

STUDENT WELDING SKILL COMPETITION DEVELOPMENT MODEL WITH KKNI AND COMPETENCY CERTIFICATION APPROACH IN VOCATIONAL SCHOOL

Putut Hargiyarto, Riswan Dwi Djatmiko, Arif Marwanto

Mechanical Engineering Education Department, Faculty of Engineering
Yogyakarta State University
putut_hargi@uny.ac.id, riswandj@yahoo.uk, redzupy@yahoo.com

Abstract

This study aims to (1) obtain a model of the organization of the Student Welding Skill Competition, (2) determine the organization of the Student Welding Skill Competition model implementation, (3) determine the management of the Student Welding Skill Competition, and (4) determine the results of the Student Welding Skill Competition which can accommodate the interests of learning welding practices while meeting the competence aspects in the form of competition .

This study is a survey to describe a systematic, factual , and accurate information on the facts , properties , and relationships in Student Welding Skill Competition phenomena. The steps are: (1) establish guidelines, modules, technical instructions and SOPs ; (2) set a piece of observation, (3) collect data, (4) analyzing the data, (5) discussion of the results of data analysis, and (6) concluded that the results analysis in the form of data description and recommendation. Quantitative data analysis techniques, to calculate the frequency, average, and percentage. In addition another trend seen from the median, mode and standard deviation that occurs, then concluded qualitatively.

Conclusion : (1) the implementation model of Student Welding Skill Competition learning module contains teaching materials, SOP, evaluation procedures, training and competency testing, (2) the implementation of the model shows that there is an increased learning outcomes with a significant difference between before and after the learning activities, (3) management aspects of Student Welding Skill Competition is good towards very good, but there are findings : inadequate rewards for participants and teachers, lack of coordination among the stakeholders, the place of training in school workshops with inadequate facilities, (4) Student Welding Skill Competition results are : weaknesses in the knowledge and understanding of the participants to determine the requirements of welding, the error in the set up SMAW machine, set the welding current, the awareness of the importance of occupational health and safety equipment, as well as the presence of welding defects in welds. It is not able to accommodate the interests of welding practices while meeting the learning aspect of competence in the form of competition / certification .

Keywords : Model Development, Student Welding Skill Competition

1. Introduction

According to Government Regulation No. 29 of 1990 Article 1 paragraph 2 of secondary vocational education that prepare students to enter the workforce, developing a professional attitude; and prioritize the development of learners' ability to carry out certain types of work. Basic points of preparation of secondary vocational education graduates are professional attitude demands on a particular job. Outstanding characteristic of these demands is the preparation of students entering employment as required mastery of the workforce form of knowledge, skills, attitudes and values needed workforce (Djojonegoro, 1998:37; Suyanto, 2008: 13; Joko Sutrisno, 2007: 33).

In the world of work, behavior, work attitude and work character is an important requirement for workers. This is to be prepared

by the school as a simulated workplace : learning how to train and work; trained to obey the rules that apply in the workplace; training to develop character; initiative to build relationships and socialize and train their peers and teachers (Crites, 1969:184). All of it is a work cultural values (Slamet PH, 2010; Widarto, 2011) include : work ethic, curiosity, trustworthy, discipline, honesty, commitment, responsibility, respect, tolerance, hard work, good relationships, integrity, persistent, cooperation, adaptation, courtesy, communication and leadership. Work culture that is part of the development of this character that should be implemented in the learning program at the school, which includes a variety of program development, be it curriculum, infrastructure, teachers and others. One of vocational development programs implemented through Students Skills

Competition (SWSC) in stages from school, District/Municipal, Provincial and National level.

Students Welding Skills Competition (SWSC) at Special Region of Yogyakarta (DIY) Province is a realization of one of the efforts in the development of human resources by the government. Students Welding Skills Competition (SWSC) is an effort to encourage Vocational School (SMK) to improve the quality of teaching and learning which refers to the Indonesian National Competence (SKKNI) in welding engineering. This is in line with the development of welding technology that economical products oriented, efficient, secure and safe. The extent of the use of welding technology because the process is faster, stronger and tight (no leaks). Quality of welding/connection is determined by the welder skill expertise, indicated by welding certificate that includes the presence of welding process,

joint design and inspection. Additionally Students Welding Skills Competition (SWSC) aims to monitor the quality and capability maps of SMK, especially schools with Welding Engineering Programs. However, the implementation of Students Welding Skills Competition (SWSC) can not be used to see who has the capability of Welding Competence Programs of vocational schools. This is due to only a few who have a vocational Welding Engineering Programs who participated in the implementation Students Welding Skills Competition (SWSC). Additionally Students Welding Skills Competition (SWSC) made an annual event organized to prepare the participant in national competition.

