid results, while one aspect received quite valid results. The display aspect has the highest percentage, where the assessment is based on the use of language, typography or fonts, media display, use of color, and navigation, which presented very well in the learning media, resulting in a very valid assessment. Furthermore, the material aspect assesses the suitability of the material, the clarity of the material structure, the use of language and examples, and the ease of understanding the material with a very valid assessment. The aspect with the lowest assessment is the aspect of usefulness.

D. Field Test Results (Large Group)

Based on the development test assessment described in Figure 2, the results of the assessment calculation were 90.02% with very valid criteria. From the assessment, it was found that the three aspects assessed obtained very valid results. All three aspects have improved from the results of the development trial. The aspect with the highest value is the display aspect, with an increase of 3.83% from the development trial value. This increase can be caused by suggestions related to the display aspect from material experts and development trial respondents. The second aspect that has increased is the material aspect, with an increase of 4.54% from the development trial value. The last aspect, namely the expediency aspect, has increased from the value of the development trial results, with a percentage increase of 7.83%. The criteria for respondents' responses to this trial, as from the results of previous research, show that this learning media is valid, which can ensure that this learning media is by learning objectives and can support the plan's usefulness.

E. Results of Students' Learning Independence Level

The results of the analysis for student learning independence in the field trial (large group) showed an increase from the percentage of student learning independence before using WCode learning media (pre-test) of 70.26%, an increase of 12.99% after using WCode learning media (post-test) with a percentage of 79.38%. The aspect of the learning independence assessment that experienced the most significant increase was the aspect of applying learning strategies, with an increase of 20.03% from the pre-test value of 64.58% to 77.50%; this could happen because in the WCode learning media, applying the Pomodoro technique, this technique has a learning system that is short but has high intensity so that students can still maintain focus in learning. [10], [11]. The aspect of learning independence that experienced the second largest increase was the aspect of monitoring, organizing, and controlling learning. This increase can occur because, in WCode learning media, students can monitor their learning progress regularly; in this media, students can find out how much material, topics, and quizzes they have learned. In addition, the increase in monitoring, organizing, and controlling learning is also because, in WCode media, students can manage study time and maintain focus with Pomodoro study time management. [12], [13], [14], [15], [16].

IV. CONCLUSION

The product, a responsive web design-based website for vocational students, has been developed and tested for feasibility. The product is designed and developed using the Plomp development model.

Based on the results of validation from material experts, media expert validation, and trial respondents, it can be concluded that: (1) WCode learning media based on RWD developed in the form of a website as a supporting learning media or as a student learning supplement both in class and independently in the Expertise Competency Subject of web programming elements for vocational students of Software Engineering; (2) Learning media has been tested for feasibility through material expert validators, media expert validators, user trials. Based on the results of the feasibility test, the media is considered feasible and can be used as a means of student learning materials both in class and supporting student learning independently in the Expertise Competency Subject of web programming elements for students of Software Engineering vocational schools; (3) The learning media has been tested on 30 students of Class XI RPL 1 SMK Negeri 2 Singosari. The results of the learning independence test after using WCode learning media show that the level of student learning independence is high at 79.38%, with an increase of 12.99% from the level of student learning independence before using WCode learning media, thus showing the effect of media implementation as a learning support to increase student learning independence in the Expertise Competency Subject of web programming elements of vocational students majoring in Software Engineering.

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