



Development of Learning Modules for Welding Techniques of Shield Metal Arc Welding (SMAW) on Manual Arc Welding Engineering Subjects at Vocational schools

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ABSTRACT

The aims of this study is to produce a valid and feasible learning module for Shield Metal Arc Welding (SMAW) welding techniques. The method used in this study is R & D (Research and Development) using the Borg and Gall models. Researchers carry out research from stages one to six. The technique of collecting data is in the form of distributing questionnaires. The validity of the module was measured based on the results of expert validation, the percentage obtained by material expert validation was obtained a value of 85.49% was in the appropriate category, media expert validation obtained a value of 89.49% was in the very feasible category and the response of class XI students of welding technique was obtained a value of 79, 51% are in the eligible category. Based on the results of the validator's assessment of the module, the module is declared very feasible. Responses are measured based on students' assessment of the products developed. Based on the results obtained from student responses, it shows that this module is declared suitable for use in learning welding techniques.

INTRODUCTION

Education is given and organized to develop all human potential in a positive direction (Ismail et al., 2021; Putri et al., 2019; Siagian, 2021). Education is a human effort to be better in dealing with life. Education is not only done at school, but can also be done at home (Manurung et al., 2021; Mawardi et al., 2020; Rafika et al., 2020; Sdeeq et al., 2021). Education knows no age limit, from children to adults, from young to old before getting to know education. Since in the womb and born in the world until the end of life, humans will not be separated from education (Istijarti et al., 2019; Mahur et al., 2019; Miftakhul et al., 2020; Nugroho, 2014). This shows that education is very important for humans. According to Prayitno (2008:45) "Education is an effort to glorify human humanity to fill the human dimension through optimal development of the five powers in order to realize a fully human identity".

Education is a step used in the intellectual life of the nation's children to build a better nation (Hasan & Chaitee, 2022; Nurjanah & Sofiwati, 2019). Education is an effort used to develop the potential of students so that they are

more knowledgeable, capable, creative and responsible. This is in accordance with the functions and objectives of National Education as stated in Law Number 20 of 2003 concerning the National Education System, Article 3 which states that "National Education functions to develop capabilities and shape the character and civilization of a dignified nation in the context of the intellectual life of the nation, aiming at developing the potential of students to become human beings who believe and fear God Almighty, have noble character, are healthy, knowledgeable, capable, creative, and become democratic and responsible citizens. In order to educate the nation's life, improving the quality of education is very important for sustainable development in all aspects of human life (Tajeri, 2020; Warriar et al., 2021).

The National Education System is one of the important factors in improving the quality of student learning, as Mulyasa (2006:4) explains in his research that "National education must always be developed in accordance with the needs and developments that occur at the local, national and international levels". Improving the quality of

formal education in schools, cannot be separated from the demands for the success of the learning process. The process of learning activities is influenced by several things that are interrelated with each other, including teachers, students, learning media and supporting facilities. These four components have an important role in determining the success of the learning activity process that will affect student learning activity and motivations (Ariani et al., 2019; Asmah et al., 2021; Sari & Surip, 2020; Wijanarko et al., 2022). Teachers are the determining factor to realize the success of teaching and learning activities in the world of education. According to Rachmadi (2014:14) "Teachers must be innovative in creating teaching and learning activities so that students can achieve learning outcomes as expected". Based on this, a teacher must have effective teaching skills so that the teaching and learning process can be carried out properly and get maximum learning activities and practices. This is supported by Aziz's statement (2012) which states that teachers who have good performance in class will be able to explain lessons well.

According to Hariadi (2013:13) "Learning is a change from the point of being able to being able to do". Based on some of these assumptions, it can be seen that learning is a very important human activity and must be done optimally to master or gain something. Through learning, humans can make improvements in various matters concerning the necessities of life. Through learning, humans can also improve their destiny to achieve their goals and get wider opportunities to work.

Based on the results of observations on March 16, 2021 that researchers have conducted at SMK Negeri 7 Lhokseumawe, it was found that the process of teaching and learning activities so far tends to be less effective because students are still using printed books, so the material presented by the teacher is too much which makes it difficult for students to understand the material. . In addition, teachers who teach productive subjects have not used learning modules so that the impact on students' responses to the materials being taught does not show interest and motivation for further study. So that researchers make student learning modules to facilitate the learning process and delivery of material to be more effective and efficient and serve as an evaluation tool and student reference material.