Students Welding Skills Competition (SWSC) results showed that in the last five years there are a striking gap between the SMK, which is reflected in the competition scores, as illustrated in table 1.

Table.1 Students Welding Skills Competition (SWSC) scores 2009- 2013

No	Vocational Schools Name	2009	2010	2011	2012	2013
1	SMK Muhammadiyah 2 Wates	68,23	60	68,4	28	34,92
2	SMK Muhammadiyah 3 Yogyakarta	36,55	70,3	55,8	76	68,46
3	SMK Muhammadiyah Playen	62,03	58,8	82,2	56,5	40,46
4	SMK Muhammadiyah Prambanan	-	51,3	32	26,3	40,46
5	SMK N 1 Pundong	-	68	78	52,3	74,46
6	SMK N 1 Sedayu	80,58	86,3	96,7	91,3	90,46
7	SMK N 1 Seyegan	31	47,5	48,4	54,5	38,46
8	SMK N 2 Depok Sleman	64,33	67,5	88,2	84,8	44
9	SMK N 2 Pengasih	60,38	65,5	84,8	82,3	76
10	SMK N 2 Wonosari	66,7	52	67,2	61,3	80,46
11	SMK N 2 Yogyakarta	65,15	77,4	88,6	63	24,92
12	SMK N 3 Yogyakarta	68,7	70,6	71,5	35,8	50
13	SMK Nasional Berbah, Sleman	17,4	-	-	-	-
14	SMK PIRI 1 Yogyakarta	-	-	59	52	-
15	SMK PIRI Sleman	-	-	-	44,5	-
16	Average	56,46	64,6	70,8	57,8	55,27

From the above data showed that between the lowest and highest scores range is very large, this is not an indication of the prevalence of students' abilities in SWSC school representative. Though participants SWSC is the best student in school, what about the other students ? When further examined the ability of all students in certain schools also similar indications. This is certainly a problem that must be solved in order to implement welding practices that adhere to standards of competence and proven through transparent and accountable competition.

Welding is a material connection with the principle of magnetic bond between atoms of the

two materials to be joined. Advantages of weld joint is lightweight construction, can hold high strength, easy implementation, and quite economical. But the most important weakness is the change of the microstructure of the material being welded, resulting in changes in physical and mechanical properties of the material being welded. Two metal which can be fused directly connected, but sometimes other additives are needed in order to deposit the weld metal is well formed, the material is called added ingredients (filler metal). Filler metal is usually in the form of bars, so-called ordinary welding rod (welding electrode). In the welding process, the welding

rod is immersed in a liquid metal that is deposited in a basin called the welding pool and together form a weld metal deposit, this way is called SMAW (Shielded Metal Arch welding), see figure 1.

In Shielded Metal Arc Welding (SMAW) that are the main transformer SMAW machine is designed on the basis of constant current (CC), with this system produces transformer volt-ampere output curve as Figure 2 below.

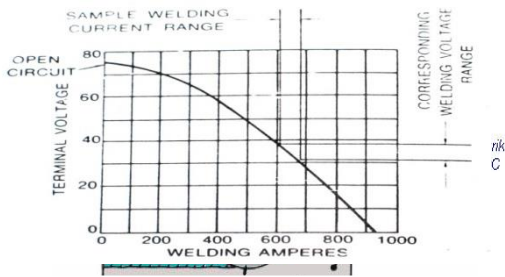


Figure 2. Constant Current Curva (Kennedy, 2004) 234)

Figure 1. Principle of SMAW

If the curves in Figure 2 were analyzed, the transformer produces a maximum voltage when zero amperes of electric current and voltage will be reduced when the electric current increases. Variations in the relationship between voltage to the current result of the heat generated by an electric arc is also changing. The heat changes depending on the distance between the workpiece with the electrode. According to Kennedy, " Without changing the machine settings, the operator can vary the welding heat by lengthening or shortening the arc" (2004 : 235). The success of metal with SMAW welding depends on the welding parameters, procedures, and welder. Welding parameters include voltage, current, and the arc length regulation is highly dependent on the welder. SMAW welding techniques with consists of three steps, according to Kennedy steps are: preparation, striking, and weaving (2004 : 242-245). Preparation is the cleaning of the workpiece in the form of grease and oxide layer. Striking had understanding the initial ignition electrode carried by the method of

scratch (scratching method) for AC welding machine and method of pounding (tapping method) for DC welding machine. Weaving or sweep selectable welding electrode useful for forming a deposit weld metal that has a shape that is required.

