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# The Development of Mobile Learning Media Using Computer-Aided Manufacturing Simulation in Computer Numerical Control Lathe

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**Abstract.** This research aims to produce products in the form of lathe computer numerical control (CNC) learning media in non-conventional machining engineering subjects at Vocational High School 2 Klaten. This research is a Research and Development research based on ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). The product was tested on 67 students majoring in Metal Fabrication and Manufacturing Engineering. Data is collected using questionnaires and data analysis using descriptive analysis techniques. The results obtained that android-based learning media developed showed positive results, including from material experts got a percentage of 91.1%, media experts 94.5%, from teachers 94.7% and student responses 77.9%. With these results it can be concluded that the learning media is feasible to be used for the learning of CNC machining lathes.

## INTRODUCTION

The teaching and learning process is often faced with abstract material and in reality the teacher explains using only textbooks and lecture methods even though the facilities and infrastructure in schools are available but are not used optimally, so that this material is difficult for students to understand. The implication is that students have difficulty due to lack of attention and tend to be passive so they need to repeat during practice time, of course this makes it ineffective and inefficient [1].

The development of mobile technology is currently so rapid, one of the mobile devices that is currently commonly used is a smartphone, students must already have one smartphone or some even have more than one smartphone. The more students who own and use mobile devices, the greater the opportunities for using technology devices in education. By utilizing smartphone technology as a means for learning aids in the form of mobile learning. The presence of mobile learning is intended as a complement to learning and provides opportunities for students to learn material that is less mastered anywhere and anytime [2].

Vocational education is education that prepares young people and adults to enter the workforce, where the learning process is related to problems and practices. The concept of engineering education is to use technology to solve problems and fulfill wants and needs. While the concept of vocational education is related to skills in using equipment and machines.

A computer numerical control (CNC) machine is a very complex machine, because it is a combination of conventional machine tools and a computer-controlled numerical control system, so virtual CNC software is very suitable for learning CNC machining engineering competencies. The software in question can use the same simulator as the school's CNC machines. With this simulator, students will find it easier to recognize CNC considering the importance of CNC lessons. Improving the quality of CNC learning can be achieved by providing the widest opportunity for each individual student to practice making CNC programs and applying the program to CNC machines [3].

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Learning can be defined as a system or process of learning the subject of students or so-called learners who are planned or designed, implemented, and evaluated systematically so that the subject or learner can achieve learning objectives effectively and efficiently. Learning media is a useful tool for the teaching and learning process. All things that can be used to stimulate the attention, thoughts, feelings, and abilities and skills of students so that they participate in encouraging the learning process. These limits become broad and deep including sources of knowledge, the surrounding environment and the use of methods to achieve learning objectives [4]. Media in the plural form of intermediary (medium), is a means of communication. Derived from the Latin medium (between), this term refers to anything that carries information between a learning resource and a recipient [5].

There are three levels in the learning model such as direct experience (enactive), abstract experience (symbolic) and pictorial or image experience (iconic). The three levels also interact with each other to gain new attitudes, knowledge and skills [6]. The benefits of using a learning media also explain the delivery of knowledge so that it is not too verbal or in the form of writing and verbally, Overcoming problems regarding the limitations of time, space and capture power [7].

Mobile Learning is the development of electronic learning. The term mobile learning refers to handheld and mobile devices such as PDAs (personal digital assistants), cellular phones, laptops, tablets, and so on. Users to access learning content anywhere and anytime, without having to visit a certain place at a certain time. Mobile learning is related to learning mobility, in the sense that students should be able to engage in educational activities without having to do it in a certain physical location [2].

There is a researcher that have investigated about learning media. A research about Android-based learning module in the XI grade metal fabrication engineering subject at vocational high school 2 Klaten was carried out using the ADDIE (analysis, design, development, implementation, evaluation) development model. The results showed that the learning module application product is suitable for use by students as a companion in the learning process [10].

Majors that are vocational in nature develop more academic competencies, but there are also vocational competencies. For the State Vocational High School 2 Klaten, especially in the productive subject group, more non-conventional competencies are developed. Therefore, it is hoped that the learning of non-conventional machining techniques can be emphasized more effectively and foster interest in the media in learning. This study aims to produce a product in the form of CNC lathe learning media and determine the feasibility of the media made for students in Department of Metal Fabrication and Manufacturing Engineering in CNC Lathe Machining Engineering Subjects at VHS 2 Klaten.

## RESEARCH METHODS

This study uses a research and development model (Research and Development). With this research, a useful product can be produced to help the learning process and consists of an android-based application using a smartphone device. To develop a learning media product, research is carried out, so that it can be known the feasibility and effectiveness of a media to be used to help the learning process. This research was carried out in class XII of Metal Fabrication and Manufacturing Engineering Skills Competence (TFLM) at VHS 2 Klaten, having its address at Senden, Ngawen, Klaten. The implementation was carried out in August 2020. The subjects of this research are one material expert lecturer, one media expert lecturer, non-conventional machining teacher and students of VHS 2 Klaten class XII TFLMA totaling 34 students and class XII TFLMB totaling 33 students.

