Development of Job Sheet Lathe Machining Practice Based on Animation Video as Interactive Learning Media

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Abstract. The weakness of paper-based job sheet is that it is less effective in facilitating students’ understanding of the explanation of images, and tends not to be stored by students for a long period of time as learning reference material so that it requires the development of job sheets to become interactive learning media that are in line with the demands of the development of the 4.0 industrial revolution. The objectives of this study are (1) to produce a job sheet for the practice of animation video-based lathe machining that can be accessed on Android SMK students, and (2) test the level of feasibility of the results of the development of animated video-based job sheets. This research method is Research and Development (R&D) with a 4-D model consisting of four stages, namely define, design, develop, and disseminate. The subject of the study consisted of material experts, media experts, and students of class XI machining techniques at Muhammadiyah Vocational School Prambanan. The instrument used was a questionnaire. While the data analysis technique uses quantitative descriptive analysis. The applications used in developing this job sheet include SSCNC (Swansoft CNC Simulator), bandicam, and wondershare filmora. The results of the study include: (1) producing a job sheet for video-based lathe machining practice with one subject of flat lathe work preparation; (2) the level of feasibility of animated videos is very feasible, it is known from the results of material expert validation which includes aspects of content, language, presentation, and benefits reaching an average value of 71.50 with a percentage of 89.50% in the very feasible category. The results of media expert validation covering aspects of appearance, ease of use, consistency, format, and graphics reached a value of 73 with a percentage of 91% in the very feasible category. The results of the small class test which included material aspects, language, graphics, and benefits obtained an average score of 62.31 with a percentage of 86% in the very feasible category and the results of the large class test obtained an average score of 59.55 with a percentage of 83% in the very feasible category.

1. Introduction

Job sheet is a form of the instruction sheet that contains a set of fundamental activities/tasks that must be carried out by students to maximize understanding in the effort to achieve competence [1]. One of them is used as a work order in the practice of lathe machining practice. The results of evaluations that have been carried out on the competency of machining engineering skills at the Muhammadiyah Prambanan Vocational School show that the job sheet used for practice is still in the
form of paper and has not met the criteria for standard job sheet. This is evidenced by a number of shortcomings in the job sheet, including (a) not including the purpose of the job; (b) making it difficult for new students to practice because without being accompanied by the steps of their work; (c) there are symbols, pictures, and orders that are not accompanied by an explanation; (d) the size of the number is not accompanied by a description of the unit; (e) does not include occupational safety / OSH that must be implemented; and (f) does not include evaluations of student learning outcomes. While the criteria for job sheets that are in accordance with the standard are: (a) title; (b) basic competencies that must be achieved; (c) settlement time; (d) equipment / materials needed to complete the task; (e) brief information about K3; (f) work steps; (g) tasks that must be done; and (h) reports that should be done [2]. These deficiencies have an impact on students not understanding the work steps in working workpieces. To support practical learning of lathe machining techniques, an interactive learning media is needed. Learning media are often used to help students improve understanding, present interesting and reliable data, facilitate data interpretation, and condense information [3].

Furthermore, media visualization, such as animation or video is highly recommended for use by teachers in the learning process. Student learning outcomes taught with 3D media (animation media) are more effective than students taught with 2D media (traditional paper media), indicated by a change in structure/concept map understanding of students in groups taught with 3D media more evenly / homogeneously compared to groups students taught with 2D media [4][5]. The use of multimedia learning media will provide an easier understanding of the topics studied by students [6] [7]. Similarly, multimedia technology is also effectively used as the development of learning media that can improve student achievement in the practice skills [8]. Learning media that can be developed in this study are animated video-based material containing the steps to workpieces from the beginning to the end of the flat turning process [9]. Animated videos are made by utilizing applications that are easy to learn and the results are easily accessed on students' Android phones for learning media. The results of the research show that the development of video tutorial media can improve the completeness of 31% learning outcomes [10]. In other words learning outcomes show the level of students' understanding of the material being taught. It can be concluded that video learning media is effective in increasing students’ understanding. Therefore, it is important to do animated video sheet work as an alternative solution to the problem of using traditional paper-based job sheets.