According to the Standard Operational Procedure (SOP) issued by the Hobart school of welding technology, there are five steps that must be performed by students are: 1) Get ready ; 2) Set the machine ; 3) Position the material ; 4) Strike the arc ; and 5) Bead weld practice (2005 : 8-11) . The quality of welds produced by Bead weld practice depends on the mastery Strike arc (startup). Initial ignition electrode becomes a very important factor in determining the quality of welded joints, it is because the characteristics of SMAW machine principled on the CC system that forces them to keep the length of the electric arc in the right position is very difficult because they are among the beginners in learning welding.

In the field of education, learning skills are more focused on the psychomotor domain has several models, one of which is Simpson's models. Simpson models developed by applying the seven steps of learning skills, namely : 1) Perception (interpreting); 2) Set (preparing); 3) Guided response (learning); 4) Mechanism (habituating); 5) Complex overt response; 6) Adaptation (modifying); and 7) Origination (creating). (Harrow : 27). In response Guided or learning step, the first step is a movement of learners imitation then they undergo a trial and error and when they feel confident to make a move then they have to get to the next stage.

Fundamental barriers experienced to produce a quality weld joints is the difficulty of keeping the flame arc length of the electrode in the correct position as yet to understand the characteristics of the arc flame. To understand the characteristics of the flame arc appropriate learning methods are needed that can provide their own experience through the practice of arrangement so that the flame arc length found the right position and produce a quality weld joints. Not all welders proficient in all positions, under the hand position (down hand) position is the easiest to do, but when the weld metal pipe on his side would be very difficult to do. Welders are able to perform welding is first class welders are equipped with international standard certificate.

In the world of industry specific coded welding position during welding in order to avoid mistakes do not define the welders and welding procedures. There are two coding systems are widely known, the system established by the American Welding Society (AWS) and the system

of the International Standard Organisation (ISO). Code set by AWS, linked to the type of position welding techniques welding connection, if the groove connection the code position with the letter G, for the down - hand position 1G, 2G horizontal, vertical 3G, 4G over-head, a pipe with a horizontal axis 5G, and 6G pipe tilted 45°. If the weld is not groove / blunt (fillet) then the code is F, for the down - hand position 1F, 2F horizontal, vertical 3F, and 4F over-head.

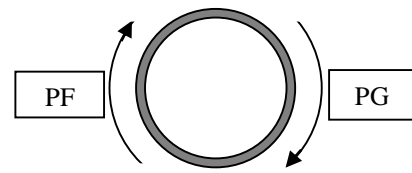


Figure 4. ISO Code Pipe Welding Position

The system code set ISO welding position different from AWS. Code according to ISO welding position based on the position of the electrodes when welding is done, to welding plate coded PA, PB, PC, PD, and PE, while the ascending pipe welding and pipe down PF PG, see Figures 3 and 4 below.

Based on IIW standard, consisting of professional welding Welding Engineer (WE), Welding Technologist (WT), Welding Practitioner (WP), and Welder (W). Welding Engineer in charge of determining welding procedures and testing procedures. Welding Technologist in charge of translating these procedures to the welding profession that has the level below. To train the welder takes a Practitioner Welding and welding are doing Welder.

Furthermore discussion of KKNi can be described as follows. Conceptually each level of qualification in KKNi organized into four main parameters, namely (1) job skills, (2) the scope of science, (3) methods and levels of ability in applying science / knowledge, and (4) managerial capabilities. These four parameters are arranged in the shape descriptor KKNi, where 9 levels KKNi explain the rights, obligations and the ability of a person to perform a job or applying knowledge and expertise (MONE, 2010: 18).