This was then confirmed from the results of interviews with teachers majoring in welding engineering at SMK Negeri 7 Lhokseumawe, where the learning process in class XI welding technique teachers played an active role in explaining learning materials using learning media in the form of books so that there was a lack of student activity during learning. This is the reason why researchers developed learning modules that aim to train students to be able to learn independently even without

teacher guidance. So that with this module students play an active role in mastering the material being taught and provide opportunities for students to learn in their own way.

Indicators of not achieving the learning objectives are caused by several factors such as limited available resources, less conducive classroom conditions and lack of learning media such as the unavailability of written modules in the form of textbooks. Teaching materials for welding practices that have been used so far have not been effective in supporting teaching and learning activities so that other modules are needed that can complement teaching materials, because the module is able to help students' readiness before practicing.

The results of previous research conducted by Heriyanto (2015: 1) revealed that students who used the module got an average score of 88.22% and the test results of students who did not use the module got an average score of 80.32%. Based on the results of the test scores, it can be concluded that the Shield Metal Arc Welding (SMAW) welding module developed is effective for use in learning welding practices. The similarity between the research that the researchers carried out was to determine the level of feasibility and effectiveness of the Shield Metal Arc Welding (SMAW) welding module produced and using the same research instrument. While the difference lies in the research method carried out.

The selection of teaching materials using the Shield Metal Arc Welding (SMAW) module is also based on the results of research that has been carried out by Nuraini and Suwito (2018:1) which explains that the development of the Shield Metal Arc Welding (SMAW) learning module can improve the learning outcomes of SMK students with completeness. learning reached 91.89%. Furthermore, the results of the study according to Subiantoro and Irfa'i (2017:1) explained that the results of observations on samples during trials without using the developed manual arc welding module obtained a percentage of student learning activities of 80.08%, while the results of observations during trials using the arc welding module the developed manual obtained the percentage of student learning activities of 90.48%. So after using the developed manual arc welding module, there was an increase in student learning activities of 10.472%.

The formulation of the problem in this study are: 1). How is the process of developing of learning module of the Shield Metal Arc Welding (SMAW) welding for students at vocational school in Lhokseumawe?.2). What is the feasibility of learning module of the Shield Metal Arc Welding (SMAW) welding to be used as teaching materials?. The objectives of this study are: 1). To find out the process of developing of learning module of the Shield Metal Arc Welding (SMAW) welding for students at vocational school in Lhokseumawe?, 2). To determine the

feasibility of learning module of the Shield Metal Arc Welding (SMAW) welding to be used as teaching materials?.

METHODS

Research Approach and Type

This study used a mixed methods approach, this type of study is research and development or known as Research and Development (R&D). Sugiyono (2019:407) states, "Research and development methods or in English Research and Development are research methods used to produce certain products and test the effectiveness of these products". According to Borg and Gall, research development is a process used to develop and validate research products. This research follows a cyclical step. Setyosari (2016: 194-195) states, "The steps of this research or development process occur on a study of the research findings of the product to be developed, product development based on these findings, conducting field trials according to the background where the product will be used and revise the results of the field test".

The development of learning modules for Shield Metal Arc Welding (SMAW) welding techniques in manual arc welding techniques in vocational school in Lhokseumawe refers to the Borg and Gall model, proposed by Sugiyono (2013: 298), this model includes 1) Potential and problems, 2) Data collection, 3) Product Design, 4) Design validation, 5) Design revisions, 6) Product trials, 7) Product revisions, 8) Usage trials, 9) Product revisions, 10) Mass Products.

Research Subjects and Objects

The subjects in this study are material experts and media experts who are teachers and lecturers who have expertise in welding techniques in manual arc welding techniques at SMK Negeri 7 Lhokseumawe. Meanwhile, the subject of this research is the teaching materials used in learning welding techniques, as well as the class XI welding technique students, totaling 29 students. The object of this research is the Shield Metal Arc Welding (SMAW) welding technique material module used in learning manual arc welding techniques. The object of this research is the validation of material experts from school teachers of SMK Negeri 7 Lhokseumawe and lecturers.

Data collection technique

The data collection techniques in this study are observation, interviews, questionnaires, and documentation. The observations that the researchers made in the field were how the conditions and environment of class XI welding techniques at SMK Negeri 7 Lhokseumawe, the teaching and learning process in class XI welding techniques between teachers and students and observing student activities during field practice to test

students' understanding, especially the welding engineering department at SMK Negeri 7 Lhokseumawe. The interview is by giving a number of questions to the teacher majoring in welding engineering.

