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International Journal of Current Research
Vol. 9, Issue, 10, pp.59148-59152, October, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

IMPROVING STUDENT ACHIEVEMENT IN MATHEMATICS USING CONTEXTUAL TEACHING AND LEARNING (CTL) MODULES

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ARTICLE INFO

Article History:
Received 27th July, 2017
Received in revised form
10th August, 2017
Accepted 30th September, 2017
Published online 31st October, 2017

Key words:
Guidance and Assessment,
Learning Process,
Teaching Module,
CTL.

ABSTRACT

The main purpose of this study is to investigate the relationship between the usage of contextual teaching and learning with students' achievement in mathematical education. The study was conducted in Madrasah Ibtidayah Negeri (a private Islamic primary schools) in South Jakarta. A quantitative inquiry method was used in this study by applying a quasi-experimental form of analysis. The data on mathematics learning process and students' achievements were gathered using questionnaires. Then, the data was analysed using inferential analysis through correlation and regression analysis. This present study found that there were differences in the students' achievements between students who learn using contextual teaching and learning (CTL) and those who learn using the conventional approach. The achievement of students using CTL modules is higher than students who had been exposed to conventional method.

Citation: Maifalinda Fatra and Prof. Madya Zulkifley bin Mohamed, 2017. "Improving Student Achievement in Mathematics using Contextual Teaching and Learning (CTL) Modules", *International Journal of Current Research*, 9, (10), 59148-59152.

INTRODUCTION

In our era of globalisation, human beings need to develop their thinking skills, which involve critical, systematic, logical, and creative thinking. These types of thinking can be developed through mathematical education. The importance of mathematical learning is inseparable from its role in various aspects of life. In addition, mathematics also plays an important role for other sciences, as suggested by Pickover "Mathematics has permeated every field of scientific endeavor and plays an invaluable role in biology, physics, chemistry, economics, sociology, and engineering." (Pickover, 2009). The triumph of teaching and learning processes in mathematics learning can be measured from the achievement of students who follow the learning activities. The achievements can be seen from the stages of understanding and mastering of mathematics content. The higher the comprehension and mastery of the material and learning achievement, the higher the success rate of learning. According to Johnson (2010), when students are able to relate the learning process with their own experience, they try to meaning making of learning process, which in turn encourages them to learn more.

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The mathematical teaching at the Madrasah Ibtidaiyah (Islamic Primary School) should start from concrete objects. Since the objects of study in mathematics are abstract and must be studied from childhood, mathematical learning activities should be planned according to the students' ability (Suherman, et al., 2003). Teaching and leaning mathematics in the Madrasah Ibtidayah should involve student-centred activities. Student-centred activities may occur when teachers are able to prepare material which encourages students to participate during the learning. Problems in mathematics learning at the Madrasah Ibtidaiyah could then be expect to be overcome by the establishment of appropriate learning modules. Research conducted by Hasratuddin (2010) demonstrated that mathematics learning with a realistic mathematical approach may be implemented to improve students' critical thinking ability. Moreover, teaching and learning mathematics needs to be improved in order to support students in developing their critical thinking, as well as their attainment. Low levels of student attainment is affected by many factors. One of the main factors is that students lack understanding of the math concepts being taught. Students tends to memorise algorithmic principles that they often use in answering math questions. This causes lack of indepth understanding of mathematical principles, which further impedes student from being proficient in problem solving.

In addition, Zulkardi (2001) suggested other factors which are behind low levels of student achievent: 1) a dense curriculum; 2) teaching materials that are overly difficult for the level they are being taught to; 3) unimpressive and outdated teaching and learning models; 4) non-interactive teaching media and; 5) a poor assessment system. In order to combat these inadequacies and iunefficiencies, a model is required that can improve the overall quality of the mathematical learning process, such as that provided by contextual teaching and learning (CTL). In fact, the CTL method has become critical to improving students' ability to solve mathematics problems. Sadia (2008) determined that the model of learning considered to contribute most significantly to developing students' critical thinking skills is CTL. In accordance with Sadia's study, Chaqiqi & Syaichudin (2014) demonstrated that teaching and learning math using the CTL approach can raise learning outcomes higher to higher levels than conventional methods (CM). So as to improve stusents' achievement, teachers should be able to design and create CTL modules. The modules are expected to promote students' understanding of mathematical principles. This study aims to investigate students' achievement through the development and guidance of CTL modules, in which the modules will support the teacher in promoting math learning that also stimulates and develops studentss critical and creative thinking.