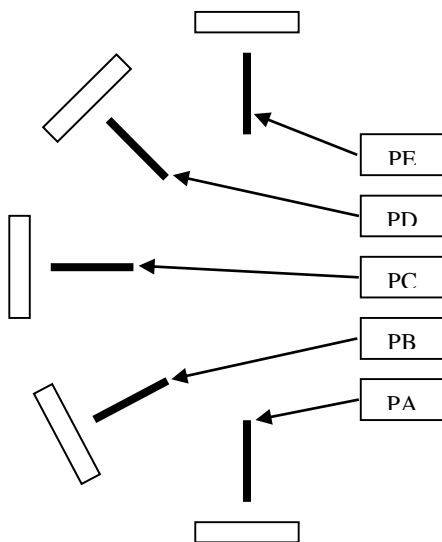


Figure 3. ISO Code welding Position

There are several basic forms of welded joints is usually done in a metal connection, the shape is a butt joint, fillet joint, lap joint joint edge, and out-side corner joint. Various forms the basis of this connection can be seen in Figure 5

Joining metal with welding process must consider several variables that appropriate quality standards required connections. These variables are the materials, processes, methods, safety and health, equipment, human resources, environment, and quality inspection of welded joints.

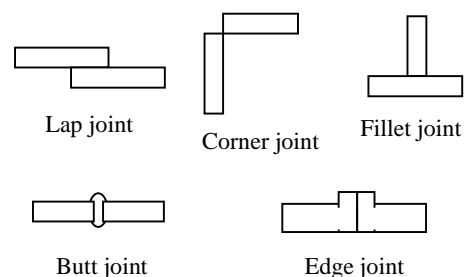


Figure 5. Various Forms Welding Connection

Description parameters that forming each descriptor are as follows : (1) job skills or competencies is the ability in the cognitive, affective, and psychomotor fully reflected in behavior or in carrying out the activities , so that in determining a person's level of competence can be traced through the element of the ability of the three domains; (2) Coverage of science / knowledge is a formulation level breadth, depth and complexity / sophistication of knowledge that should be possessed, so the higher the person's qualifications in KKNI formulated with wider, deeper and more sophisticated knowledge / science he had; (3) the method and level of ability is the ability to take advantage of knowledge is knowledge, expertise and controlled method of doing a particular task or job, including the ability to think (intellectual skills); (4) a person's managerial ability and attitude required to perform a task or job, and the level of responsibility in the work field.

Internalization and accumulation of the four parameters are achieved through a structured educational process or through work experience is called learning outcomes. Hierarchy in KKNI have characteristics that indicate that in each descriptor for the same level of qualification may contain or consist of elemental composition of knowledge (science), knowledge, skills (know-how) and skills which varies from one another. This means that every educational attainment of learning a skill can have content (skills) are more prominent than scientific (science), but given the recognition hierarchy equivalent qualification. The higher the level of qualification of the more scientific character (science), the lower the more emphasis on the mastery of skills.

Students Skills Competition is one of the tangible manifestation of the efforts in the development of human resources by the government through the Director General Directorate of Vocational Secondary Education. It is based on the future challenges in the era of globalization that gives a double effect; The first opportunity broadest cooperation between regions and between the state, the second open competition is getting tougher and sharper in all areas of work. To deal with the above challenges, the government should strengthen the competitiveness and competitive advantage in all sectors by relying on the quality and capability of human resources with a mastery of technology and management. Therefore, the government is always trying to prepare a workforce competent in their respective fields, one of which is the Student Skills Competition (Kemdikbud , 2012: 1). Student Skills Competition purpose is : (1)

encourage SMK to improve the quality of teaching and learning which refers to the Indonesian National Competence (SKKNI); (2) monitor the quality of the maps and vocational capabilities throughout Indonesia, especially schools with Welding Engineering Programs; (3) promote the competence of vocational students for Welding Engineering Skills Competency to businesses and industries as potential users of labor; and (4) provide the opportunity and motivation for students to compete in a positive way, to foster pride in the competence of practiced expertise, also of pride for the school and region / province. Entries are taken based on field welding vocational high school curriculum, Welding Engineering Skills Competency. Assessment for an entry field welding performance using methods that include: working attitude (observation - demonstration) (20%) of observation and assessment products (80 %).

Referring to the above description then conducted a study on the implementation of SWSC with the aim to (1) obtain a model of the organization of SWSC; (2) determine the organization model implementation; (3) determine the management of SWSC; and (4) determine the results of the implementation of SWSC all of which are expected to accommodate the interests of welding practices while meeting the learning aspect of competence in the form of competition.

