COMPARISON OF THE EFFECTIVENESS OF CONSTRUCTIVISM AND CONVENTIONAL LEARNING KIT OF MATHEMATICS VIEWED FROM ACHIEVEMENT AND SELF CONFIDENCE OF STUDENTS IN VOCATIONAL HIGH SCHOOL
(AN EXPERIMENTAL STUDY IN YEAR XI OF SMK MUHAMMADIYAH 2 YOGYAKARTA)

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Abstract

This research was aimed to describe and compare constructivism and conventional learning kits of mathematics viewed from achievement and self confidence of students in vocational high school. This research was a quasi experimental study using the pretest-posttest nonequivalent comparison-group design. The research population comprised all Year XI students, consisting of 5 classes of SMK Muhammadiyah 2 Yogyakarta. From the population, two classes, Class XI TKJ 1 and Class XI TKJ 2, were selected randomly as the research sample. Students' Class XI TKJ 1 learned through the constructivism learning kit and students' Class XI TKJ 2 learned through the conventional learning kit. The data collecting instruments consisted of learning achievement test and student's self-confidence questionnaires. To test the effectiveness of the constructivism and conventional learning kits, the one sample t-test was carried out. Then, to test the more effectiveness of the constructivism learning kit than the conventional learning kit, the MANOVA was carried out and then continued by the t-Benferroni test. The results of the study show that the constructivism and conventional learning kits are effective and the constructivism learning kit is more effective than the conventional learning kit in probability viewed from viewed from achievement and self confidence of students in vocational high school.

Keywords: *Learning Kit, Achievement, Self Confidence*

Introduction

Regulation of the Educational and Cultural Ministry (Permendikbud) No. 54 of 2013 states that to achieve national education goals required qualifications profile outlined in the ability of graduates Graduate Competency Standards (SKL). SKL is a qualifying criterion regarding the ability of graduates that includes attitudes, knowledge, and skills. SKL will be elaborated on their core competencies and core competencies which will be elaborated on the basis of competence achievement indicators. This also indicates that the achievement of the basic indicators of achievement of competence is very important to be able to determine the graduation of students in certain subjects, including mathematics courses for a particular material.

The achievement of the indicators related to the achievement of basic competencies of mathematics learning achievement of students. Regarding the importance of the study of mathematics, Lovat, et al. (2011, p.6) states that "since the early 1990s, there has been a concentration of effort Aimed at maximizing student achievement in school education." That since the 1990s, the concentration of teaching in schools is to maximize the learning outcomes of students.

National Education Standards Agency's (BSNP) data on the reported results of a national exam (UN) mathematics vocational technical group in the city of Yogyakarta to material probability in the school year 2010/2011 showed that the absorption rate reached 55.94 and the absorption capacity of the school year 2011/2012 reached 58.38. For two consecutive years, the material absorption is low opportunities. One of the causes of low achievement of competency shown above is mastery of concepts by students is still low. Many students are confused where problems can be solved by permutation and which should be solved by the concept of combination.

In fact, apart from the cognitive problems as just described above, also need to be considered in terms of psychological problems or affective. Kloosterman revealed that self-confidence is very important for students to be successful in learning mathematics (Yates, 2002, p.5). This is supported by several previous studies revealed the existence of a relationship between self-confidence by learning achievement. Hannula, et al. (2004, Q17) revealed that the mathematics learning achievement is influenced by confidence in mathematics, especially by self-confidence in mathematics. Permendikbud No. 54 of 2013 is mentioned that one of the graduation competencies of the students which the students have confidence in life.

With regard to confidence, Nunes, et al. (2009, p.24) found *"one can form a measure of children's self-confidence by considering their answers about how much they like maths and also how good they think they are in the subject"*.

The confidence of students towards mathematics is confidence in the ability of students to learn and deal with the problems of mathematics. The aspects confidence of learners towards mathematics, which are: (1) confidence in mathematical ability; (2) a realistic and rational thinking; (3) positive thinking; and (4) firmness. (Margono, 2005, pp.48-49; Lie, 2003, p.4; Ghufron Risnawati, 2012, pp.35-36; Preston, 2007, p.14).

Based on observations made in research on mathematics learning in class XI TKJ SMK Yogyakarta city is seen that at the time of learning, the sel confidence of the students is still low. They are still afraid to express their opinions in class. This indicates that low self

confidence of the students because it is part of the confidence indicator. Therefore, when encountered a problem, the students with a sense of low self confidence are often reluctant to try to find a solution and chose to wait it out answer will be given the teacher or see the answers belong to another friend.

Constructivism learning is a learning model that tailored to the circumstances of students, the character of each indicator, and the competencies to be achieved in each indicator. Constructivist approach provides opportunities for students to construct their knowledge and understand through the experiences and thoughts on his experience (Matthews, 2003, p.60).