RESEARCH METHOD

In attempting to investigate the presence or absence of causal relations, this study applies a quasi-experimental approach (Cresswel, 2009; Arikunto, 2010). Experimental research is conducted by manipulating the object of research and the control (Nazir, 2005). Two sets groups were established: a CTL group and a CM group. Students in the CM group had been exposed to conventional lectures and completed training questions. On the other hand, CTL group students had been exposed to CTL learning in which teacher asked to do a group work to understand the problem given and designing the solution to the problem. To ensure feasibility and accessibility of the data collection process, this study was conducted at four Madrasah Ibtidayah (MI) in South Jakarta, namely Kebayoran Lama, Pesanggrahan, Jagakarsa, Pancoran. The choice of location was based on the fact that the four areas are located in the city of Jakarta, which have more complete facilities when compared to other regions. The population of this study is limited to year four students at the MI. The sample was 120 students from four classes in four schools in Kebayoran Lama, Pesanggrahan, Jagakarsa, Pancoran.

The data collection tool for the research was a series of questionnaires which were adopted from the questioning instrument Inventory of Learning in School by Selmes (1987). Five indicators of learning style were evaluated, using a total of 25 questions: 1) depth type, 5 questions; 2) surface approach, 5 questions; 3) persistent attempts, 5 questions; 4) impulse, 5 questions, and; 5) design, 5 questions. Student performance questionnaires were used to obtain information on the understanding of mathematical subjects related to the basic competencies that students should master at that level. The questionnaire for student learning achievement through social skills used four indicators: 1) ask actively, 5 questions; 2) giving opinions, 5 questions; 3) becoming a good listener, 5 questions, and; 4) working in a group, 5 questions (Arends, 2008). The effectiveness of CTL modules was empirically valued using the T test, regression and correlation.

In this analysis, the variables that are the focus of the study are student achievement and the teaching and learning process for experimental groups and control groups. To ascertain the strong or weak relationships between mathematical learning and creative thinking with student learning achievement among the CTL groups, correlation analysis was used, while to find out whether there was an influence of mathematics learning on student learning performance in both groups, multiple linier regression analysis was used.

RESULTS

Differences in Student Learning Performance

The difference in student learning performance during mathematical lessons among students was obtained from student learning performance questionnaires which were answered by 60 experimental group students and 60 participants of conventional groups.

The Difference Between Students Learning Outcomes

The difference between student learning achievement among student groups, ie experimental groups and conventional groups, can be seen in Table 1. Table 1 shows that there is a difference in learning performance between the experimental group and the control group based on $p < 0.05$ level. The t value for student learning achievement is -6,296, with a Sig = 0.000. For the experimental group (CTL group) the minimal value is 73.00, with a standard deviation of 5.699, whilst for the conventional group the minimal value is 65.43, with a standard deviation of 7.361.

Differences in Mathematical Learning Among Groups

The difference in mathematical learning between the two groups of students, ie experimental groups and conventional groups, can be seen in Table 2. From Table 2, it can be concluded that the overall mathematical learning shows that there is a difference between the conventional group in mathematical learning with the experimental group based on $p < 0.05$ level. The t value for math learning is -6.594, with Sig = 0.000. For the experimental group (CTL group), the minimal value is 90.65, with a standard deviation of 8.489, whilst the minimal value for the control group is 80.27, with a standard deviation of 8.758.