While the benefits to can be learned include (1) the public, especially SMK will have insight, understanding, attitudes and skills of students and teachers should be prepared to face the SWSC; (2) University as a scientific institution will receive feedback to develop the science, especially the science of welding; and (3) education department will be helped in the development of human resource capacity.

2. Research Methods

This study is a survey research to describe a systematic, factual, and accurate information on the facts, properties, and relationships between SWSC welding competence phenomena. The steps are: (1) establish guidelines, modules, technical instructions and SOPs; (2) set a observation sheet; (3) collect data; (4) analyze the data; (5) discussion of the results of the analysis of data; and (6) concludes the analysis results in the form of data description and recommendation. The subject and the study population is SMK vocational industrial technologies program which organizes a welding skills. Research time for 4 months starting from June till September 2013. Data were analyzed

with quantitative techniques, to calculate the frequency, average, and percentage. In addition another trend seen from the median, mode and standard deviation that occurs, then concluded qualitatively.

3. Results and Discussion

The results of the study consists of four things, SWSC implementation models and tools, mplementation of the model and its dynamics, management and evaluation of the implementation of SWSC. The model successfully developed illustrated in the figure 7 below.

The device has been developed by researchers such as: teaching materials training modules, test welding theory, observation sheets of competency examination, assessment worksheets (refer to SWSC guidelines).

Implementation SWSC development models by implementing the following steps: (1) establish a model school group, consisting of 30 students and teachers were briefed on the program and its preparation activities to be carried out; (2) orientation and assessment capabilities with the initial test (pre-test); (3) learning theory and practice, guided by: welding expertise lecturer of FT UNY, supervising teacher and student from Mechanical Engineering Education Departement FT UNY. Lesson is done with a competency-based approach. Teaching materials form a complete module: welding theory, welding jobsheet practice, procedures and tips SWSC cover, held 8 weeks; (4) the initial competency test to filter out students who are ready to follow the SWSC; and (5) the last stage is a the deployment into the SWSC arena.

