IOSR Journal of Research & Method in Education (IOSR-JRME)
e-ISSN: 2320–7388,p-ISSN: 2320–737X Volume 6, Issue 3 Ver. IV (May. - Jun. 2016), PP 67-73
www.iosrjournals.org

The Scientific Approach-Based Cooperative Learning Tool for Vocational Students Vocation Program of Autotronic (Automotive Electronic) Engineering

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Abstract: *This research was conducted to produce the products such as learning tools to support the scientific approach-based cooperative learning and examine how its effects on the learning process in laboratory in Vocational High School in vocation program of autotronic (automotive electronic) engineering throughout the city of Malang. This study used the stages of research and development by Borg & Gall to make the products, while for researching the effects, the researcher used a quantitative approach with experimental research method. The samples used were 66 students of class XI, consisting of 37 students as an experimental group and 29 students as a control group. The product validation phase is conducted by seven lecturers of Mechanical Engineering, State University of Malang, 2 teachers of SMKN (State Vocational High School) 6 Malang and SMK (Vocational High School) 10 and 25 students of SMKN 6 and SMKN 10 Malang. The product testing was conducted by some experts consisting of material content experts, instructional design experts, learning media expert and small group trial. Based on the product testing data, it was obtained the data from experts that the learning products developed at the valid level and reliable was used as the learning products while in testing the effects of product usage in learning by the students, it was obtained the data that the products developed significant affected on the learning outcomes and was effective to be used.*

Keywords: *cooperative learning, learning products, learning tools, scientific learning, student learning outcomes*

I. Introduction

Problem in the learning process is one of the problems in teaching and learning activity. Years after years, the Indonesian government keeps making any improvements in the educational field, one of which is to make improvements to the learning activities namely the curriculum improvement and the standard process improvement.Since the implementation of the curriculum 2013 (K13), then the learning process at schools in Indonesia gradually until the year 2019/2020 shall apply the learning process guided by the principles of scientific approach (Permendikbud – Regulation of Minister of Education and Culture - No. 65 of 2013, concerning Process Standard of Primary and Secondary Education). The learning process with K13 in Vocational High School (SMK) uses a scientific approach. The scientific approach is a learning approach which was first introduced in America in the late of 19th century (Hodson, 1996: 115). The Learning with scientific approach is one of the activities with more effective learning results compared to the traditional learning (Atsnan&Gazali, 2013). The scientific approach can be integrated into several learning models, one of the learning models which can be integrated in scientific learning is cooperative learning model (Nugroho, 2013).

There are still many obstacles faced in the implementation of scientific approach integration into cooperative learning, especially for the vocational high school teachers, the phenomenon occurs because there are many teachers who have not been able to change the mindset of learning from the old (previous) curriculum to the K13 and are not yet available teaching materials that support the learning with the scientific approach. This product research and development of learning tool seeks to help the vocational high school teachers particularly in the vocational field of autotronic engineering in implementing the K13.

II. Literature Study

Learning Tool: the learning tools are the tools or equipment to perform the process which will enable educators and learners to perform the learning activities, Zuhdan (2011), while Ruhadi (2008) argued that "the learning tools are a number of materials, tools, media, instructions and guidelines which will be used in the learning process." The learning tools are the vital things used in the learning process. Every teacher in the educational unit has the obligation to draw up a learning tool, gives directions so that the implementation of teaching and learning process takes place in an interactive, inspiring, fun, motivating for the students to participate actively (Poppy, 2009: 1-5). So, it can be concluded that the learning tools are one of the preparation manifestation made

by the teacher before they perform the teaching and learning process in the classroom, such as syllabi, lesson plans, learning modules, LKS-student work sheets, instructional media, and assessment instruments.

Cooperative Learning: According to Johnson, Johnson and Holubec in Felder&Rebecca (2007), "Cooperative learning is the learning using small groups in which the students work together to maximize their learning activities, each other or as a team". The cooperative learning model is based on Vygotsky's learning theory which emphasizes on the social interaction as a mechanism to support the cognitive development (Peter, 1995). The students are given the responsibility to create a community in a learning and participate in the learning process and make the learning process in the classroom into meaningful than to work individually (Gupta &Jyoti, 2014). The cooperative learning provides many ideas and concepts from different members, easily and clearly in a learning process (Kiran, Qaisara, Sidra, Mehwish&Amna, 2012). The structure of cooperative learning is an instructional relationship between teachers, students and technology, as well as the appropriate and constructive learning framework to support the learning process, the learning is directed as a social perspective in the constructivist learning, the cooperative learning is a very credible alternative (Neo, 2005). So, it can be concluded that the cooperative learning is the learning using study groups using the principle of constructivism learning framework and based on the learning theories giving emphasis on the social interaction process.