This study uses a development model developed by Molenda and Reiser [8], namely, the stages of research using development guidelines with five stages, namely ADDIE which includes Analysis, Design, Development, Implementation and Evaluation. These stages will be used to obtain research results in the form of learning media based on Android in non-conventional machining subjects more specifically, namely machining material about CNC lathes.

The data collected in the form of quantitative data as basic data and qualitative data in the form of suggestions and input from respondents as additional data. This development research uses non-test data collection techniques in the form of a questionnaire (questionnaire). The type of questionnaire or questionnaire used in this study is a closed questionnaire using a Likert scale by determining the value or score of the statement answer choices.

The data analysis technique was carried out in two steps. The first step is to change the category value into an assessment score. The assessment in the form of category values is then converted into an assessment score. The criteria for changing category values into assessment scores in the questionnaire by media experts, material experts, teachers, and students. The second step is to analyze the score by calculating the score obtained from the study divided by the maximum score for all items multiplied by 100%. Descriptive statistics are statistics used to analyze data by describing or describing the data that has been collected as it is without intending to make conclusions that apply to the public or generalizations [9].

Qualitative data is first transformed based on the assigned score weights into quantitative data, namely one, two, three, or four so that the data can be used according to the purpose of the study. The percentage is calculated using Eq. 1.

$$\text{Percentage} = \frac{\text{Obtained Score}}{\text{Maximum Score}} \times 100\% \quad (1)$$

The feasibility category of this learning media is determined by using a Likert Scale measurement scale. With a Likert Scale measurement scale, the data obtained are in the form of numbers which are then interpreted in a qualitative sense is shown in Table 1. Meanwhile, the Likert scale of assessment for students consists of four categories and scores as shown in Table 2. Calculation of the assessment data using descriptive analysis techniques in order to obtain the feasibility of non-conventional machining media. The measurement scale used is the Likert scale by setting the value or score of the answer choices according to the statements obtained, which can be entered into the range of criteria in Table 3.

**TABLE 1.** Likert scale for experts and teachers

| Category | Score |
|---|---|
| Excellent | 5 |
| Good | 4 |
| Average | 3 |
| Poor | 2 |
| Very Poor | 1 |

**TABLE 2.** Likert scale for students

| Category | Score |
|---|---|
| Strongly agree | 4 |
| Agree | 3 |
| Disagree | 2 |
| Strongly disagree | 1 |

**TABLE 3.** Percentage scale of feasibility criteria

| Category | Percentage range |
|---|---|
| Very feasible | 85% - 100% |
| Feasible | 69% - 84% |
| Less feasible | 53% - 68% |
| Not feasible | 37% - 52% |
| Very inappropriate | 20% - 36% |

## RESULTS AND DISCUSSION

The process of making learning media about using CAM (Computer Aided Manufacturing) simulation CNC lathes requires several stages that must be passed. These stages will be used to obtain research results in the form of android-based learning media in non-conventional machining subjects more specifically about CNC lathes. Research has used several steps according to the ADDIE model such as the analysis step, the design step, the development step, the implementation step, and the evaluation step.

The analysis step involves analyzing the curriculum needs, material needs, the media needed and the needs and level of students' abilities. The design step involves designing a product-making concept in the form of learning media. The develop step is the step where a learning media product is successfully created. The media that has been created consists of several parts in it such as the initial application menu display, the main menu section, the introduction section, the material section, the exercise section, quizzes and videos. An example of the display of the media in the main menu section is shown in Fig. 1. Meanwhile, the display of the learning media material is shown in Fig. 2.


**FIGURE 1.** Home menu display of learning media

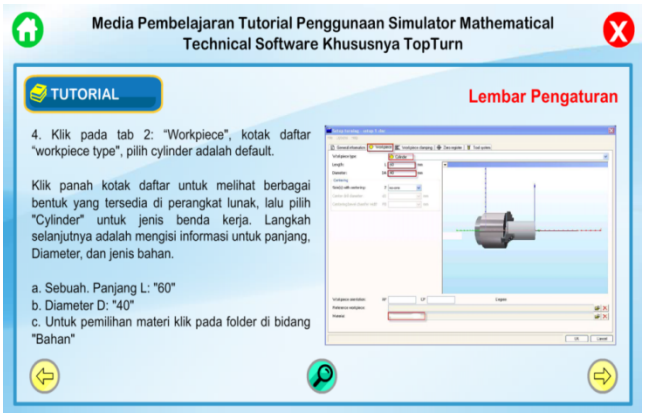


**FIGURE 2.** Material sections display of learning media

Implementation is a step taken for students to use android-based mobile learning learning media. The implementation was carried out at the State Vocational High School 2 Klaten on Friday, August 28, 2020 and on Monday, August 31, 2020. The evaluation step was carried out by looking at the results of the response to the media that had been developed so that the level of feasibility of a medium for use in learning activities could be obtained.

