The development of job sheet practice shield metal arc welding assisted augmented reality

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Abstract. The purpose of this research is measuring the feasibility of a job sheet of shielded arc metal welding practice assisted augmented reality. This research used the method of research and development studies (R&D). The research was conducted on 32 students of class X at vocational high school Muhammadiyah 1 Salam. Data collection techniques were conducted using a questionnaire. The questionnaire was validated by an evaluation of the expert. The instrument test included 30 respondents outside the research sample. Data analysis technique performed with quantitative descriptive analysis technique percentage. The result of this research is in form of a job sheet practice welding SMAW using augmented reality.

1. Introduction
Vocational High School (VHS) is a provider of education that specifically has the competence of skills and attitudes according to their respective judges. Vocational High school becomes one of the milestones in building the young generation who have the skills to suit their respective fields, in order to realize the quality of human resources (HR) that is ready to compete in national competitions or international. In small scope, the quality of education can be seen from the results of the learning process that the students gained in the school.

Learning is a series of student interaction activities and educators in a specific circle with the help of certain media in the interaction process, resulting in a change of knowledge, attitudes and skills to learners [1-4]. Learning in VHS Muhammadiyah 1 Salam especially in the field of welding technique still there are some problems such as lack of supporting media and the lack of facility welding practices that there is a welding.

To support the benchmarking activities in order to improve the competency of student skills especially in the field of welding techniques, VHS Muhammadiyah 1 Salam implemented the curriculum 2013. In this curriculum, machining techniques is a basic subject of mechanical engineering which is the basic material engineering supplied to the students to have competency in the machining field. Basic Competency (BC) in the subject of mechanical engineering contains the routine of shielded metal arc welding (SMAW) process. SMAW welding is the connection of two or more metals with a way of utilizing the heat that is uncompressed from an electric arc between the electrode and the metal that will be welded so that it dilutes the tip of the electrode and some basic material so that between the atoms of the interconnected material [5], [6]. There are a number of basic learning activities such as welding. In the process of learning, students are not supported with suitable media and teaching materials. Lack of practice facilities in the welding workshop affects the students’ welding skill. Therefore, it is necessary to develop a teaching material that is able to address the
problem of welding learning in VHS Muhammadiyah 1 Salam. Learning requires the presence of teaching materials that are an important component of learning excitement aimed at knowing the boundaries of the material that is systematically arranged as well as the evaluation to know how much achievement their competence [7],[8]. Printed teaching materials prepared in paper for the purpose of conveying information, such as hand out, modules, books, student worksheets, brochures, leaflets, wall charts, photos/pictures, models/mockups [9].

Augmented reality is a technology that builds a two-dimensional or three-dimensional virtual object into a real three-dimensional environment, and then projects the virtual objects in real time, but the system is closer to real-life. The three characteristics of augmented reality are: combines real and virtual worlds, interactive in real time, allowing it to be displayed in 3D form [10]. The use of augmented reality is useful for interactive and real-life learning media by learners and able to improve the imagination of learners [11].

The teaching material developed in the form of student worksheet/job sheet is relatively easy to develop and ideal for implementation in vocational learning. Job Sheet is a learning tool that consists of printed media, consisting of sheets that contain guidance for students in completing a task [12]. The conventional job sheets have not been able to solve some of the problems that exist in the learning activities in VHS Muhammadiyah 1 Salam. In order to overcome the problems that exist in the learning and literacy, the researchers provide additional or guidance in the development of job sheets with augmented reality.

2. Research Method
This research was using Research and Development (R&D) type. the research and development (R&D) method is a research method used to produce a specific product and test the effectiveness of the product [13]. The Model of development was adapted to Thiagaradjan, Semmel, and Semmel namely 4-D Models covering 4 stages; Define, Design, Develop, Disseminate. This research is focused on the feasibility of the resulting product.