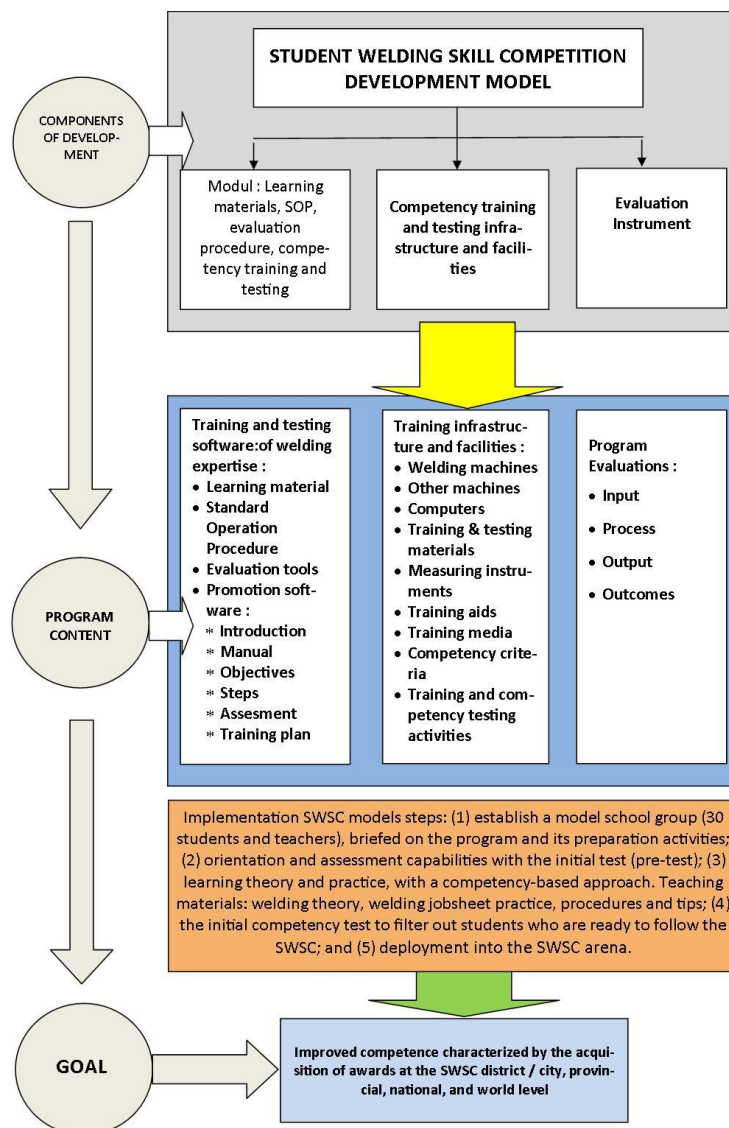


Figure 7. Development of Training Model of SWSC welding competence

The quantitative results of the implementation illustrated in Table 2, such as assessment test results to the theory, process and performance, the final test for the theory, process

and performance, as well as an increase in the different test results before and after the treatment.

Table 2. Recapitulation of development scores beginning and final

No subjek	Beginning Score				Final Score			
	Teory	Process	Outcome	Total	Teory	Process	Outcome	Total
	20%	10%	70%	100%	20%	10%	70%	100%
Average	48.83	67.67	27.83	36.02	65.17	85.33	32.92	44.61
Minimum	40.00	40.00	5.00	20.50	40.00	60.00	5.00	24.50
Maksimum	65.00	80.00	55.00	59.50	85.00	100.00	72.50	79.50

The table above can be described by the following histogram

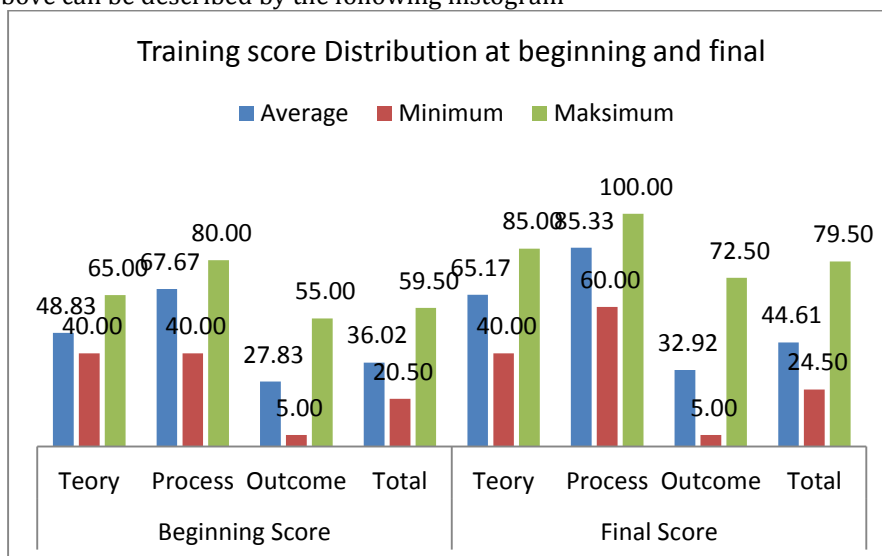


Figure 8. Histogram Training Total Score

From the table and the histogram is known that the mean total score of initial training activities is 36.02. Lowest total score of 20.50 and a high of 59.50. Mean total score after training 44.61, the lowest score and the highest score 79.50 24.50. This result is not very satisfactory. Participants of the best representatives of the school to SWSC Daerah Istimewa Yogyakarta (DIY) level only reached a score of 79.50. It is still very worrying, ideally nearly perfect score is 100, because they have to compete with other school representatives champions. Thus the more intensive training is still needed, the student already has the capability of capital theory and process, but it should be added that adequate skills training.

Furthermore, the management aspect revealed how schools handle SWSC activities ranging from planning, organizing, implementing and controlling the POAC approach. Ideally, the plan should be 100 % very well, because of the careful planning and adequate preparation of students participating in SWSC is the key to success. Deficiencies in competition preparation less than 1 month. Job obtained information that must be done in less than 1 week so it is less time to prepare. Things that need attention are inadequate appreciation for participants and teachers, lack of coordination among the stakeholders, where only a mere training in school workshops while inadequate facilities.

