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Arm Support for Practical Work in 6g Welding Position

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Abstract: This study aims to help assist the student that undergo 6G position welding practical work. The issue for most students who did 6G position welding practical work is their difficulty to find their rhythm to do 6G position welding in an inconsistent way. The development of arm support for practical work in the 6G welding position is to help those who have weakness in conducting the 6G welding position by giving support towards the arm to keep stamina towards electrodes with left-hand help. The objective of the study is to design, develop, and test the functionality of the arm support 6G welding position. ADDIE model as a guide to developing this tool and its stand for analysis, design, development, implementation, and assessment. Software SOLIDWORK was used to develop this product starting from the small development of components until a combination between large parts and arm support. This software is also used as an implementation by combining every large portion and implementing simulation video presentations to see tool-developed functionality. Feedback from three people experts from areas of common in the welding field with welding experience of more than five years. This expert chose to assess and identify functionality tools developed for this. Retrieval from expert feedback results shows all three experts have confirmed that support arm development to 6G position welding practical work has achieved the objective that had been set. Nevertheless, this development needs to improve more with a suggestion by experts so that this tool can be used for a long period to help a student that is less skilled learn.
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Keywords: Arm Support, Welding, 6G Position, Skill.

1. Introduction

The process of learning that involves students needs to apply theory-based learning methods to the technicality of practical work and tools. The same situation occurs in the welding field where students are having difficulty performing in the 6G welding practice. In doing 6G welding work, students have difficulty dealing with limited positions such as overhead welding. According to Ahmad & Wan (2011), the most difficult type of welding to perform is overhead welding. This difficulty results in the success

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of welding work being defective or imperfect for the less experienced. The process of welding in a limited position such as the 6G position is very difficult which means students have to find their ideas to run the welding process successfully. Students have to use another way to provide support when carrying out welding on overhead or difficult positions for difficult parts. Therefore, time for students to learn the types of positions in 6G welding will be economical. 4G welding is known as overhead welding which is the most difficult position in the process of welding 6G. This position requires a lot of commitment and a long training period to suit the students.

Therefore, this issue needs to be solved immediately as it involves the achievement of students. If students can't counter this hard part, maybe it can cause bad achievement to the student or they will fail to become good welders in industry. This issue also can cause students hesitant and uncomfortable to do welding work because they do not know the exact position of 6G welding. According to Jeffus (2008), welders need to find comfort before doing welding. Student's difficulty in performing homework can affect their academic achievement. One of the factors that make it difficult for students to perform 6G welding skills is that their skills level is so low that all practical work cannot be solved because every practical task is like someone solving a problem.

The skill factor is seen to greatly influence the work in the welding process. According to Ayo and Mbarika (2017), skills are the ability of humans to carry out tasks assigned to them and complemented by the knowledge and theory they have learned. As a result, the student's level of theory is too low, causing the learning process to slow down, failing to solve the problem, and failing to synthesize the rules learned in the face of practical problems in the workplace. This is important to ensure good formulation and acceptance according to the standards set in the American Welding Society (AWS). According to Baker & Jeffus (2017), the angle of the electrode plays a very important role in determining the flow of the electrode and the formation of the coil. The position of the electrode is seen to be very important to produce good welding as well as proper welding procedure specification (WPS).

The skills of a welder also depend on the amount of intense training and the perfection of the performance (Timings, 2008). Therefore, someone new to welding, they have to spend a long time studying to ensure that they master the skills. Therefore, multiple internships and ongoing assignments need to be given to a trainee to ensure that their skills are constantly improving, especially for welding coaches to ensure that all available positions are mastered.

According to Pedelton and Krohn (2018), arm support is a mechanical device that holds or supports the weight of the arm and provides relief to the shoulder and arm and elbow movements. It also works to overcome a person's arm weakness that limits one's ability to do a job. The process of doing long-term work will build on the work done with the help of arm support. The formation of habits is part of the learning process (Crow, 1983). By using arm support as support, it creates a habit and feels how to do the 6G welding process. Using support tools such as arm support will help students to do better homework faster and faster as it can provide support for positioning during the welding process at 6G position.