The questions that the researchers interviewed were: (a) How are the learning activities carried out at SMK Negeri 7 Lhokseumawe ?, (b) What is the method used by the teacher in teaching?, (c) How far is the teacher's knowledge about learning media, especially SMAW welding?, (d) How to use learning media, especially SMAW welding at SMK Negeri 7 Lhokseumawe ?, e) In your opinion, what media is suitable and suitable for welding engineering students at SMK Negeri 7 Lhokseumawe ?.

Researchers collect data with a questionnaire sheet which is a data collection technique carried out with a number of written questions that are used to obtain information, where researchers provide answer choices with a checklist (√) in the column of choices that have been provided. Research results from observations are used as evidence to strengthen interviews and observations. In this case the researcher collects data by taking photos and videos while studying in class and field practice is ongoing.

Data analysis technique

The data analysis technique used in this study is a descriptive analysis technique by describing the results of the development of the Shield Metal Arc Welding (SMAW) welding technique learning module in the form of a feasibility and product suitability questionnaire to be implemented on manual arc welding technique material. The results of the analysis used expert validation sheets, educator response sheets, and data analysis using a Likert scale. for data processing using the equation formula.

$$P = \frac{f}{N} \times 100\%$$

Information:

P = Percentage

f = Score earned

N = Maximum score

The results of the data analysis used the interpretation criteria. Interpretation is the interpretation of the results of the analysis of the respondent's data. The assessment score of each expert validation was averaged to determine the validity and feasibility of teaching materials. As a guideline for interpretation, criteria are set as set out in the **Table 1**.

Table 1. Results of data analysis using interpretation criteria

Category	Percentage	Qualification
4	86% - 100%	Very worth it
3	76% - 85%	Worthy
2	56% - 75%	Decent enough
1	≤ 55%	Not worth it

Table 2. Eligibility Criteria by Student Responses

No.	Achievement Rate (Percent)	Qualification
1	86% -100	Very worth it
2	76% - 85%	Worthy
3	56% - 75%	Decent enough
4	≤ 55%	Not worth it

RESULTS AND DISCUSSIONS

Results

Module Development Results

Potential Problems

At this stage, it is carried out in the form of pre-planning or thinking about what kind of teaching material products will be developed. Identify products that are in accordance with the development objectives, content or learning materials and what strategies or models are used in their delivery. Based on the results of the observations above, the learning module for Shield Metal Arc Welding (SMAW) welding techniques was developed in manual arc welding techniques as the final result of the analysis of product requirements or teaching materials needed by students in the learning process.

1). Data Collection

a. Observations

Observations made in this study were direct observations by looking at and observing how things actually happened in the field. The results of the observations that the researchers got were the condition of the classroom environment that was less conducive where students had not mastered the material provided, during the learning process in the classroom, the teacher was still using the lecture method and had not used innovative learning media so that it made it difficult for students to understand the lesson. during practicum in the practice room and the lack of learning facilities that can support the learning process such as the lack of availability of learning modules for teachers and students.

b. Interviews

The interviews conducted in this study were structured interviews with the use of pre-prepared interview sheets. The purpose of using structured interviews is to find out what problems, shortcomings, and needs are needed by students from the side of the teacher who always sees and observes how students progress in the learning process.

c. Questionnaires

There are three questionnaires or questionnaire sheets used in the implementation of this research. First, a feasibility test sheet by a media expert is used to see how the results of the product or module developed are based on aspects of the appearance of ease of use, concentration,

and a predetermined format. Second, the material expert feasibility test sheet with aspects of content feasibility assessment, presentation feasibility and contextual assessment contained in the developed module. Third, the respondent's questionnaire sheet by students to see how the students respond or reciprocate in the use of the modules used. The three questionnaires or questionnaire sheets contain a number of questions and written statements to obtain information, by means of respondents providing answer choices with a checklist in the column of choices that have been provided.

d. Documents

Documentation in the form of pictures from the results of observations, the implementation of the module implementation, as well as the implementation of tests used as supporting results and strengthening evidence of the implementation of activities.

1. Product Design

- The front cover has a big title written with the name of the Shield Metal Arc Welding (SMAW) Module used and the material discussed in it. The module is intended for students of class XI welding techniques and the school where the module is used, namely at SMK Negeri 7 Lhokseumawe.
- Background color, blue and orange gradient colors are selected, as well as a combination of black.
- The font, for the front cover, uses Arial Black size 42. And for writing large titles and subtitles on the content of the module using Times New Roman size 18, as well as explanations and material presented using *Times New Roman* size 12.

