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EXPERIENTIAL VERSUS COOPERATIVE LEARNING: TRAINING OF SHIELDED METAL ARC AND OXY-ACETYLENE WELDING AT VOCATIONAL HIGH SCHOOL KARAWANG, INDONESIA

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Abstract
One of the main problems in welding training conducted in vocational high schools is the use of training methods. The question is how training efficiency can be improved. This study aims to determine the difference between experiential and cooperative learning methods of training results on Shielded Metal Arc and Oxy-Acetylene Welding. We compare the two modalities of training design that are anchored in two learning methods: experiential and cooperative learning. This is an experimental study with pretest and posttest of training with these methods. Stratified random sample of 96 students were recruited from the population of 450 girls and boys belongs to grade 10 to 11. The age of participants ranged from 16 to 18 years old (M=17,00; SD=,768). The training consisted of 16 sessions that was conducted twice a week. The outcome were measured by multiple choice answers tests and practice. The data were analyzed with analysis of covariance. A significant difference was found between the experiential and cooperative learning methods on Overall achievement welding training (F=2,953, p<.000). Experiential learning is better than cooperative leaning. It can be concluded that experiential method is more efficient applied to vocational schools especially welding training.

Keywords: experiential learning; cooperative learning; shielded metal arc welding; oxy-acetylene welding, training

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Introduction

The phenomenon in Indonesia today is the scarcity of welding profession, it takes 45000 welding profession to meet development needs in some industry sectors (Gareta, 2015). Government efforts to meet the needs of mid-level welding profession through vocational high schools to provide knowledge and skills in industrial processes such as metal cutting and connecting, steel construction and machining construction in the manufacturing industry (Djazidie, 2016). Welding profession can be done by male and female, such as female who attended welding training for 2-3 months work as female welder at PT. McDermott an oil mining company located in Batam, Indonesia (Deny, 2013). The training content is shielded metal arc and oxy acetylene welding it was discussed ("WLD 111 Shielded Metal Arc Welding (E7024) and Oxyacetylene Cutting"). According to Djatmiko (2008) The types of welding given in the most popular training in Indonesia are using shielded metal arc welding (SMAW) and oxy acetylene welding / OAW). The purpose of welding training is: Learners have skills in the use of tools and equipment on shielded metal arc welding (SMAW) and Oxy Acetyline Welding (OAW); Learners can do work according to worksheet, and finish on time; Learners know the causes and constraints experienced during welding work. Competencies that must be mastered by learners include: Identify arc welding equipment; Describe the weld electrode section; Draw the shape of the weld joint; Apply welding procedure.

According to Deutsche Industrie Nornem (DIN) Welding is a metallurgical bond to the metal joints carried out in the molten state that was discussed ("Welding Technique Definition", n.d). Shielded Metal Arc Welding (SMAW), also known as Manual Metal Arc (MMA) welding, flux shielded metal arc welding or informally as stick welding, is a manual arc welding process that uses a consumable electrode coated in flux to lay the weld (Houldcroft, 1973). While Oxy Acetylene Welding (OAW) is the process that uses fuel gases and oxygen to weld and cut metals, respectively (Su, Trice, Faber, Wang, & Porter, 2004). Welding training is conducted to ensure the availability of skilled human resources (Weber, Geldermann, Löffler, & Bednarz, 2015). The question is how training efficiency can be improved. We compared two welding training designs anchored to two intervention methods: experiential and cooperative learning.

Experiential learning

Acording to Kolb (1984) learning "The process of knowledge is created through the transformation of experience". Kolb explains that the experiential learning mindset consists of four steps: Concrete experiment (students are tasked and completed); Reflective observation (students discuss it); Abstract conceptualization (reflection of conclusions on each cycle about the level of achievement of success criteria); Active experimentation (undertaking improvement). Acording to Lewis and Williams (1994) Experiential learning means learning by doing or learning from experience. There are two main categories of experiential learning: field-based experience and classroom-based learning. Field-based experience includes practicum, internships, and service learning. Experience-based learning in the classroom can take many forms, including role playing, games, simulations, case studies, presentations, and various types of group work (p. 7).