Research and development of Job Sheet SMAW welding practice with augmented reality is held on 24 September 2018 – 24 October 2018 in VHS Muhammadiyah 1 Salam, located at salam, Magelang, Central Java. This research and development respondent is a material expert, media expert, and grade X students in the engineering department of VHS Muhammadiyah 1 Salam with a total of 32 students.

2.1. Data, Instrument, and Technique of Collecting Data
The data in this study is qualitative and quantitative data. Quantitative data is a response score about product quality from material experts, media experts, and revamped students in percentage form. Qualitative data in the form of criticism, input advice from material experts, media experts and students to repair job sheet welding practices. The research instruments used in this research form a poll consisting of material validation test instruments, media validation test instruments, and student feasibility testing instruments. Poll instruments are arranged with the aim to evaluate the quality of job sheet so that the product deserves use. Scoring polls are compiled using the modified likert scale scoring criteria using only 4 options as in table 1.

| No. | Criteria            | Value |
|-----|---------------------|-------|
| 1.  | Highly agree        | 4     |
| 2.  | Agree               | 3     |
| 3.  | Disagree            | 2     |
| 4.  | Highly Disagree     | 1     |
2.2. **Technique of Analyzing Data**

This research data analysis technique used a quantitative descriptive method of percentages. Quantitative data collected through a poll is then analyzed in a descriptive percentage. The percentage calculation process is done by the way the observation score is divided by the expected score, then multiplied by one hundred percent (Sugiyono, 2016:133), as in Equation 1.

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Percentage = \left( \frac{\text{observation score}}{\text{expected score}} \right) \times 100\%
\]  

The data that has been calculated in the percentage of eligibility formula is changed to qualitative data with terms of meaning and decision-making according to [14] as in Table 2.

| No. | Percentage | Criteria      |
|-----|------------|---------------|
| 1   | 81% - 100% | Very decent   |
| 2   | 61% - 80%  | Worth         |
| 3   | 41% - 60%  | Enough        |
| 4   | 21% - 40%  | Less          |
| 5   | 0% - 20%   | Very less     |

3. **Result and Discussion**

3.1. **Developing an job sheet assisted augmented reality**

The final product produced in this study is the practice of job sheets of SMAW-assisted augmented reality welding practices titled Job Sheet welding techniques. This job sheet comes with a preface, a table of contents, a brief explanation of augmented reality and a user guide of augmented reality, Job 1, Job 2, Job 3, Job 4, bibliography. This job sheet is arranged based on the previous job sheet with modified for the improvement of the previous job sheet. This job sheet contains a series of student worksheets on various SMAW jobs that exist in VHS Muhammadiyah 1 Salam. Job in this job sheet includes welding down hand position in producing narrow welding line, welding down hand position in producing wide welding line, welding 1 F position for T joint, welding 1 G position for V-groove butt weld joint.

The feasibility rate of the job sheet is determined by the results of material validation, media validation and the test result of a job sheet on students. Once the product design is completed, then the next stage is the product in validation by the media experts and the material experts. The media experts are the one who assesses the job sheet as a teaching material that is reviewed from the indicator of appearance, consistency, format, graphing. The media expert in this study was the lecturer in Mechanical Engineering education Faculty of the State University of Yogyakarta.

3.2. **Job sheet Feasibility**

The results of the validation sheet of the feasibility job sheet that the media experts do could be seen in table 3. Based on the percentage of data obtained, from the evaluation of the media experts are reviewed from the quality of display, consistency, format, and graphic in the job sheet welding practice SMAW. Based on a review of the assessment aspect it obtained data that the display quality indicator gained a feasibility percentage of 85%, the consistency indicator gets a feasibility percentage of 91.66%, the format indicator obtains a feasibility percentage of 91.66%, the graphic indicator gains a feasibility percentage of 91.66%. Overall job sheet products got 89.99% from the experts.
Table 3. Media validation results

| No. | Judging aspect | Feasibility Percentage |
|-----|----------------|------------------------|
| 1.  | Display        | 85 %                   |
| 2.  | Consistency    | 91.66 %                |
| 3.  | Format         | 91.66 %                |
| 4.  | Graphic        | 91.66 %                |
|     | Rating Average | 89.99 %                |