With regard to constructivism, Piaget (1971, pp.77-78) found:

For the genetic epistemologist, knowledge result from continuous since each act of understanding, some degree of invention is involved, in development, the passage from the one stage to the next is always characterized by the formation of new structure which did not exist before, either in the external worl or in the subject's mind. The central problem of genetic epistemology concerns the mechanism of this construction of novelties which creates the need for the explanatory factors which we call reflexive abstraction and self regulation.

With regard to learning constructivism, Vygotsky suggests three principles: (1) socially meaningful activity (Vygotsky, 1986, p.xxiii-xxiv); (2) ZPD (zone of proximal development) (Vygotsky, 1986, p.xxxv); and (3) mediated learning (Vygotsky, 1986, p.xxxv).

Vygotsky emphasized the importance of utilizing the learning environment. The neighborhood around the student includes the people, the culture, including experience in that environment. Other people are part of the environment, the acquisition of the student's knowledge stems from the social sphere, between individuals, and then the scope of the individual as an internalization event.

In its development, constructivism is widely used in learning. With regard to the principle of construction of knowledge during the learning process that refers to the theories of constructivism. According Karagiogi & Symeou (2005, p.24) that:

Today, learning is approached as a constructive, self-regulated, situated, cooperative, and individually different process. In a world of instant information, constructivism can become a guiding theoretical foundation and provide a theory of cognitive growth and learning that can be applied to several learning goals.

Some constructivist learning principles are stated by Clements and Battista (2009, pp.6-7), namely (1) Knowledge is actively created or invented by the child, not passively received from the environment; (2) Children create new mathematical knowledge by reflecting on

their physical and mental actions; (3) No one true reality exists, only individual Interpretations of the world; (4) Learning is a social process in the which children grow into the intellectual life of those around them.

Constructivism learning model through the following stages: (1) motivation; students are encouraged and motivated to put forward the concept of knowledge initially subject or sub-subject to be discussed; (2) discussion and inquiry; students are given the opportunity to investigate and discover the concepts and issues in groups; (3) presentation; students provide an explanation and a solution based on observations with explanations of teachers; and (4) application; students apply the concept of understanding the topic at that time with the help of a teacher. (Brown & Abell, 2007, p.58; Gagnon & Collay 2006, pp.4-6)

Based on the descriptions above, the goal of this research is to describe the effectiveness of learning (constructivism and conventional) and the effectiveness of constructivist learning device compared with the conventional learning opportunities on the material terms of aspects of the learning outcomes and the confidence of students in vocational schools. The research will be able to contribute to the learning of mathematics, especially those related to the constructivism learning, conventional learning devices, and how the effectiveness of the devices in vocational learning.

Method

The research is a quasi experimental pretest-posttest design with nonequivalent comparison-group design. This research was conducted at SMK Muhammadiyah 2 Yogyakarta from May to June 2014. The population was all students of Grade XI SMK Muhammadiyah 2 Yogyakarta academic year of 2013/2014 consisting of 5 classes. By choosing randomly, the students of XI TKJ 1 and XI TKJ 2 are selected as the sample of the research.

The independent variable in this study is the learning kits (constructivism and conventional) and the dependent variable are the learning achievement and self confidence of students. The instrument used to measure learning achievement is achievement test consisting of 13 essay questions. The instrument used to measure the confidence of students is student's self confidence questionnaire.

In this study, data analysis was done by describing the data and inferential statistical analyzes of the data obtained. Description of the data is done by finding the average, standard deviation, variance, minimum score, and the maximum score from the data obtained, both for the data prior to treatment, as well as to the data after treatment.

To test whether the learning kits (constructivism and conventional) is effective in terms of the learning achievement and the self confidence of students in vocational school used one sample t-test with the following formula:

$$t = \frac{\bar{x} - \mu_0}{\frac{S}{\sqrt{n}}} \qquad (1)$$

(Tatsuoka, 1971, p. 77) where:

$\bar{x}$ = the average value obtained

μ_0 = hypothesized value

S = deviation standard of the sample

n = the numbers of sample.

Rejection criteria of H_0 : if $t_{hit} > t_{(\alpha;n-1)}$.

For data prior to treatment MANOVA test to see if there are differences in ability between the two classes of samples early in the learning opportunities in terms of learning achievement and self confidence of students in vocational schools by using the following formula:

$$T^2 = \frac{n_1.n_2}{n_1 + n_2}(\bar{y}_1 - \bar{y}_2)'S^{-1}(\bar{y}_1 - \bar{y}_2) \qquad (2)$$

Where:

T^2 = *Hotelling's Trace*

n_1 = the numbers of the first sample

n_2 = the numbers of the second sample

$\bar{y}_1 - \bar{y}_2$ = mean vector

S^{-1} = the inverse of covariance matrix.