In the process of learning a student choosing to solve problems will be different from other students, and what a student takes from an experience will be different from the others. In other words "learners play an important role in assessing their own learning" (Wurdinger, 2005, p. 69). To gain success in experiential learning students are given examples of simple exercises and led through discussions that make them familiar with the concepts, then move from basic to more complex forms (Moon, 2004). The characteristics of experiential learning include: Instructors should create a safe space for students to be able to perform analysis, exploration, and working on their own self-discovery process; Activities should build students' ability to see relationships in complex systems and find ways to work within them. Students should be able to reflect on learning, and gain insight about themselves and their interactions with the learning environment (Chapman, McPhee, & Proudman, 1995). Experiential Learning Assessment to confirm on the learning and growth that has and is occurring. Furthermore, the use of appropriate assessment methods produces a reflective process that ensures continued growth after specific learning is completed. Therefore, it is necessary to design a unique assessment method to measure success in both process and product (Moon, 2004; Wurdinger, 2005; Qualters, 2010).

Cooperetive learning

The theoretical perspective underlying cooperative learning is a cognitive development perspectives, which is suggested by Piaget (1965). The

cognitive development theory explains that when group members are involved in Cooperative Learning, they will participate in the discussion. Participants will present their information and views, discuss their own insights, identify their weaknesses, make corrections and learn new information from each other. The behavioral social perspectives, which is purported by Albert Bandura (1977) The behavioral learning theory emphasizes the effects of cooperative group reinforcement and the extrinsic motivation for learning.Cooperative learning is a teaching method by dividing small groups working together to maximize the learning potential of each group member (Johnson, Johnson, & Smith, 1991).

There are five essential elements for maximizing the success of the Cooperative Learning. These elements include positive interdependence, individual accountability, face to face promotive interaction, social skills and group proces (Johnson & Johnson, 1994). Cooperative learning is a highly structured classroom method involving students teaching each other and working together to achieve learning outcomes (Slavin, 1980; Bruffee, 1999). Cooperation among students in groups creates interdependencies that can occur to improve motivation and cognitive processing. Cooperation among students in study groups is a basic principle of effective undergraduate teaching (Chickering & Gamson, 1987; Astin, 1993; McKeachie, 1999; Tinto, 2003, Pascarella & Terenzini, 2005). According to Slavin (1994) Cooperative Learning is a teaching method in which students learn in small groups that help each other. Students work together in a structured team, they discuss and process information, thus more likely to experience a gain in cognitive development of students working separately from each other (Pascarella & Terenzini, 2005).

The cooperative learning model was developed by Johns Hopkins called Student Division Team-Achievement (STAD) and Teams Games-Tournament (TGT). The learning process is designed to involve the role of the student as a peer tutor and contains elements of game and reinforcement. Cooperative learning can improve, student achievement, skills, positive interaction between students, acceptance classmate (Slavin, 2008). Characteristics of cooperative learning is interdependence members of the group in the learning process, four major approaches to cooperative learning include Game Tournament Team, Student Team, Achievement Division, Jigsaw, and Small Group Teaching (Slavin, 1980).

Objectives

Main objective

The purpose of this study is to develop and test training methods that can improve efficiency. Training is designed with two intervention methods: experiential and cooperative learning.

Specific objectives

The effectiveness of research methods are investigated through experimental design by two groups was tested over a period of 60 days. The effectiveness of training methods will be evaluated by the difference between the preetest and posttest mean scores of the two experimental groups.

Hypotheses

1. There are significant differences between the experiential and cooperative learning methods on outcomes Shielded Metal Arc Welding training;
2. There are significant differences between the experiential and cooperative learning methods on outcomes Oxy-Acetylene Welding training;
3. There are significant differences between the experiential and cooperative learning methods on Overall welding training.

Method

Participants

The present study participants were recruited from a Public higher vocational School, located in Karawang, Indonesia. Stratified random sample of 96 students were recruited from the population of 450 girls and boys belongs to grade 10 to 11. Their age ranged between 16 to18 old (M=17; SD=0,76). From the selected 96 sample, equal number of participants was allocated into two experimental groups; cooperative learning and experiential learning groups.