Validation of the material is done to assess the job sheet judging from the material indicator whether it is feasible or not with the need of students VHS Muhammadiyah 1 Salam reviewed from the indicator of conformity of material, material quality, presentation of materials, benefits. The material experts in this study are 1 lecturer in the Mechanical Engineering Education Department of Yogyakarta State University and 1 teacher of basic mechanical Engineering in VHS Muhammadiyah 1 Salam. Validation data was obtained via poll assessment or a prepared questionnaire. The poll will be assessed by the material experts by filling in accordance with the specified scoring criteria. The amount of the statement for the material validation test is 42 grains. In addition to providing value or scores on the product, the validator also fills in the advice required to repair each component of the job sheet product in terms of material. The percentage of material validation results as in table 4.

Table 4. Material validation results

| No. | Judging aspect       | Percentage feasibility |
|-----|----------------------|-------------------------|
| 1.  | Conformity of Materials | 88.55 %                |
| 2.  | Material quality     | 92.70 %                 |
| 3.  | Presentation of material | 91.66 %              |
| 4.  | Benefits             | 93.75 %                 |
|     | Rating Average       | 91.66 %                 |

Based on a review of the assessment aspect, it is obtained that the material conformity, material quality, material presentation and benefits indicators have gained a feasibility percentage of 88.55%, 92.70%, 91.66%, and 93.75%, respectively. The overall job sheet products are made to get an average assessment of material eligibility from the material members by 91.66% with very decent criteria. Once the job sheet is validated by the media experts and the material experts get the results in terms of media and material that the job sheet is worth using with the revision. The next step is trial for students. The feasibility test of this job sheet is 32 students from grade X, where they were given questionnaire accompanied by a job sheet and an augmented reality application that has been developed as a material to be assessed in terms of eligibility.

The valuation indicator of the job sheet eligibility test includes the indicator of material presentation, linguistic, graphic, benefit. Each number of items has 24 questions. The results of a job sheet feasibility test on students can be seen in table 5. Based on the data, it can be noted that conformity of materials, linguistic, graphic, and benefits eligibility are 81.07%, 83.39%, 85.67%, and 85.78%, respectively. Overall job sheet product has eligibility assessment of 83.97% with very decent criteria.
Table 5. The results of job sheet eligibility test

| No. | Judging aspect      | Percentage feasibility |
|-----|---------------------|------------------------|
| 1.  | Conformity of Materials | 81.07 %                |
| 2.  | Linguistic          | 83.39 %                |
| 3.  | Graphic             | 85.67 %                |
| 4.  | Benefits            | 85.78 %                |
|     | Rating Average      | 83.97 %                |

4. Conclusions

The results of this study in the form of job sheet consists of 31 pages. This Job sheet is equipped with preface, Table of contents, short description augmented reality user guide augmented reality, Job 1, Job 2, Job 3, Job 4, bibliography. This job sheet is arranged based on the previous job sheet with modified for the improvement of the previous job sheet. The processes of preparing this job sheet using several stages such as define, design, develop, and disseminate.

The feasibility level of the teaching materials in the form of job sheet welding practice SMAW assisted augmented reality in machining techniques in VHS Muhammadiyah 1 Salam is based on material validation results, Media validation, and overall student trials. Results showed that the three criteria have feasibility more than 80%.

Developed augmented reality app still lacks the problem of application size if used to store multiple images and videos that exceed 4 job applications too large, for that, advanced research is required to improve the application in order to save more images and video with small fixed application size. This research of augmented reality development is only limited to 2D stage, advanced research can further enable the development of augmented reality until 3D is discovered.

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