1.1 Problem statement

Welding 6G position is the most difficult position for a student to carry practical works. 6G position welding is a combination of positions 1G, 2G, 3G, and 4G. Student difficulty to weld in this position will reduce the efficacy of their welding work and will be detected as defect test coupon. Resulting in failing the students' welding qualification test. The position becomes one of the factors which caused the student to hesitate to do the 6G welding practical and it causes the student uncomfortable because had not found a position that is suitable to weld. The effect of no comfort can cause the student's achievement in practical works affected and can cause the defect to be coupon or irregular. The electrode location factor also played a role that is important in bead formation. Every electrode had their position of the corner that is specific, maybe the angle used by students is the wrong angle in the position. This case also can cause the welder to experience fatigue because it does not use the proper

position and electrode angle correctly. At the same time, students also can experience failure if the welding period that is given to learning the skill is very short and not sufficient. Therefore, to handle the problem, the researcher develops a type of support arm tool which could help students that find it difficult to carry 6G position welding practical, in order to facilitate those doing welding works and learn to angle properly and with ease, concurrently save time and energy.

1.2 Objective

The objectives of this project are to:

- Design arm support for 6G position welding practical work.
- Develop arm support for 6G position welding practical work.
- Test the functionality for arm support 6G welding practical work.

1.3 Literature review

This study uses design theory as the cornerstone of product design and development. According to Jalil (2000), he argues that design and development studies are systematic and structured studies on design, product development, and design. This study uses the ADDIE model design as a guide in implementing product development.

Welding is a combination of two types of materials into one. The welding process involves combining two materials into one another using specific techniques and methods as well as other additives (Bowditch et al., 2010). Welding is also an operation between two parts of the material combined by the use of heating or pressure as well as friction to ensure that it is joined together using the additives.

Arc welding is a type of welding process that uses electricity to produce high degrees of heat and melt the workpiece. Arc welding can be categorized into two types of consumable electrode types such as Shield Arc Metal Welding (SMAW), Gas Metal Arc Welding (GMAW), Submerged Arc Welding (SAW), Electro-Slag Welding (ESW), and Arc Stud Welding (SW). Permanent electrodes such as Tungsten Inert Gas (GTAW), Plasma Arc Welding (PAW) (TWI, 2019). All of these welding processes involve fully electricity as a spark to melt iron.

2. Methodology

The methodology used for research Arm Support for Practical Work In 6G Welding Position is Model ADDIE that has five main stages to follow: Analysis, Design, Development, Implementation, and Evaluation. Therefore, this model is suitable for this project including product development.

2.1 Phase 1: Analysis

This phase is the beginning of the first step in the development of a product. The researcher gathers all the information that is related to the study. Data collection various methods through the book, earlier studies, or the internet. This phase involves facts for a study like material and equipment used and statements to support product development. According to Wipshasith et al., (2016) phase identify problems are in the analysis stage. The information acquired will pass to the process of analysis to interpret the problem or the issue. In this phase, information achieved is listed and compared to meet the needs. This phase researcher making observations and preliminary study towards trainee or students, laboratory chief and instructor in welding laboratory. Initial feedback from student and laboratory keeper will be analyzed to be applied in phase design and making design based on criteria needed. From the analysis, this product needs to be developed because there are still students that can't do the welding in the right place. They need support for the arm to help them maintain stamina to run the electrode.

2.2 Phase 2: Design

In this phase, design selection that suits the look to consumer viewpoint is very important to ensure its effectiveness to users. A process plan is closely related to need and consumer demand and in this study scope. Information to carry the process plan achieved is the result of observation and experience when conducting the process. The design was brought up based on information obtained. Based on Figure 1, product design supports equipment towards the hand or trainee arm to familiarize themselves with the 6G position welding process correctly. The researcher makes three early designs sketches to compare the aspect of the advantage and weaknesses. Discussion with the chief laboratory and supervisor to regard their opinion and result of this research, every positive point and comment about the product will be taken to produce a perfect design. The design criteria to design this arm support is friendly to the consumer, safety factor, cost of the product, size of the product, and weight of the product.