Measure

Measurement of achievement welding include productive theories and practicum results. Tests were given multiple choice answers for productive theories. It has 20 multiple choice answers with 4 answer options. Internal consistency reliability (α=.82) has been shown to be acceptable. Practicum results are measured by visual tests includes; Undercut, Porosity, Distortion and Cracking.

Procedures

We conducted a pretest session to all the initial set of participants from cooperative and experiential groups (N=48) The training consisted of 16 sessions that was conducted twice a week in the Friday and Saturday. Each for approximately 2 hours. The first session was for pretest, and the last session was for posttest. The independent variable was the experiensial and cooverative learning and the dependent variable was acheavement welding.

Design

Training design with experiential learning groups

Step I: The students are placed in rooms equipped with welding equipment;
Step II: The students are taught the theory and practicum of welding;
Step III: The students are given hands-on experience in the workplace;
Step IV: The students conduct discussions and reviews of their experiences for improvement;
Step V: Teachers and students evaluate the training process.

Training design with cooperative learning groups

Step I: Teachers provide target skills that are achieved;
Step II: The students are divided into groups of 4 people, teachers provide tasks to be done;
Step III: The students conduct discussions and reviews of task success cooperatively;
Step IV: the students conduct presentations to each other teams of the group;
Step V: Teachers evaluate the learning outcomes of theory and practice.

Data analysis

The data was first tested for normality using Kolmogorov-Smirnov, second tested for homogeneity of variances using Levene, then analyzed using analysis of covariance (ANCOVA). The posttest scores between two the experimental group was analyzed for differences, while making the pretest scores from both groups as the covariate. For the main statistical analysis descriptive and inferential statistical methods were used to analyze the data. Mean, SD, Mean difference and 2 x 2 repeated measures ANOVA was employed to analyze the data.

Statistical analysis

The collected data was statistically treated. For the main statistical analysis descriptive and inferential statistical methods were used to analyze the data. Mean, SD, Mean difference and 2 x 2 repeated measures ANOVA was employed to analyze the data.

Results

Background data of the participants

Table 1. Descriptive Statistic Data Of The Participants (N=96)

VARIABLES	Males			Females		
	N	M	SD	N	M	SD
Shielded Metal Arc Welding	51	47.84	6.83	45	46.62	6.72
Oxy-Acetylene Welding	51	47.55	6.32	45	46.62	6.64
Overall welding	51	95.39	12.84	45	93.24	13.32

Note: SD = Standard Deviation

Table 1 shows welding knowledge scores of males and females participants before being trained in Shielded Metal Arc Welding. Welding knowledge of the males participants (M=47.84; SD=6,83) is better than the females participants (M=46.62; SD=6.72). Oxy-Acetylene Welding of the males participants (M=47.55; SD=6.32) is better than the females participants (M=46.62; SD=6.64). Overall welding score of the males participants (M=95.39; SD=12.84) is found to be better than the females participants (M=93.24; SD=13.32). The mean score of overall welding of the males participants was slightly higher than for female participants.

Table 2. Descriptive Statistics Measure

Groups	Cooperative Group				Experiential Group			
	Pre Test		Post Test		Pre Test		Post Test	
Variables	M	SD	M	SD	M	SD	M	SD
Shielded Metal Arc Welding	49,50	6,57	77,67	6,90	49,38	6,75	87,42	5,75
Oxy-Acetylene welding	47,08	5,76	75,12	6,40	47,63	8,36	81,58	6,22
Overall welding	96,58	12,29	152,72	13,25	97	15,05	169	14,91

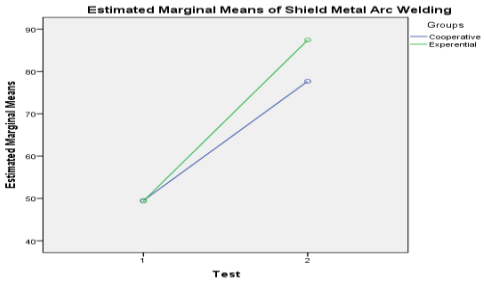
The above Table 2 shows the level of significance between cooperative and experential groups. On analyzing the pre test and post test mean scores of Shielded Metal Arc Welding (M=49.50, SD=6.57; M=77.67, SD=6.90), Oxy-

