The development of mechanical drawing job-sheet for vocational high school instructional

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Abstract. This study aims to develop a mechanical engineering drawing job sheet and determine the feasibility of the media. This research uses research and development by referring to the Four-D development model (define, design, develop, disseminated). Data collection techniques with observation and interviews. The instrument used was a non-test instrument in the form of a closed questionnaire with a Likert scale of five answer choices. The results showed that the job sheet learning media was carried out with several steps, namely defining needs, designing, developing and distributing. The feasibility of the job sheet media for learning engineering drawings based on the results of the validation of media experts has a score of 4.58 and a material expert score of 4.66 which is included in the very feasible category. The results of teacher user responses with a mean score of 4.21 and 4.5 students in a very feasible category.

1. Introduction
Education is the key to improving and developing the quality of human resources; therefore, education has a vital role in human life. Education is related to the learning process. Learning is an activity that is deliberately planned by the teacher to provide learning experiences to students so that they can learn independently [1]. Learning is a human process for achieving competence [2]. It shows that the achievement of competence is a learning activity that involves infrastructure assistance in the form of learning media. Learning media as one of the factors that influence the successful implementation of the 2013 Curriculum in Indonesia [3]. The media has a significant role in increasing the success of students in achieving basic and advanced competencies [4], [5]. However, the quality of students can be optimised by maximising the use of media in the teaching process.

Vocational high schools (VHS) are vocational education institutions that focus on preparing graduates to work [6]. One of the 148 expertise competencies in Indonesia that provides a significant role in producing graduates who are ready to be accepted by industry is machining engineering [7]. Machining engineering has three main competencies, such as design, machining, and fabrication. The design part is the key to the success of the next process. Therefore, this research is focused on the problems encountered in learning technical drawing.

Observations at the VHS of the Special Region of Yogyakarta reveal that some of the problems found in VHS learning include an understanding of the basic rules and particular standards in technical drawing that have not been comprehensively applied. The impact caused learning is less active. One strategy that can solve these problems is the use of job sheets in practicum [8]. However, the development of job-
sheets can be an alternative to provide students with independent understanding to improve their ability to draw techniques.

2. Research Method
The main objective of this research and development is to develop job sheets for mechanical engineering drawing subjects. The method used in research is research and development. The development model of Four-D models consists of four stages of development, namely defining, designing, developing, and disseminating [9]. The object of research is the job sheet used in learning mechanical engineering drawings. The subjects of this study were material experts, media experts, and subject matter mechanical engineering teachers. Collection techniques using observation and questionnaires. Data collection tool is an observation sheet with observation guidelines and a questionnaire with five choices. Questionnaires have been tested through the feasibility test of material experts, media experts, and student users.

The analysis technique used is a simple qualitative and quantitative descriptive analysis. Qualitative data were analysed based on inputs, criticisms, and suggestions obtained from respondents through a feasibility questionnaire. The second analysis is the analysis of expert assessment questionnaire data in the form of quantitative values that will be converted into qualitative values. The determination of the feasibility category of this learning media uses a Likert scale.

3. Result and Discussion
The development of the VHS mechanical engineering job sheet learning media adapted the 4D model which consisted of four stages.

3.1. Defining stage
The defining phase is carried out by identifying needs, analysing problems and all the information needed in the development of job sheet learning media. At this stage, the data is obtained through observation and interviews with the teacher, documentation on learning tools, teaching materials, and students who are analysed in a descriptive qualitative manner. Analysis at this stage is the initial analysis, student and curriculum analysis, material analysis, and goal formulation. Data that has been obtained at the stage of defining: (1) learning tools such as syllabus; (2) learning media used are powerpoint and job sheets; (3) the methods used are lectures and demonstrations; and (4) the constraints experienced in the learning process, namely students have not been able to learn independently.

3.2. Design stage
The design phase is a step in making media learning in technical engineering job sheet drawing. The design step is the preparation of an outline of the contents of the job sheet, designing the learning content on the job sheet that is adjusted to the syllabus, selecting the format, doing the initial design of the job sheet, and the job sheet material consists of ten jobs based on the assessment of expert and practitioner validators. Figure 1 shows that the results of the validation of the job sheet design by design experts from several aspects of the assessment obtained an average score of 4.76 and included in the very feasible category. Evenly, the assessment of the job-sheet design shows a good impression. This indicates that the acceptance of the job sheet design affects the next research stage.

![Figure 1. Feasibility diagram of design stage](image-url)
3.3. Develop stage
The development stage is validating material experts and media experts. It aims to determine the teacher’s response as well as a validator from the school. Figure 2 explains that the results of material validation by material experts from three aspects of the assessment obtained an average score of 4.66 with a very decent category. Besides, Figure 3 reveals the results of validation by media experts from five aspects of the assessment obtained by a mean score of 4.58 and included in the very feasible category. The recapitulation results from the responses of teachers in mechanical engineering drawing subjects from eight aspects of the assessment obtained a mean score of 4.21 and included in the very feasible category. The three results of the experts showed a positive impression on the assessment of media development.

![Figure 2. Material Expert Assessment Results](image)

![Figure 3. Media expert assessment results](image)

![Figure 4. Teacher's response to the job sheet](image)

3.4. Disseminate stage
This deployment phase is the final stage of research into the development of 4-D models. The aim is to disseminate the media of job sheets in a limited object of research. Job sheet test results by comparing the average assessment results obtained by students on drawing tasks done using job sheets by not using job sheets. The average value obtained before using the job sheet is 75.55 with two weeks of work completion, while the average value obtained by students using a 79.07 job sheet with one week time with a more complicated level of drawing from the previous task picture.
4. Conclusion

Based on the findings and analysis of calculations, it can be concluded that the development of job sheets is carried out in four steps, namely define, design, development, and disseminated. Based on the results of the feasibility test, trials, and dissemination showed a positive response. However, these results are a reflection of the implementation of VHS in DIY and can be a reference in the development of technical drawing learning media through the help of job sheets.

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