The Relationship between Mathematical Learning and Learning Performance among Students

Untuk Mengetahui hubungan antara pembelajaran matematik terhadap prestasi belajar pelajar yang dilihat dari kumpulan pelajar. Dapatan kajian hubungan antara pembelajaran matematik terhadap prestasi belajar pelajar dapat dijelaskan sebagai berikut. The relationship between mathematical learning and students' achievement among groups is explained in the following sections (3.2.1 and 3.2.2).

The Relationship between Learning Mathematics and Students' Achievements for the Control Group

The relationship between learning mathematics and student achievement for the control group was analyzed using correlation analysis and simple regression analysis. The results are presented in Table 3.

Table 1. T-Test on Group Based Student Learning Achievement

Dimention/Indicator	Group	N	Mean	Std. Deviation	T Value	Significance
Actively inquired	Conventional	60	17.28	2.624	-2.633	.010
	Experimental	60	18.45	2.213		
Giving an opinion	Conventional	60	15.83	2.918	-5.630	.000
	Experimental	60	18.65	2.550		
Being a good listener	Conventional	60	17.03	3.931	-2.989	.003
	Experimental	60	18.85	2.590		
Can work in groups	Conventional	60	15.28	4.051	-2.729	.007
	Experimental	60	17.05	2.954		
Student Learning Achievement	Conventional	60	65.43	7.361	-6.296	.000
	Experimental	60	73.00	5.699		

* Significant at the level $p < 0.05$

Table 2. Group-Based Mathematical Learning T Test

Dimention/Indicator	Group	N	Mean	Std. Deviation	T Value	Significance
Stylish	Conventional	60	16.55	2.389	-3.400	.001
	Experimental	60	18.07	2.497		
Surface approach	Conventional	60	16.75	2.984	-2.331	.021
	Experimental	60	17.95	2.645		
Persistent effort	Conventional	60	15.68	3.735	-4.309	.000
	Experimental	60	18.32	2.908		
Encouragement	Conventional	60	15.50	3.802	-4.802	.000
	Experimental	60	18.45	2.861		
Implied	Conventional	60	15.78	3.076	-4.244	.000
	Experimental	60	17.87	2.236		
Mathematical Learning	Conventional	60	80.27	8.758	-6.594	.000
	Experimental	60	90.65	8.489		

* Significant at the level $p < 0.05$

Table 3. Relationship between Mathematical Learning and Student Learning Achievement Based on Conventional Setting

Student Learning Achievement / Mathematical Learning	Actively inquired	Giving an opinion	Being a good listener	Can work in groups	Student Learning Achievement
Stylish	.153	-.184	.296*	.183	.241
Surface approach	.053	.622**	-.096	-.067	.177
Persistent effort	.134	-.070	.444**	.344**	.447**
Encouragement	-.009	-.053	.183	.430**	.309*
Implied	-.122	-.261*	.045	.416**	.106
Mathematical Learning	.056	-.031	.379**	.580**	.529**

* Significant at the level $p < 0.05$

Table 4. Relationship between Mathematical Learning and Students' Achievement for the Experimental Group

Student Learning Achievement / Mathematical Learning	Actively inquired	Giving an opinion	Being a good listener	Can work in groups	Student Learning Achievement
Stylish	-.125	.267*	.175	.096	.200
Surface approach	-.051	.382**	.259*	.313*	.431**
Persistent effort	-.149	.287*	.261*	.270*	.329*
Encouragement	-.014	.266*	.378**	.148	.362**
Implied	.204	-.047	.178	.301*	.295*
Mathematical Learning	-.055	.373**	.395**	.347**	.506**

** Significant at the level $p < 0.05$

The results presented in Table 4 demonstrate that there was a significant and strong interaction between mathematical learning and students' achievement (r = 0.529; p <0.05). Moreover, there is a strong relationship between mathematical learning and work in the group dimension (r = 0.580; p <0.05), and between the surface approach and giving an opinion (r = 0.622; p <0.05). Furthermore, from the calculation of simple regression analysis on the data of the mathematical learning variable to student achievement, the regression direction b = 0.424 and the fixed value of 27.634 were obtained. Thus, the two forms of the relationship (X1 with Y) can be described by the regression equation $\hat{Y} = 27.634+0.424X_1$.