Acetylene welding (M=47.08, SD=5.76; M=75.12, SD=6.40). and Overall welding (M=96.58, SD=12.29; M=152.72, SD=13.25) of the cooperative group there are significant difference identified. Similarly experiential group, on analyzing the pre test and post test scores of the Shielded Metal Arc Welding (M=49.38, SD=6.75; M=87.42, SD=5.75), Oxy-Acetylene welding (M=47.63, SD=8.36; M=81.58, SD=6.22), Overall welding (M=97, SD=15.05; M=169, SD=14.91) there are significant difference.

Table 3. Repeated Measures ANOVA 2 x 2 Of Pre Test and Post Test Shielded Metal Arc Welding Of Cooperative and Experiential Groups

Source	Type III Sum of Squares	df.	Mean Squares	F	p	Effect Size
Shielded Metal Arc Welding	555,844	1	555,844	13,110	,000	0,948
Shielded Metal Arc Welding x group	585,094	1	585,094	13, 799	,000	0,957
Error	3900,792	92	42,40			

The Mean and Standard Deviation are presented in Table 2. There is a significant effect of cooperative and experiential learning on Shielded Metal Arc Welding group participants (F(1,986)=13,110, p<,005). The experimental was found to be much better than the cooperative group scores in the post test. There is a significant interaction effect between over time and group (F(1,986)=13,799, p<,05). Thus, H1 "There is a significant differences between the experiential and cooperative learning methods on outcomes Shielded Metal Arc Welding training" is accepted.



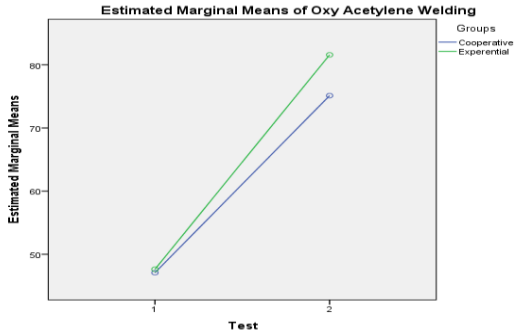
1 = Pretest :2 = Posttest

Figure 1. Estimated Means Scores of Pretest and Post test of cooperative and experiential Groups of Shield Metal Arc Welding

Table 4. Repeated Measures ANOVA 2 x 2 of Pre Test and Post test Cooperative and Experimential Group of Oxy-Acetylene Welding

Source	Type III Sum Of Squares	df.	Mean Squares	F	p	Effect Size
Oxy-Acetylene Welding	294.000	1	294.000	6.428	.013	0.708
Oxy-Acetylene Welding X group	210.042	1	210.042	4.259	.035	0.564
Error	4207.917	92	45.592			

The mean and standard deviation is presented in the Table 2. There is a significant effect of cooperative and experiential learning on Oxy-Acetylene Welding group participants (F(1, 98)=6,428, p<.05). There are significant differences between the experiential and cooperative learning methods on Oxy-Acetylene Welding training. There is a significant interaction effect between over time and group (F(1, 98)=4,259, p<.05). Thus, H2 "There are significant differences between the experiential and cooperative learning methods on outcomes Oxy-Acetylene Welding training" is accepted.



1 = Pretest: 2 = Posttest

Figure 2. Estimated Means Scores of Pretest and Post test of cooperative and experiential Groups Oxy acetylene