After obtaining T^2 Hotteling's value, then the value is transformed to obtain the value of the F distribution with the following formula:

$$F = \frac{n_1 + n_2 - p - 1}{(n_1 + n_2 - 2)p} T^2 \qquad (3)$$

(Stevens, 2009, p. 151), where p is the number of dependent variables.

Rejection criteria of H_{01} : if $F_{hit} \geq F_{(\alpha; p; n1 + n2 - p - 1)}$.

Having in mind that there is no difference between the two classes beginning ability samples, the test and questionnaire data after treatment were tested to see whether there are differences in the effectiveness of learning kits (constructivism and conventional) in terms of learning achievement and self confidence in vocational school students using MANOVA formula (2) and (3). Once it is known that there are differences in effectiveness, the data was

tested by t-Benferroni to know what constructivism learning kit is more effective than the conventional learning kit terms of these two aspects by using the following formula:

$$t = \frac{\bar{y}_1 - \bar{y}_2}{\sqrt{\frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \qquad (4)$$

(Stevens, 2009, p. 147).

Rejection criteria of H_{02} and H_{03} : if $t_{hit} \geq t_{(\frac{\alpha}{p}; n1+n2-2)}$.

However, before doing the analysis, first tested the assumption that the multivariate normality test and the test of homogeneity of variance-covariance matrix, for both groups before and after treatment. Multivariate normality test was performed using the Mahalanobis distance test (d_i^2) with the decision criteria that if the data is said to be normally distributed about 50% of the data have value $d_i^2 < \chi^2_{(p; 0.5)}$ (Johnson & Wichern, 2007, p. 184). Test homogeneity of variance-covariance matrix is done by using Box's M test with the decision criteria that the data is said to be homogeneous if the significance value of F is greater than 0.05 (Rencher, 1998, pp. 139-140).

Finding and Discussion

Implementation of constructivism and conventional learning kit are going according to the learning activities that have been defined. Although all of these learning activities have been implemented but found some limitations that constrain the implementation of this study, especially at the initial meetings, such as the allocation of time between learning activities less attention and students tend to be afraid to give feedback during class presentations conducted. However, at the next meeting the issue does not look up again.

Data description of learning achievement and the self confidence of student, for both classes of constructivism (KKT), as well as for the conventional class (KKV) can be seen in Table 1.

Table 1. Data Description of Learning Achievement and Self Confidence of Students

Description	Learning Achievement				Self Confidence			
	KKT		KKV		KKT		KKV	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Average	21.86	81.71	24.71	77.71	79.78	90.93	79.96	87.07
Maximum of Theoretical Score	100	100	100	100	120	120	120	120
Minimum of Theoretical Score	0	0	0	0	24	24	24	24
Maximum Score	42	86	36	82	103	105	103	105
Minimum Score	8	78	8	74	63	83	62	81
Deviation Standard	9.17	2.48	7.32	1.70	8.66	5.30	7.23	5.59
Variance	84.13	6.14	53.69	2.88	74.99	28.07	52.26	31.25

Based on Table 1 above, information was obtained that the average value of student learning achievement, both for class constructivism, as well as conventional class before treatment has not reached an average value of 75 and after the treatment has reached an average value above 75. For aspects self confidence of students showed that the average total score of the questionnaire, both for constructivism class, as well as the conventional class before treatment has not achieved an average score of 80 and after the treatment has reached an average score above 80.

Test assumptions for the two groups either class test for normality and homogeneity tests are reached. Because the test assumptions are reached then proceed to test the hypothesis. The test results on the effectiveness of the devices in terms of learning achievement and self confidence of students of vocational school are presented in Table 2.

Table 2. Results of One Sample t-test

Aspect	KKT		KKV	
	T	Sig.	t	Sig.
Learning Achievement	14.362	0.000	8.497	0.000
Self Confidence	10.915	0.000	6.693	0.000

According to Table 2, the results showed that the significance of t for all aspects is less than 0.05. Constructivism and conventional learning kit are effective in terms of learning achievement and self confidence of vocational students.

The test results on whether there is a difference between the two classes before treatment and after treatment are given in terms of learning achievemenr and self confidence of students in vocational school is presented in Table 3.

Table 3. Results of MANOVA Before and After Treatment

	F	Sig.
Class (Before Treatment)	1.473	0.247
Class (After Treatment)	30.946	0.000

Based on Table 3 note that the significance value before treatment is less than 0.05, There is no difference between the average of the two classes of experiments. Because there is no difference, then two classes are given a different treatment. After treatment, the data show that the significance is more than 0.05, means that there are differences in the effectiveness of learning kit in terms of learning achievement and self confidence of students in vocational school.