The learning media that has been made will then be validated to obtain suggestions and improvements from the validator which aims to find out whether the developed media is suitable for use. The validation process was carried out on three validators such as material experts, media experts, and teachers of non-conventional machining subjects at State Vocational High School 2 Klaten.

From the results of material validation, researchers found the high quality of the material from the developed android-based learning media. There are several statements that represent various aspects of learning. The results of the material validation that have been carried out are shown in Table 4. The total score obtained is 41 and the percentage of eligibility is 91.1%. After being adjusted into the feasibility scale table, it is included in the very feasible criteria so that these results can be interpreted as learning media using CAM simulation is feasible to use in accordance with suggestions and improvements.

Validation of media experts about the developed learning media was carried out to determine the quality of the media. Several aspects of the statement can represent an assessment of the quality of a learning media. The results of the validation by media experts are shown in Table 5. The assessment by media experts based on several statement indicators shows good and very good results. The total value obtained is 71 and the percentage of eligibility is 94.5%. After being adjusted to the feasibility scale, it is included in the very feasible criteria, but there are improvements and suggestions given by media experts.

**TABLE 4.** Material expert assessment results

| Aspect | Score | Percentage |
|---|---|---|
| Curriculum | 10 | 100% |
| Material delivery | 8 | 80% |
| Evaluation | 10 | 100% |
| Language | 13 | 86.6% |
| Total | 41 | 91.1% |

**TABLE 5.** Media expert assessment results

| Aspect | Score | Percentage |
|---|---|---|
| Display quality | 27 | 90% |
| Software quality | 10 | 100% |
| Execution | 10 | 100% |
| Interface | 14 | 93% |
| Compatibility | 10 | 100% |
| Total | 71 | 94.5% |

The results of the validation according to the teacher are assessing the learning media from two aspects, namely the material aspect and the appearance of the program. The validation carried out by the teacher was done because they better understand the character's knowledge about the CAM simulation used in the school. The results of the validation by the teacher are shown in Table 6. From the assessment by the teacher, the validation results from the statement indicators are good and very good with a total score of 70 and the percentage of eligibility is 94.7%. Then the percentage is adjusted into the feasibility scale which shows the results are very feasible. From the validation results, the teacher gives the meaning that the learning media that has been made is suitable for use in learning.

**TABLE 6.** Teacher assessment results

| Aspect | Score | Percentage |
|---|---|---|
| Display quality | 28 | 93% |
| Software quality | 10 | 100% |
| Material presentation | 9 | 90% |
| Execution | 9 | 90% |
| Language | 14 | 93% |
| Total | 70 | 94.7% |

The results of product trials were carried out by students using smaller research subjects involving 6 students of class XII of the metal fabrication and manufacturing engineering department at the state vocational high school 2 Klaten. The results of the trial of learning media products are shown in Table 7. The first stage of the trial was carried out with a survey containing 12 statement indicators filled out by a total of 6 students. Furthermore, the results of the assessment are adjusted to the feasibility scale where a value of 49.2% is obtained which falls into the criteria of being quite feasible. This means that android-based learning media needs to be revised again.

**TABLE 7.** Assessment results at first trial

| Aspect | Score (%) | Category |
|---|---|---|
| Interest in media | 40% | Not feasible |
| Material | 33% | Not feasible |
| Display | 40% | Not feasible |
| Execution | 83% | Feasible |
| Average | 49.2% | Not feasible |

After a revision is made on Android, it is necessary to test the media. The trial of this product involved 67 students of class XII metal fabrication and manufacturing engineering at the state vocational high school 2 Klaten. The results of the trial of learning media products are shown in table 8. The results obtained from the assessment by students are then adjusted into the rating scale. There are 12 assessment indicators filled by 67 students. After being converted to a feasibility scale, it was obtained 77.9% and was classified as eligible, so that overall android-based learning media

did not need to be revised again. Based on the assessment of students, there is an increase in effectiveness before and after media revision. Before the revision, the assessment score was 49.2% which was classified as sufficient and after the revision, it was obtained 77.9% and was classified as eligible. Based on these results, it can be concluded that there was an increase in effectiveness as much as 28.7% from the criteria enough to be feasible.

## CONCLUSION

The research carried out resulted in learning media consisting of various menu options as follows: application initial display menu, learning media main menu, introduction menu, material menu or tutorial using CAM simulation, sample practice menus, quiz menus carried out by students and video menus. The results of the assessment obtained from the validation of material experts, media experts, teachers and responses from students aimed to determine whether or not the android-based learning media, especially the CAM CNC lathe simulation material at the State Vocational High School 2 Klaten. Based on the results obtained, it can be concluded that the android-based learning media developed showed positive results, including 91.1% from material experts, 94.5% media experts, 94.7% from teachers and 77.9% student responses. So, based on these results, it can be concluded that the learning media is feasible to be used for learning CNC lathe machining.

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