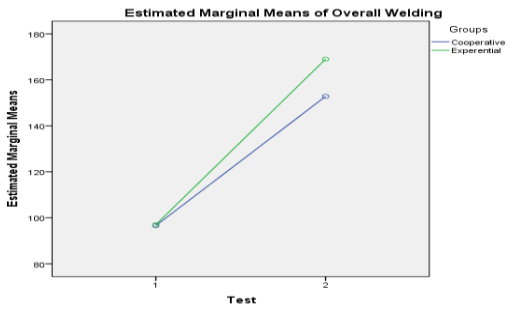
Figure 2 denotes the pre test and post test mean scores of cooperetive and experiential group on Oxy-Acetylene Welding. The pre test mean Score (M=47,08) and post test mean score (M=75,12) of the cooperetive group was increased greater when compared to pre test and post test. Whereas the mean scores of pre test (M=47,63) and post test (M=81,58) of the experience groups

were found to increase significantly larger than the cooperative group. This significant difference is attributed the influence of Shielded Metal Arc Welding intervention practiced by the experiential group participants. The cooverative group participants are significant differences in the mean scores of Oxy-Acetylene Welding. There is a very high difference in the mean scores of pre test and post test.

Table 5. Repeated Measures ANOVA 2 x 2 of Pre test and post test of cooperetaive and experiential groups of Overall Welding

Source	Type III Sum of Squares	df.	Mean Square	F	p	Effect Size
Overall Welding	1658.344	1	1658.344	9.545	.000	0.864
Overall Welding x Group	1496.260	1	1496.260	8.612	.000	0.867
Errors	15983.792	96	173.737			

The mean and SD is presented in the Table 2. There are significant differences between the experiential and cooperative learning methods on Overall welding training (F(1, 98)=9,545, p<.05). The experimental was found to be much better than the cooperative group scores in the post test on overall welding. There is a significant interaction effect was found between over time and group (F(1, 980=8,612, p<.05). Thus, H3 “There are significant differences between the experiential and cooperative learning methods on Overall welding training” is accepted.



1 = Pretest: 2 = Posttest

Figure 3. Estimated Means Scores of Pretest and Post test of cooperative and experiential Groups Overall Welding

The above figure denotes the pre test and post test mean scores of overall welding among cooperative and experiential groups. The Mean Score of the cooperative group in the pre test (M=96.58) and post test is (M=152,72), it is obvious that there is significant difference found between pre test and post test scores of overall welding among cooperative group. The mean Score in the pre test (M=97) and post test (M=169). Scores of overall welding in the experiential group is found to be improved better. This significant difference in the level of overall welding the mean score of Shielded Metal Arc Welding found to increase is much higher than in Oxy-Acetylene Welding.

Discussion

The present findings shows mean score of the two welding training and its combination of these two dimensions method. While comparing the Shielded Metal Arc Welding of males and females student, the mean score of males (M=47.84) is much higher than that of femals (M=46.62). Whereas the mean score of Oxy-Acetylene welding among both males (M=47.55) and females (M=46.62) are found to be similar. Overall welding mean scores of males (M=95.39) is higher than that of females (M=93.24). On observing the overall welding rate of vocational high school students found boys were higher than girls. But the level of weld achievement is found to be similar in both genders. The findings of this study are consistent with the results of Myers's research (2006) shows that there is no real difference in thinking ability between male and female students. However, there is little difference research conducted by Halpern and LaMay (2000), Halpern (2004), Mitrevski and Zajkov (2012) found that of teenage boys generally perform better in manipulating visual images, prakticum, computer and numerical ability.

Comparing the mean score of pre-test and post-test on Shielded Metal Arc Welding in cooperative group (M=49.50; M=77.67). Oxy-Acetylene welding (M=47.08; M=75.90). Overall welding (M=96.58; M=152.72). While experiential group on Shielded Metal Arc Welding (M=49.38; M=87.42), Oxy-Acetylene welding (M=47.63; M=81.58), Overall welding (M=97; M=169).