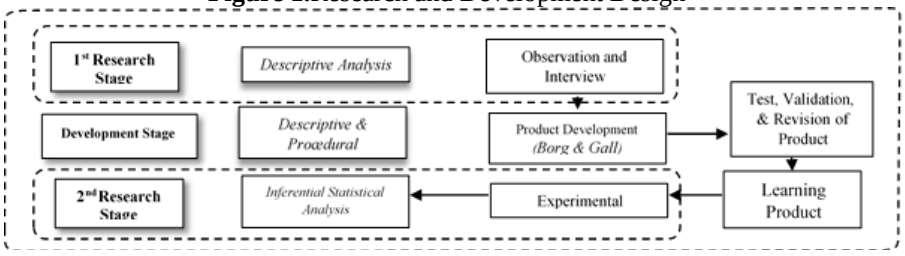
The Characteristics of Cooperative Learning: According to Johnson & Johnson in Richard M. Felder & Rebecca (2007), the characteristics of cooperative learning model consist of: Positive interdependence; Individual accountability; Face-to-face promotive interaction; Appropriate use of collaborative skills; Group processing.

Learning with Scientific Approach: According to Sani (2014) the scientific approach is closely related to the scientific method which should normally involve examination or observation needed for the formulation of hypotheses or data collection, while Hidayah (2013) mentioned that the learning with scientific approach is a scientific and inquiry approach, where students act directly either individually or in groups to explore the concept and principles during the learning activities and the teacher's task is to direct the learning process performed by the student and provide any corrections to the concepts and principles which the students have been obtained. Marjan (2014) stated that, theoretically the learning with scientific approach is the learning which is more emphasis on the inquiry learning, which has relevance to the nature of science, which is not just a collection of facts and principles, but include ways how to get the facts and principles as well as the scientists attitude in the basic science process namely observing, classifying, communicate, measure, predicting, and concluding. According to Nur (2011) and Ibrahim (2010), the scientific approach or method is an approach or method to obtain the knowledge through two channels, namely mind (reason) path and observation.Based on the explanation above, it can be concluded that the scientific learning is the learning using the scientific method which involves the scientific processes through two channels, namely reason path and observation.The scientific Learning is the learning to adopt the scientific measures in building the knowledge through the scientific methods (Kemendikbud-Ministry of Education and Culture, 2013). The scientific approach allows teachers or curriculum developers to improve the learning process, namely by breaking the process down into steps or stages in detail which contain any instructions for the students to carry out any learning activities (Varelas&Ford, 2008: 31). The required learning model is the one allowing the culture of scientific thinking skills, development of 'sense of inquiry' and creative thinking abilities of learners.

III. Methodology

This study Methods uses experimental research and development methods by Borg & Gall. The study was conducted over three months at SMK – State Vocational High School - 6 and SMKN - State Vocational High School - 10 Malang on the vocation of autotronic engineering department while development. Research and Development Design described on Fig. 1.

Figure 1. Research and Development Design



Population and Sample: The population in this study were all students of SMK in Malang in the vocation field of autotronic (Automotive Electronic) Engineering, namely there are 66 students, while the number of samples in research and development was 37 students of SMKN 6 Malang and 29 students of SMK 10 Malang. In the product validating process, the researchers used an expert judgment technique including 9 experts in the field of learning, among others were 7 Lecturers in Mechanical Engineering, 2 teachers of SMKN 6 Malang and SMK 10 Malang, while the product trials were conducted on 25 students of SMK 6 Malang and SMK 10 Malang.

Research Instrument: the research instruments used were tests, documentation, observation, treatment of experimental and interview.

Data Collection Technique: The data was collected by using test, questionnaire, and documentation. The test and questionnaires were distributed to the research respondents. The data from interviews and observation result was used as the supporting data which was to complete the obtained data.
Data Analysis: The data analysis used in this research was the inferential statistics by using SPSS version 20.0.0 to examine the hypothesis.

IV. Results

A. 1st Research Stage

The observation and interview results conducted by the teachers and students of class XI SMK N 6 Malang and SMK N 10 Malang have found some empirical information related to the implementation of the Teaching and Learning Activities (KBM) which can be described in Table 1 below.

Table 1. Observations& Interview

No	Observation	SMK N 6 Malang	SMK N 10 Malang
1	Learning Strategy	Lecturing ***(not well-suit to K13)***	Lecturing ***(not well-suit to K13)***
2	Teaching materials	Module, power point	Module, power point
3	Tools / materials	Laptop, In-focus, blackboard, Engine Stand	Laptop, In-focus, blackboard, Engine Stand
4	Interview with the students	The students were bored at theory learning & direct practice ***(the students require new learning method and teaching materials)***	The students were boring at theory learning & direct practice ***(the students require new learning method and teaching materials)***
5	Interview with teachers	Classical learning is easier to be applied ***(not well-suit to K13)***	Classical learning is easier to be applied ***(not well-suit to K13)***
6	Facilityand infrastructure	Adequate	Adequate

Based on the preliminary research conducted at SMK Malang, it has found some fundamental problems that occurred during the teaching and learning process as described in Table 1 above, among others were the atmosphereof learning, teaching materials, students, and student learning outcomes.