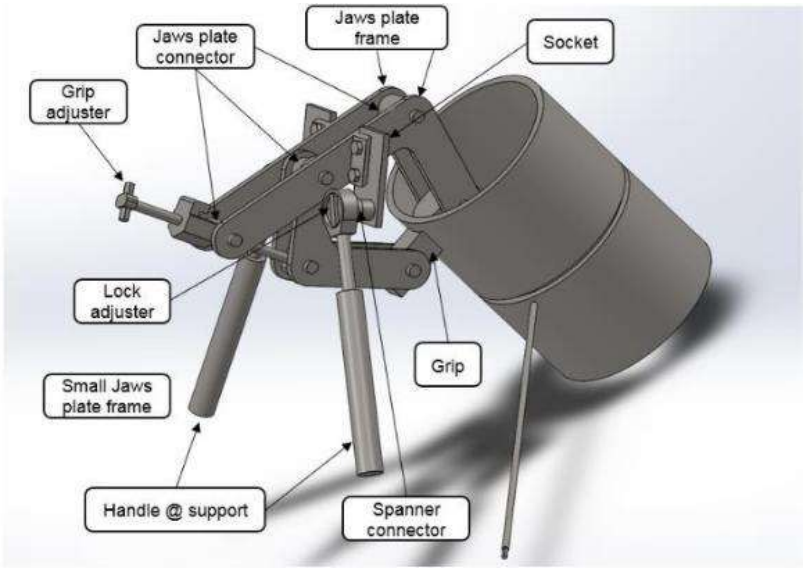

Figure 1: Design of the product

2.3 Phase 3: Development

The researcher develops the products that were designed in the development phase. Product development in this phase was carried out by simulation video by using SOLIDWORK software. This software has various functions apart from designing product small parts, it also functions as the place to consolidate every part developed to become a support arm tool as having been sketched. The development of a product all starts from small parts and combined likewise similar to a product developed by the researcher. Arm Support developed by the researcher requires the development of every part and combined to become arm support real. The component and instrument components develop through a sketch of three views first before developing through SOLIDWORK software.

2.4 Phase 4: Implementation

This phase involves tests towards the product that were produced towards students which carried out practical. Implementation is aimed at improving a product produced (Nasohah, et al., 2015). Based on Figure 2, researchers use the simulation method to develop products through simulation videos and use animation to test the movement in every part and make improvements. Every measure is always altered to get a measure that is suitable based on the tool produced.

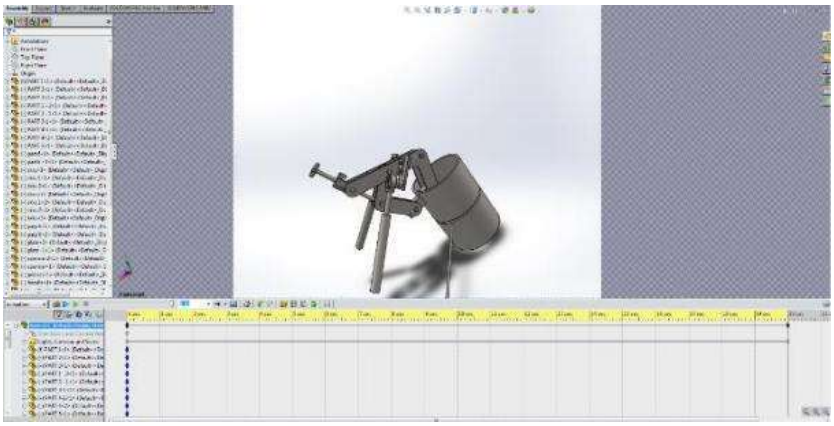

Figure 2: Simulation Video by Using Motion Study

2.5 Phase 5: Evaluation

This phase involves the evaluation of the product being produced. The products produced will be tested and evaluated for effectiveness. Evaluation of this product involves experts in the field. Their expertise can be used to identify the acceptability of the product. This evaluation phase aims to achieve the research objective of which the product being produced is acceptable to the customer. The researcher distributes the questionnaire as well as the expert verification form to gather the information for analysis. The functionality of the tool can be proven through analysis based on a questionnaire distributed to experts and determining the extent to which this product is acceptable.

3. Results and Discussion

Demographic data in this study had two parts of the items, experience in welding and qualification in welding. Table 1 shows the demographic analysis of the two items as stated in the questionnaire.

Table 1: Demographic Data

No.	Item	Respondent
	Experience in Welding Fields	
1.	1-2 year	-
	3-4 year	-
	5-6 year	1
	7-8 year	2
	9-10 year and above	-
	Qualification in Welding	
2.	Yes	3
	No	-

3.1 Design Development Data Analysis

This section deals with the analysis of design development data related to the research that has been developed. The design aspects analysis has fourteen questionnaires that have been distributed to respondents or experts for evaluation.