This result is due to cooperative and experiential group training interventions for a period of 60 days. After 60 days of this intervention, the mean scores post test were welded at all three levels of this situation, the post test score of the experimental group increased significantly compared to the initial mean

scores test. In the training of Shielded Metal Arc with cooperative group intervention, there was an increasing of 28.17 point (M=49.50; M=77.67) under experiential group 38.04 point (M=49.38; M=87.42). In Oxy-Acetylene welding training with cooperative group intervention obtained 28.82 point (M=47.08; M=75.90) under experiential group 33.95 point (M=47.63; M=81.58). In the overall welding intervention the cooperative group obtained an increasing of 56.14 (M=96.58; M=152.72) below experiential group 72.00 (M=97; M=169). Therefore, it is evident that the intervention affects the effectiveness of the training of the clarification. The results showed that both treatments were equally effective in overall welding training, the experiential groups are more effective than cooperative groups. Recent study results conclude that the use of Work-Based Learning Approach (WBL) in vocational education has a positive influence in achievement, motivation, and continuation of education (Lynch & Harnish, 1998; Fallow & Weller, 2000; Braham & Pickering, 2007; Garnett, 2008). This result is consistent with the study (Moon, 2004; Wurdinger, 2005; Qualters, 2010) In this study, experiential learning proved effective in improving welding capability. Experiential group success emphasizes student-centered learning, learners have a willingness to reorder or change the conception of a topic. Learners have clarity of purpose by performing the tasks, and skills necessary to work successfully both individually and in groups. Learners are aware of the "rules" that govern the discipline of their operation, but also open-minded, and able to work with people with different views.

Finally, learners gain experience in controlling and identifying the role of emotion in their learning, as well as reflecting on how they know their new knowledge (Moon, 2004). The present study design using Deway's "pattern of inquiry" as suggested Wurdinger. Pattern of inquiry is so effective that "thinking occurs not only after an experience but also throughout the entire experience" (Wurdinger, 2005, p. 8). When applying the training using an inquiry pattern, the training should be student-centered. Training should be done immediately, and ask students to complete the welding practicum. Students' interest in designing project activity increases: "Projects are more meaningful than tests because students need to think, plan, and execute their ideas to produce something from their own creativity" (Wurdinger, 2005, p. 13). Similarly, cooperative learning has been found to be very effective in Shielded Metal Arc Welding. This result is consistent with the study (Johnson & Johnson, 2014; Slavin, 2013; Slavin,

2014) it was found that well structured methods such as cooperative learning yielded a more positive measure of effect than other learning. In cooperative learning is characterized by positive interdependence resulting in greater motivation and achievement than negative or non-interdependent situations. In summary, there is much evidence that cooperative learning as a pedagogical practice has a profound effect on student learning and socialization (Slavin, 2014).

The results obtained here also prove the scores of welding increasing after this intervention. Significant major effects were attributed to group interactions and time studied statistically with split-plot ANOVA

The results show that there are significant differences on Shielded Metal Arc, Oxy-Acetylene and overall welding pre test scores and post test scores. And there is significant interaction effect found between cooperative group and experiential group and time (pre test and post test).

Conclusions

In this study we examined the extent to which both experiential learning and cooperative learning methods can improve efficiency in both types of welding training that are popular in Indonesia, namely Shielded Metal Arc and Oxy-Acetylene Welding (Djatmiko, 2008).

Experiential learning is done in four steps; first the student is assigned to carry out concrete experiments and complete; then students make reflective observations, then students discuss the results of the experiment and the last observation students formulate abstract conceptualizations and reflect conclusions on each cycle about the level of achievement of success criteria (Kolb, 1984). Cooperative learning is designed by involving the role of students as peer tutors and contains elements of play and reinforcement that can improve achievement, skills, positive interaction between students (Slavin, 2008). The results showed: First, on the type of Shielded Metal Arc Welding training score the average post test with Experiential learning increased by 38.04 points (M=49.38; M=87.42). while the average score of post test with Cooperative learning increased by 28.17 points (M=49.50; M=77.67). Second, on the type of Oxy-Acetylene Welding training. The average score of post test with Experiential learning increased by 33.95 points (M=47.63; M=81.58). While the

score of the average post test with Cooperative learning increased by 28.82 points (M=47.08; M=75.90).

On the basis of these results we conclude that Experiential learning is more efficient than Cooperative Learning. Experiential learning is very relevant to vocational education. Students are placed in a workshop that has been prepared by welding tools and equipment to conduct learning activities through practice, observe the situation, conduct discussions and and evaluate the success of each stage. This is a way to improve thinking skills and achievement related to real life work activities that can be applied to several population groups.

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