After that there are differences in effectiveness between the two learning kits, there will be a t-Benferroni test to see that constructivism learning kit is more effective than conventional learning kit terms of learning achievement and self confidence of students in vocational school. T-Benferroni test results can be seen in Table 4.

Table 4. Results of t-test Benferroni

Aspect	t-Benferroni	t_{tab}
Learning Acievement	7.049	2.0049
Self Confidence	2.650	2.0049

Based on Table 4, the information obtained t-Benferroni is more than t-tab. Or in other words, constructivism learning kit is more effective than the conventional learning kit in terms of learning achievement and self confidence of students in vocational school.

These results are consistent with the theory that the constructivism learning allows students to be more active and construct the concepts independently. The student's activeness will be able to increase the self confidence of the students. While the concept is constructed independently, it will improve the learning achievement of students in vocational schools.

Conclusion and Suggestion
Conclusion

The learning kits (constructivism and conventional) are effective and the constructivism learning kit is more effective than the conventional learning kit on the probability material in terms of learning achievement and self confidence of students in vocational school.

Suggestion

Although the results of this study are consistent with the study of theory, but as noted there are some limitations which become obstacles in the implementation of this study. Based on this, then there are a few things suggested, among other things: the allocation of time for each learning activity is taken to ensure that the allocation of time between learning activities are not mutually reduce each other and the teacher should be to convince the students not to be afraid to give a response at the classroom presentations.

References

Brown, P. L., & Abell, S. K. (2007). Examining the learning cycle . *Science and Children*. Artikel. Diambil pada tanggal 21 Februari 2014 dari http://web.missouri.edu/~hanuscind/4280/ExaminingLearningCycle.pdf

Clements, D. H., & Battista, M. T. (2009). Constructivist learning and teaching. *Article*. [Versi Elektronik]. Diambil pada tanggal 15 Januari 2014 dari www.nctm.org

Dehyadegary, E., et. al. (2012). Academic engagement as a mediator in relationship between emotional intelligence and academic achievement among adolescents in Kerman-Iran. *Journal of American Science*. 2012, 8(9): 823.

Depdiknas. (2006). Peraturan Menteri Pendidikan Nasional No. 22 tahun 2006 tentang Standar Isi.

Gagnon, G. W. & Collay, M. (2006). *Constructivst key questions for learning teaching to standards design*. London: Corwin Press.

Ghufron, N. & Rini R.S. (2012). *Teori-teori psikologi*. Yogyakarta: Ar-Ruzz Media.

Hannula,M. S., Maijala, H., & Pehkonen, E. (2004). *Develop*ment Of understanding and self-confidence in mathematics; Grades 5−8. *Proceedings of the 28th Conference of the International Group for the Psychology of Mathematics Education*, Vol 3, 17-24.

Kemdikbud. (2013). Peraturan Menteri Pendidikan dan Kebudayaan No. 54 tahun 2013 tentang Standar Kompetensi Lulusan Pendidikan Dasar dan Menengah.

Lie, A. (2003). *101 Cara menumbuhkan percaya diri anak.* Jakarta: PT Elex Media Komputindo.

Lindenfield , G. (1997). *Mendidik anak agar percaya diri*. (Terjemahan Ediati Kamil). London: Harper Collins Publisher. (Buku asli diterbitkan tahun 1994)

Lovat, T., et. al. (2011). *Values pedagogy and student achievement*. London: Springer.

Margono, G. (2005). Pengembangan instrumen pengukur rasa percaya diri mahasiswa terhadap matematika. [Versi Elektronik]. *Jurnal Ilmu Pendidikan, 12.1, 45-61*.

Matthews, M. R. (1998). *Constructivism in science education : a phi1osophical examination*. New South Wales: Kluwer Academic Publishers.

Nunes, et. al. (2009). *Develop*ment of maths capabilities and confidence in primary school. *Research Report DCSF-RR118*. Oxford United Kingdom: University of Oxford.

Piaget, J. (1971). *Genetic epistemology*. New York: Norton Library.

Preston, L. D. (2007). 365 *Steps to self-confidence*. Oxford United Kingdom: How To Books, Ltd.

Slavin, R. E. (2006). *Educational psychology theory and practice (8th ed.)*. United States of America: Pearson Education Inc.

Vygotsky, L. S. (1986). *Though and language*. Baskerville United States of America: Library of Congress Cataloging in Publication Data

Yates, S.M. (2002). The Influence of Optimism and Pessimism on Student Achievement in Mathematics. *Mathematics Education Research Journal, Vol. 14, No. 1, 4-15*. Diakses pada tanggal 25 Februari 2014 dari: http:// www. merga.net.au/documents/MERJ_14_1_Yates.pdf