The learning environment in SMK Malang can be seen to be not conducive, the students seemed less excited or bored due to the boring learning because there were too many components which should they record, and how to be memorized, while to understand the workings of a component was not supposed to be a rote but the students must be shown how to work through the props or simulations in the form of hardware or software. Muhtadi (2005: 1) explained that, the learning process should be able to create the conducive classroom climate or atmosphere which to support the formation of quality learning, further, Maisaroh&Roestrieningsih (2010: 1) explained that, a fun learning environment will have an impact on the increasing motivation and discipline in the learning process.The teaching and learning process with the learning tools developed for vocation program of Autotornic Engineering is expected to become more focused, active, meaningful, orderly, maximizing the facilities and infrastructure provided by the school and regular as well as the teaching materials are up to date and then able to improve the student competence and attitude particularly the student competence in the learning theory and instructional practices and change the mindset of learning for the vocational school teachers.

B. The Products Produced on Development Stage

The products from this research and development are the scientific approach-based cooperative learning tools including: interactive multimedia software, group sheet, software of picture viewer, and learning scenarios which have been uploaded on https://cooperative-scientific.appspot.com/. In detail, the research and development products are outlined below.

a. Interactive Multimedia Software: the interactive multimedia software of development product is realized in the form of ".exe" having the capacity of 304.555 Mb*(Secondary Product).*

b. Group Sheet: Group sheet is realized in a form that includes a group identity, the task of each group member, and important points of what they can use as presentation materials*(Primary Product).*

c. Photoviewer Software: the photoviewersoftware is realized in the form of the use of software svBuilder with image formats of JPG, JPEG, GIF, or PNG*(Third Party Product).*

d. Learning Scenarios: The learning scenario is embodied in the form of task project sheet*(Primary Product).*

Where:
Primary product is fixed product that produced.
Secondary product is changeable product which following the content technology of teaching of autrotonic.
Third Party Product is the utilization of other software supporting primary product.

C. Product Trial Data Analysis in Development Phase & 2nd Research Stage

The products which have been produced then are tested their validity by some experts. As the basis and guidelines for determining the validity level as well as the basis for a decision to revise the results of the development media, it used the qualifying criteria of validation assessment to the minimal valid percentage of 70% (Akbar, 2013), while the analysis results of product trials are described in Table 2.

Table 2. Analysis Results of Product Trial Data

Data Analysis Results	Score	Percentage	Explanation
Material Content Expert Test	31	77,5%	Valid
Learning Designing Expert Test	34	85%	Valid
Learning Media Expert Test	72	90%	Valid
Small Group Expert Test	940	82%	Valid
Product (media) Attractiveness	21	87%	Valid
Product (small group) Attractiveness	435	90%	Valid

Based on the analysis results of product trials by some experts, so it is obtained the results when the product is produced at valid level and it means that it is reliable to be used as a means of learning products.

Learning Assessment Results

Once the product is manufactured and tested for its feasibility, then the researcher needs to test it on the experimental research to see differences in student learning outcomes among students in the experimental group and the control group. The data results of learning assessment are presented in this section consisting of post-test results from the experimental group and the post-test results from the control group. The data analysis of learning assessment was performed by t test of two independent samples.

Descriptive Statistics of Learning Assessment Results

The descriptive statistics are used to describe the learning assessment results data using SPSS. The descriptive statistical procedures used are frequencies. The data results of learning assessment summarized include the post-test score from the experimental group and the post-test scores from the control group. The descriptive statistics results of learning assessment in complete will be presented in Table 3.

Table 3. Descriptive Statistics Results of Learning Assessment

		Experiment Post-test Score	Control Post-test Score
N	Valid	37	29
	Missing	0	0
Mean		82.16	71.59
Median		84.00	72.00
Mode		76	72
Std. Deviation		6.296	5.985
Variance		39.640	35.823

From SPSS output in Table 3 above, it shows that for the variable of post-test scores from the experiment group conducted on 37 students in the experimental group, it is obtained the mean = 82.16; median = 84.00; mode = 76; standard deviation = 6.296; and variance = 39.640. As for the variable of post-test scores from the control group conducted on 29 students the control group, it is obtained: mean = 71.59; median = 72.00; mode = 72; standard deviation = 5.985; and variance = 35.823. Based on this, it can be known if the value of the learning results obtained by the experimental group is higher than the value of the lessoning results by the control group.