Table 3. The percentage of SWSC Management Functions

	Planning	Organizing	Implementing	Controlling	Total
Lack	10	6	8	13	9
Moderate	15	21	16	14	17
Good	38	32	40	30	34
Very Good	36	41	36	44	40

Mean	3.07	3.09	2.87	3.04	3.05
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The table above is illustrated in diagrammatic form figure 8. as follows

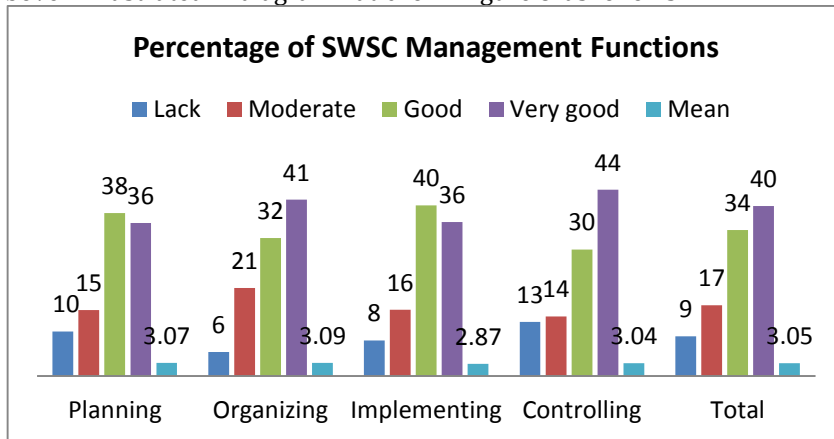


Figure 8. Histogram percentage of SWSC Management Functions

Overall management aspects of SWSC stated 9% less, 17% adequate, 34% good and 40% very good, with a mean of 3.05 on a scale of 0-4, or good to very well.

Furthermore, the results of SWSC in 2013: process score 92.94, outcome score 45.93 and total score 49.55. Refers to the mean score SWSC in 2013 shows that the participants have followed procedures during the welding process quite well. But if you look at the average score is low results. This proves that the weld technique requires special skills, although procedurally correct, but if the skills of the participants was not

good then the results are not optimal. In addition, it also shows that only a few participants who have the skills and follow the procedures correctly so get the maximum score.

In more detail, the following exposure data based on observation of welding processes, and outcome score. Welding process assessment indicators include: using welding auxiliary equipment, using welding safety and health equipment, SMAW machines operate correctly, as well as perform routine welding using the SMAW process. The results of the welding process in SWSC illustrated in histogram Figure 11 below.

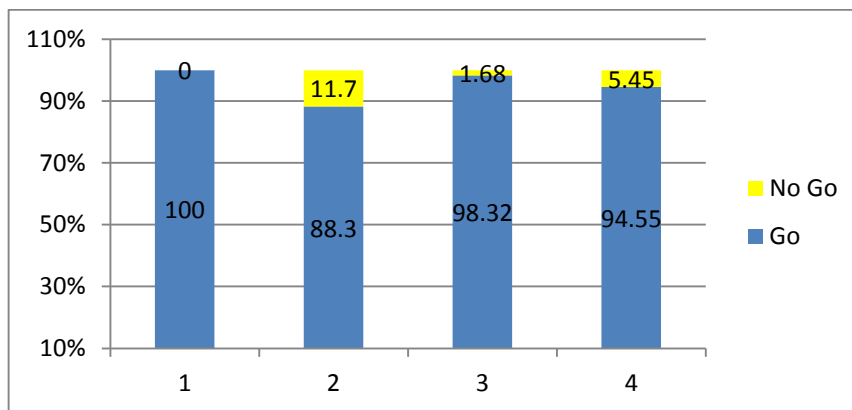


Figure 11. Histogram Welding Processes Assessment

The results of the welding process assessment in SWSC in general has seen a majority of the participants fulfilled the criteria. Some participants do not fulfill welding procedure in a process that includes the following indicators: 1) operate the set-up SMAW machine correctly (6013 AC, DC ±, 7016, root DC ±, 7018 filler, cover, DC +), the set-up machine affects the results of the welding process. 2) perform routine welding using the SMAW

process, errors in the work piece fit-up properly (0-3 mm root gap affects the root pass welds; election in accordance with the type of electrode and workpiece thickness (root pass 6013, 7016, filler & Cover Pass 6013, 7018), determines the success of the breakout. 3) there is SWSC participants who have not aware the importance of the use of health and safety equipment during the welding process: apron, safety gloves, and

safety shoes. All of them can be illustrated in figure 12 below.