2. Design Validation

Before the finished module or product can be used, the module that has been made is evaluated through expert considerations to obtain data about product results in terms of appearance and content in order to identify deficiencies and what needs to be improved on the product.

3. Design Revision

After getting validation results from material experts and media experts, revisions were made to errors and deficiencies in the modules developed before implementing the module on students.

4. Product Trial

Is the implementation of a module that has been developed for students to measure how the influence of the module on student learning outcomes after treatment is given in the learning process.

Results of Module Development Feasibility

Material Expert Validation Results.

Table 3. Results of Feasibility Aspects Validation

Item number	Material Expert Score 1	Material Expert Score 2
1	3	4
2	3	4
3	3	3
4	3	4
5	3	3
6	3	4
7	2	4
8	3	4
9	3	3
10	3	4
11	3	4
12	3	4
Amount	35	45
Average	2,91	3.75
Percentage	72,75%	93,75%
Validator Percentage	83,25%	
Criteria	Worthy	

Based on the **Table 3**, the results of validation by material experts from the validator are welding engineering subject teachers and lecturers in the teaching and education faculty. It can be seen that the validation of the content feasibility aspect by material experts gets the following values, validator 1 percentage is 72.75% with the criteria "fair enough". In validator 2 obtained a percentage of 93.75% with the criteria of "very feasible" and the score of the percentage value of 2 validators 83.25% with the criteria of "decent". From the validation results, it can be seen that the percentage value of the validation of the content feasibility aspect by material experts is very feasible. In addition to the table form of the validation results of the content feasibility aspect by material experts, data is also presented in the form of the following graph to see the results of material expert comparison research.

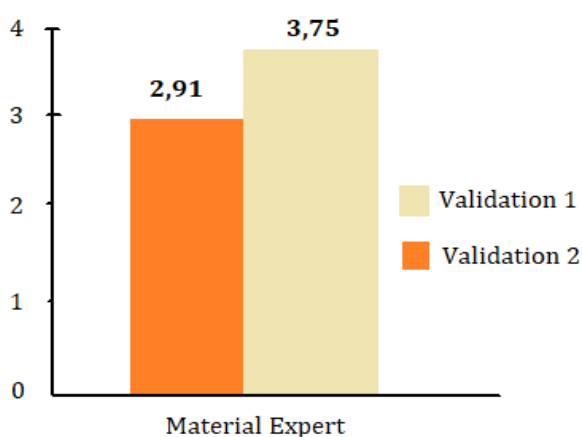


Figure 1. Results of Comparison of the Contents Feasibility Aspects Validation

The data results from the validation of the contents feasibility aspects in **Table 3** show the percentage of 83.25%. These results are obtained from the calculation of the percentage of the two material experts, namely 72.75% plus 93.75%, then the result of the sum is divided by the number of material experts, namely 2 validators.

Media Expert Validation Results

Media expert validation aims to test the graphics and presentation of teaching materials for the Shield Metal Arc Welding (SMAW) welding technique module. The media experts consist of a school teacher at SMK Negeri 7 Lhokseumawe named M. Anwar HS, S. Kom as a teacher who has expertise in computers and a lecturer in the faculty of teaching and education from Malikussaleh University named Nuraina, SPd., M.Pd. The results of the media expert validation data can be seen in the **Table 4**.

Table 4. Data Validation by Media Experts

Item number	Media Expert Score 1	Media Expert Score 2
1	3	4
2	4	4
3	3	4
4	3	3
5	3	4
6	3	4
7	3	4
8	3,5	3,5
9	3	4
10	4	3,5
11	3	4
12	3,5	3,5
13	3	3,5
14	3	4
Amount	45	53
Average	3,21	3.78
Percentage	80,25%	94,5%
Validator Percentage	87,37%	
Criteria	Very Worthy	

Based on the **Table 4**, It can be seen that the validation of media experts obtained the following values, validator 1 percentage of 80.25% with the criteria "feasible". In validator 2 obtained a percentage of 94.5% with the criteria of "very feasible" and the score of the percentage value of 2 validators is 87.37% with the criteria of "very feasible". From the validation results, it can be seen that the percentage value of the media expert's validation is appropriate, so the teaching materials for the development of learning modules for Shield Metal Arc Welding (SMAW) welding techniques are not repaired. In addition to the table form of validation results by media experts, the data is also presented in the following graphic form to see the results of the comparison research of media experts.