Table 2: Design Development Analysis

Item	Total agree	Percent of approval (%)
1	3	100
2	3	100
3	3	100
4	3	100
5	3	100
6	3	100
7	3	100
8	2	67
9	2	67
10	1	33
11	3	100
12	3	100
13	3	100
14	3	100

The findings in Table 2 show the number of respondents who agree to the items for the design development aspect. Based on the data obtained from the respondents' survey, eleven items from the responses of all three respondents (3 people, 100%) agreed with the questionnaire. They agree that the development of this tool is a very user-friendly, very attractive design, is ideal for arm support in practical work, agrees it has security features, is easy to carry anywhere, agrees that the tool is developed very easy to operate for practical, development interesting design, product development fits the design, product development is in great demand for the dimensions of each part and product development meets the criteria of the required criteria. People, 67%) and one respondent disagreed. For the design items of this tool that met the student's need for practical work, two out of three respondents (2 of them, 67%) agreed that the design complied with the students' need to do the work of both items with two respondent's consent.

However, there were items that respondents disagreed with that the design had other functions than as a support tool. One respondent agreed (1 person, 33%) while two others disagreed (2 people, 67%). This tool is specifically a support tool for 6G position welding work. Based on the respondents' consent, it can be interpreted that the respondent agrees to the development of a 6G welding arm support work design.

3.2 Design Functional Data Analysis

This section deals with the analysis of design functional data about the research that has been developed. The functional analysis aspects of the design have three parts which consist of the function part as the support, the part to the search angle, the part of the electrode travel speed function. Table 3 shows the total agreement for product functionality in terms of support. The results of the respondents' responses show (3 agree, 100%) arm support for practical work in 6G welding as a support tool. All items were agreed upon by the respondents and this indicates that this tool is suitable for use as a support tool.

Table 3: Design Functional Analysis (Support)

Item	Total agree	Percent of approval (%)
1	3	100
2	3	100
3	3	100

4	3	100

Table 4 shows the total agreement for product functionality in terms of angle. The result of the respondents 'response indicates that the respondents' overall agreement to only two items is that the tool item can facilitate welding with a good angle and that the tool item can provide accurate angle search. While angle items can be done efficiently using the tools developed disagree by two of respondents. Based on the data obtained, the respondents agreed that this tool could be used as an assistant to find the angle.

Table 4: Design Functional Analysis (Angle)

Item	Total agree	Percent of approval (%)
5	3	100
6	3	100
7	1	33

Table 5 shows the total agreement for the product's functionality in terms of electrode travel speed. The results of the respondents' responses agree on the item regarding electrode conductance. This tool item can influence the speed of the electrode to get two consents from the respondent, while the tool item is very helpful to the welder at the speed of the electrode while the welding also receives two approvals from the respondent and in addition to this tool item is very suitable for use in the new welding at the speed of travel. The right electrode also received two consents from the respondents. Based on the percentage of respondents in this section, this tool can be used as a support tool to help welders determine electrode travel in the welding process as the percentage of respondents is 67%.

Table 5: Design Functional Analysis (Travel speed)

Item	Total agree	Percent of approval (%)
8	2	67
9	2	67
10	2	67

4. Conclusion

These tools have been successfully developed through video methods using SOLIDWORK software. The objective of the study was to design, develop, and test the arm support functionality for 6G position welding work. The current state of the art forces the researcher to develop the product through the simulation video method to demonstrate the functionality of the mechanical part of the tool developed. At the design stage, the researcher takes into account the current state of the range of criteria for designing arm support to facilitate the researcher developing the tool and facilitating the students' use of the tool. An analysis of the problems and needs has also been conducted to identify the need for students to undertake practical work on welding of 6G. The discussion of the analysis was to answer the question that raised the need for arm support tools. In the development phase, the researcher developed this tool using SOLIDWORK primers. Each part of the tool is developed in stages and combined to form one part before combined. Each section is developed as described in the development section of Chapter 4 and is included with the dimensions of each section. The researcher first used the CAD software to draw a preliminary description of the product section before entering the development stage using SOLIDWORK.

Simulation video production is at the stage of implementation where the combination model will be made into a simulation video. The simulation video is generated using the motion study SOLIDWORK function by adding movement to each of the mechanical joints to see the functionality of the product. As a result, simulation videos can be developed and presented to experts to assess their level of

functionality. In conclusion, the development of arm support tools has been successfully developed through video simulation and able to see the product's functionality.

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