2. Job sheet based on animation video

One of the most dominant aspects in the engineering practice learning process is the existence of a job sheet because job sheets are used for guidance or guidance in learning and mastering one of the competencies taught by educators. Job sheet is a page of instructions/instructions used to assist workers in carrying out certain tasks [11]. Job sheet that will be developed is limited to one basic competency in applying the lathe machining technique with the subject of work preparation (WP) for flat turning.

With the WP, a video-based job sheet was developed. The type of animation video chosen is computer generated animation that is used for 3D animation. The benefits of using animated videos in learning activities include being able to show how to use the tool as a whole, demonstrate the skills to be learned, can facilitate the process of applying complex concepts visually or demonstration, show the stages of the process and can be played back [12]. The applications that support the development of animated video-based worksheets include: (a) SSCNC (Swansoft CNC Simulator), used to make the animation work process turn flat; (b) Bandicam, used to record the flat turning process on the SSCNC application that will produce a video; (c) wondershare filmora, used to edit videos by adding text, marks or cutting videos as needed. The final step in this application is to export the edits and produce an animated video.
3. Research Methodology

This research includes the type of research and development (R & D). Research and development is an industry-based development model where research findings are used to design products, which are then systematically tested and refined to meet quality standards [13]. The purpose of this development research is to develop job sheets and determine the feasibility level of video animation-based job sheets as a learning media for lathe machining techniques in class XI machining engineering competency at Muhammadiyah Vocational School Prambanan. The development model used in this study is Four-D Models (4-D) [14]. The 4-D development model consists of 4 main stages including (1) Define; (2) Design; (3) Develop; (4) Disseminate [15]. The research subjects consisted of material experts, media experts, and class XI students of Muhammadiyah Prambanan Vocational School as respondents for the small class test (19 students) and large class trials (54 students). The instrument used was a questionnaire. Data analysis using descriptive quantitative.

4. Result and Discussion

4.1. Final Product Design

The preliminary analysis found that the job sheet for class XI lathe machining practices in the Prambanan Muhammadiyah Vocational School still lacked such steps as the absence of workpieces so that 80% of students still had difficulty in knowing the correct work steps when working with workpieces using the lathe. Characteristics of students tend to be more interested in learning media such as animated videos compared to 2D image media. Furthermore, the formulation of the objective of developing a basic competency 3.4 special job sheet was chosen, namely the job of applying a flat turning technique.
The results of the design of the animated video sheet are presented in a video consisting of:

1. Title of the job sheet

![Figure 2. The initial appearance of the animated video](image)

2. Equipment
   Contains material about the equipment used for flat turnings, such as: facing and flat lathe, drill center, and caliper/calipers.

![Figure 3. Display equipment](image)

3. Workpiece specifications
   Workpiece specifications that will be done through a flat turning process. The size of the workpiece before work is done.

![Figure 4. Display of workpieces](image)

4. Parameters
   The theory of parameters or formulas used when turning flat consists of cutting speed / CS, lathe / Rpm rotation speed, feed speed / F, flat lathe machining time / tm.
5. Occupational safety and health
The application of occupational safety and health or K3 is mandatory when carrying out the practice of turning — consisting of checking the equipment used, using PPE such as the use of glasses, wearing short-sleeved clothes, and wearing shoes. Store equipment safely and neatly operates machines according to SOP, study work drawings, check workpiece sizes, clean machines, and practice rooms.

6. Step work
The work steps resulting from the development of the job sheet show the process of turning flat in 3D that resembles quality using a standard lathe. Consisting of installation of workpieces in choking, installation of lathe tool as high as the rotary center, setting of engine rotation speed / Rpm based on calculated parameters, flat lathe processing, checking of workpiece size and finishing.

7. Quality results
The results of the workpiece are the appearance of the workpiece after the turning process is carried out. It is consisting of the results of turning the lathe flat. Besides, it is also accompanied by workpiece size specifications resulting from work.
Figure 8. Display results of quality

8. References
references that can be used as additional information for students about lathe machining techniques in the form of modul.