The t-test of two post-test Result- Independent samples: T-test of two independent samples (independent-samples t-test) learning assessment results are used to compare the mean difference between the two independent samples with assumption that the distributed data is normal and homogeneous. The data of two independent samples to be compared are the result data of post-test results from the experimental group with the data of post-test results from the control group. Based on the issues to be examined, the form of hypothesis for the t-test used was one-sided hypothesis test or one-tailed test for the upper side (upper tailed) with the hypothesis:

H0 :$\mu Experiment = \mu Control$
H1 :$\mu Experiment \neq \mu Control$

Where:
$\mu Experiment$= mean of post-test results of the experimental group.
$\mu Control$ = mean results of post-test control group.

The t-test result of two independent samples of post-test result data from the experimental group with the post-test results from the control group are more described in Table 4.

Table 4. The t-test result of two independent samples of post-test result data from the experimental &control group

Statistics Results		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Posttest scores	Equal variances assumed	3.072	.084	6.290	61.595	0,00	10.576	1.528	7.523	13.629

From SPSS output in Table 4 above, the t value = 6.290 with a degree of freedom = 61.595 and p-value (two-tailed) = 0,000. Because p-value = 0.000 smaller than $\alpha = 0.05$, H0: $\mu 1 = \mu 2$ is rejected. It can be concluded that there is a significant difference between the post-test results from the experimental group and the post-test results from the control group.

V. Discussion

After the research and development stage, then the next stage will be presented about the quality and effectiveness of product development, because the product quality and effectiveness are the description from the research and development results performed after the small-scale field trials and large-scale field trials.

Product Quality: According to Kotler (2005: 49), 'The product quality is the overall characteristics as well as from a product or service, is the ability to satisfy the needs expressed implicitly', while according to Lupiyoadi (2001: 158) stated that, 'Consumers will be satisfied if their evaluation results showed that the products which they use are qualified. Based on the test results, the content experts, design of learning trial experts, instructional media trial experts, and a small group trial in Table 2 are described that the product development results are classified into valid category, this means that the product development has reasonable levels and has the quality to be used as a learning tool.Kotler and Armstrong (2001: 354) explained that, a qualified product is a product which is able to carry out its functions including, its durability, reliability, ease of operation and improved accuracy, as well as other valuable attributes.

Product Effectiveness: Effectiveness is called as effective if the goals or objectives which have been defined previously are achieved. Streers (1980: 4-5) explained that, Effectiveness is elaborated based on the capacity of an organization to obtain and utilize scarce and precious resources as smart as possible in the pursuit of its business operations and its operational objectives. Robbins (2002: 22) defined the effectiveness as an activity that shows the level of management success in achieving the goals set before, while Campbell (1989: 121) stated that, the way to measure the effectiveness is by knowing the achievement of overall objectives.The effectiveness of product development is seen from the results of large-scale field trials as a comparison between the conclusionsof the learning assessment data analysis (post-test) from the experimental group compared to the data of learning assessment (post-test) from the control group. The conclusion of data analysis results is obtained from the t-test of two independent samples on the learning assessment results by using the cooperative learning – based learning tools (development result product) than the traditional learning.

Based on the t test results of two independent samples, it can be concluded that there is a significant difference between the post-test results from the experimental group and the post-test results from the control group. The conclusions are when seen from the product effectiveness, then the resulting product development is seen from a comparison of learning assessment which can be said to be 'effective'.This is because (1) the students are more quickly to form a group when they are instructed by the teacher; (2) the students from the experimental group are more orderly and regulated when they do the tasks given by the teacher; (3) at the one learning process, it starts by forming a group to complete the learning materials obtained in the right time; (4)

The students are enthusiastic and excited when learning because the learning is not boring (5) The students can measure their own abilities individually through interactive multimedia software when they learn individually; and (6) the teachers are more easily control the student development through the group-sheet.

VI. Conclusion

The research & development products of resulting learning tools are included: interactive multimedia program, group-sheet, photoviewer and learning scenarios. The resulting products are the learning tools to support the scientific approach-based cooperative learning. Based on the analysis results of development data, the resulting products are concluded to have quality and effective to be used as the learning products. The product quality is assessed by the learning experts and small group trial, while the product effectiveness is assessed by the learning outcome assessment in a large-scale field trials where the learning outcomes show the significant values between the control group and the experimental group.

Based on the observations during the product trials and experimental research conducted, the resulting research and development products have advantages, among others are: (1) the students are more quickly to form a group when they are instructed by the teacher; (2) the students from the experimental group are more orderly and regulated when they do the tasks given by the teacher; (3) at the one learning process, it starts by forming a group to complete the learning materials obtained in the right time; (4) The students can measure their own abilities individually through interactive multimedia software when they learn individually; and (6) the teachers are more easily control the student development through the group-sheet.

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