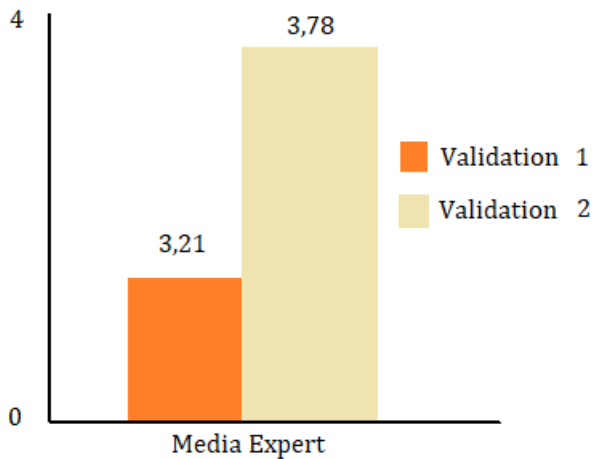


Figure 2. Results of Comparison of the Validations between Media Expert

Product Trial Results

The data obtained from product trials are responses from students regarding the Shield Metal Arc Welding (SMAW) welding technique module which is expressed through statements in student questionnaires. Data collection on the results of this trial was carried out after students used the teaching materials in class. The product trial was carried out on 16 students who were present in class XI welding techniques at SMK Negeri 7 Lhokseumawe.

Table 5. Test Results Data for Use by Students

Student's name	Total Score	Percentage	Information
AM	60	83,25	Worthy
BS	56	77,75	Worthy
IS	60	83,25	Worthy
MA	49	68	Decent enough
MID	65	90,25	very worthy
MJ	56	77,75	Worthy
MNM	59	81,75	Worthy
MRZ	63	87,5	Decent enough
MA	56	77,75	Worthy
MI	56	77,75	Worthy
MI	52	72	Decent enough
MZ	61	84,5	Worthy
MR	60	83,25	Worthy
RTZ	61	84,5	Worthy
RZ	45	62,5	Decent enough
ZA	58	80,5	Worthy
Total	57	79,51%	Worthy

Based on the **Table 5** presented, the total student response score was 79.51% and the response qualification of the developed module was "appropriate". The following is a graph of student response choices to the module.

Discussion

The development model used in this study is the modified Borg and Gall development model. In research and development of learning module Shield Metal Arc Welding (SMAW) welding technique, adapted from the development model of Sugiyono (2012) which includes six

stages of research and design, namely potential and problems, data collection, product design, design validation, design improvement and testing. try the product. The reason the researchers limited to only six research steps and this design to stage six was because it was able to answer the research objectives in the development of the Shield Metal Arc Welding (SMAW) welding technique learning module.

Module Feasibility Test

After calculating the results of the research that has been obtained, previously several tests were carried out on the instrument to determine the feasibility of the instrument used in the study. And obtained the results of material expert validation of 85.49% in the appropriate category, media expert validation obtained a value of 89.49% in the very feasible category and the response of class XI students of welding techniques obtained a value of 79.51% in the feasible category. Based on the results of the validator's assessment of the module, the module is declared very feasible.

CONCLUSION

Based on the results of research and development of learning modules for Shield Metal Arc Welding (SMAW) welding techniques, it can be concluded that: (1). Teaching materials in the form of learning modules for Shield Metal Arc Welding (SMAW) welding techniques in manual arc welding techniques have been developed with the manufacturing stage developed by Borg and Gall which consists of potential and problems, collecting data, product design, design validation , design improvement and product testing. It can be concluded that the Shield Metal Arc Welding (SMAW) welding technique module that has been developed meets the minimum module quality standards. (2). Modul pembelajaran teknik pengelasan Shield Metal Arc Welding (SMAW) is feasible to be developed with the percentage of assessment by material expert validation obtained a value of 85.49% is in the "appropriate" category. Media expert validation obtained a value of 89.49% in the "very feasible" category and the response of class XI students in welding techniques obtained a value of 79,51% in the "appropriate" category, so the learning module can be used as teaching material and self-study.

Author's Contributions

All team members contributed equally in the writing of this article. They carry out collaborative activities according to the tasks and functions that have been mutually agreed upon, from research planning to writing articles for journals.

Conflict of Interest

All authors in this manuscript have no conflict of interest. All team members work professionally according to their expertise.

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