Figure 9. Reference display

The final job sheet for turning flatwork preparation can be accessed on the link: https://youtu.be/2xRVgO_tGjs.

Figure 10. Animated video job sheet lathe working steps

4.2. Product Feasibility Level
The feasibility of developing an animation video based job sheet can be seen from the results of the assessment or validation of material experts, media experts, and student responses. Assessment or validation of material aspects is carried out by two experts obtaining an average score of 71.5 with a percentage of 89.50% in the category of "very feasible." This category can be interpreted that the suitability of the material in the animated video as a practice learning media for lathe machining techniques is stated to be very feasible to be used as a learning medium and tested to students. Evaluation or validation of the media aspect was carried out by media experts obtaining a total score of 73 with the percentage of 91.25% included in the "very feasible" category. This category can be interpreted that the suitability of the media in animated videos as a practical learning media for lathe machining techniques is stated to be very feasible to be used and tested on students.
The video animation product trial involved 19 students in a small class and 54 students in a large class of class XI Mechanical Engineering. In the small class obtaining the feasibility score data for the "very feasible" category with a percentage of 89% totaling 17 students and for the "feasible" category with the percentage of 11% totaling 2 students. The total score of responses of students in small classes is 62.31 with a percentage of 86% in the category of "very feasible" because of $X \geq 54$. In the large class, the feasibility score data for the category "very feasible" with the percentage of 78% is for students "decent" category with a percentage of 22% totaling 12 students. The total score of responses of students in large classes is 59.55 with a percentage of 83% included in the category of "very feasible" because of $X \geq 54$. The category can be interpreted that students really understand the material in animated videos, deeply understand the language used in animated videos, very interested in graphic/video display animation, and is very useful in learning the practice of lathe machining techniques.

Table 1. Results of student responses to each aspect in a small class

| No | Aspect   | Average Score for Each Aspect |
|----|----------|-------------------------------|
| 1  | Material | 21                            |
| 2  | Linguistics | 13,16                        |
| 3  | Integrity | 14,10                         |
| 4  | Benefits  | 14,05                         |
|    |          | **Average Total Response**   |
|    |          | **62.31**                     |

Table 2. Results of student responses to each aspect in a large class

| No | Aspect   | Average Score for Each Aspect |
|----|----------|-------------------------------|
| 1  | Material | 19,89                         |
| 2  | Linguistics | 13,12                        |
| 3  | Integrity | 13,26                         |
| 4  | Benefits  | 13,28                         |
|    |          | **Average Total Response**   |
|    |          | **59.55**                     

There are previous development studies that produce animation-based learning media, as in this study. Appropriate animation-based learning media used in learning and student learning outcomes have increased after participating in learning using animation-based learning media [16]. Furthermore, animated video-based learning media that are suitable for use in learning and student learning interest have increased after using animated video-based media [17]. Given that the results of this animated video job sheet product can be accessed through student android, the resulting job sheet is classified as 3D multimedia learning media. It is confirmed from the research findings that multimedia-based learning media that utilize the internet, computers, video, audio combined in effective hardware and software in providing enhanced learning facilities and attention to specific needs of individual users.
Multimedia technology empowers the educational process between teachers, students, and courseware, also innovative ways to make learning more dynamic, longer lasting, and more outside the classroom [18].

Based on this research and previous research proves that the product of video animation based development is feasible to be used as a learning media. Besides that, the product of learning media development based on animation is also able to improve learning outcomes and student learning interest. This is because there are benefits from the learning media itself [19] [20].

4.3. Disseminate
Product dissemination from the development was carried out by researchers by distributing animated videos to students during product testing, uploading to youtube and submitting a manual book for developing interactive video learning animation videos to teach engineering skills, competency teachers [21].

![Figure 13. Manual Book results of the Development of Job 3D / video-animation Sheet](image)

5. Conclusion
This research has been successfully demonstrated by successfully producing a product in the form of a video animation based flat lathe machining with a very reasonable level of product feasibility, both the assessment of material experts, media experts and small and large class trials Learning media in the form of animated video job sheets are highly recommended for teachers to use in practical learning activities.

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