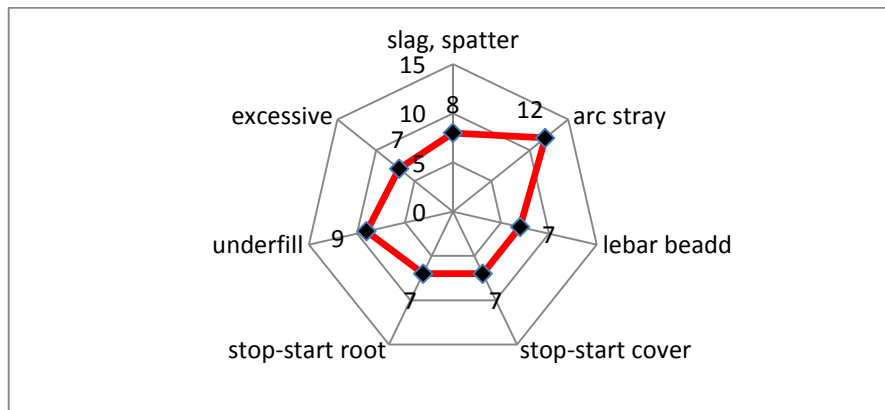


Figure 12. Participant error in welding processes

The above diagram illustrates the errors that occur include: 1) workpieces free of slag, spatter, and arc stray. Slag, spatter and arc welding stray is a visual defect that can be directly observed. Slag and spatter caused by the current is too large, the wrong type of current, and wrong polarity. Selection and calculation of current will reduce the occurrence of slag and spatter. Stary Arc is a defect caused by scratches electrode on the workpiece. Scratches electrode on the workpiece will damage the workpiece. 2) Variation of bead width does not exceed 2 mm. It is commonly found wide variations exceeding 2 mm bead, this occurs when the cover pass welding unstable. This can be avoided by strengthening the hand holding the pedestal electrode when welding. 3) the workpiece is free from incomplete penetration defects or root fusion porosity, this occurs in unperfect or not translucent root pass welding. The reason for the electrode position during the first welding is too high, and the current used is too low. In addition, distance-hand side seam (root gap) is too tight. 4) the workpiece free from stop-start defects on the surface of the cover and the root pass. Stop-start height difference is due at the time of temperature decrease after welding electrodes run out. Therefore melting new electrode welding is not perfect so the result is higher at the beginning, so that preheating is required when connecting as electrodes run out. 5) the workpiece is free from under fill defects. Errors that occur on the surface (cover pass) is not full or below the surface of the workpiece. This occurs because the movement is too fast or when the filler pass welding is still lacking. 6) the workpiece is free from excessive face reinforcement defects. Welding defect is caused by the movement of the electrode is too slow, resulting in accumulation molten weld is too

high. How to prevent it by maintaining the stability of the electrode movement.

4. Conclusions

Several conclusions can be drawn include: (1) implementation of the SWSC model module contains learning materials, SOP, evaluation procedures, training and competency testing; (2) there is improvement learning outcomes with a significant difference between before and after the learning activities, both in learning theory, processes and practices; (3) SWSC management aspects 9% of respondents said less, 17% adequate, 34% good and 40% very well, with a mean of 3.05 on a scale of 0-4, or good to very good. But there is a note: inadequate appreciation for participants and teachers, lack of coordination among the stakeholders, where only a mere training in school workshop with inadequate facilities, not yet the growth of achievement motivation and the limited information; (4) The results of the implementation of SWSC for the last 3 years has deteriorated, where there are deficiencies and weaknesses of the participants in the knowledge and understanding to determine the welding conditions, the error in the set up SMAW machine, set the welding current, the awareness of the importance of health and safety equipment, as well as the presence of welding defects in welds. These results not yet able to accommodate the interests of welding practices while meeting the learning aspect of competence in the form of competition / certification.

The advice regarding school development in participating in SWSC include: (1) need improvement models apart from modules that have been made, such as a minimum standard equipment, standard time training, management

support; (2) implementation of the model needs to be enhanced with the intensification of the learning, training and equip additional instructional time in order to obtain optimal results; (3) management aspects that need to be developed is a communication and coordination among stakeholders so that students can more adequately prepared in participating in welding SWSC; and (4) needs to scrutiny so that weaknesses can be minimized in the future. The implications of the implementation of SWSC are required to improve the role of the stakeholders to the maximum supported by accountable management.

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