Prior to using it for forecast purposes, the regression equation must satisfy the requirements of the test of significance and the linearity test. Based on variance analysis of regression significance test between X1 and Y, it shows that $F_{count} > F_{table}$ (22.584 > 7.08) at $\alpha = 0.01$. It can be concluded that the regression X1 on Y is very significant. F_{Price} matches the calculation result $F_{count} < F_{table}$ (0.825 < 2.50), so the regression form Y over X1 is linear. It is then concluded that $\hat{Y} = 27.634+0.424X_1$ is very significant and liniear. This regression implies that when mathematics learning increases for one unit, it will correlate with the improvement of students' learning achievement of 0.424 units at a fixed value of 27.634.

The relationship between learning mathematics and students' achievements for experimental group

The relationship of mathematic learning to student's learning achievement for the experimental group was analyzed using correlation analysis and simple regression analysis. The results of the analysis can be seen in Table 4. Table 5 shows that there is a significant and strong interaction at $p < 0.05$ between mathematics learning and student learning performance ($r = 0.506$; $p < 0.05$). Moreover, there is also a significant and strong relationship between surface approach to giving an opinion ($r = 0.382$; $p < 0.05$), between surface approach and working in groups ($r = 0.313$; $p < 0.05$), and between surface approach and students's achievement ($r = 0.431$; $p < 0.05$). Furthermore, from the calculation of simple regression analysis on the data of the mathematical learning variable to student achievement, a regression direction b = 0.339 and fixed value of a =42.234 were obtained. Thus, the two forms of the relationship (X1 with Y) can be described by the regression equation $\hat{Y} = 42.234+0.339X_1$. Prior to use for forecast purposes, the regression equation must satisfy the requirements of the test of significance and linearity test. Based on variance analysis of regression significance test between X1 and Y, it shows $F_{count>}$ F_{table} (19.916 > 7.08) at $\alpha = 0.01$. It can be concluded that the regression X1 on Y is very significant. The value of Fralat, according to the calculation ($F_{count} < F_{table}$, 0.564 < 2.36), represents that the regression form Y over X1 is linear. It can be concluded that $\hat{Y} = 42.234+0.339X_1$ is very significant and linear.

DISCUSSION

Based on the above results, this study has found that there were differences in student learning achievement and mathematical learning processes between the experimental and control groups. Overall, students' learning achievement shows that there are differences in the learning performance of conventional group students with experimental groups.

The results of this study did not differ with the students' dimensions of performance, indicating that there were differences between the conventional group (CM) and the experimental group. It may conclude that the performance of conventional students' learning compared to experimental learning achievement shows a significant difference in which the achievement of CTL group higher than CM groups. Furthermore, there is a difference in mathematical learning between the groups, notable from the overall dimension of mathematical learning. The process of learning mathematics in the classroom which applies the CTL approach is superior to the learning using a conventional approach. The results show the achievement of students from the control group (CM) is lower than for the experimental group. This constitutes evidence that mathematical learning using CTL modules is superior to the conventional approach since the former, when used in the direct teaching and learning process, will influence students' performance both inside and outside classroom (Joyce, Bruce and Weil, 2009). Implementing the CTL approach requires that teachers utilize various learning resources. Learning activities are quite flexible and can be changed according to the conditions and circumstances of classroom environments and even beyond the classroom itself as learning by CTL is comfortable with a wide variety of media and need not necessarily be implemented only in the classroom. This contrasts starkly to conventional learning, which still focuses on classroom activities and a teacher-centered aproach in which the teacher directs the vast bulk of the learning proces (Masriyah, 2002). Conventional learning can make the atmosphere and conditions of the classroom less comfortable and less enjoyable, which may have a negative impact on students' motivation to learn. The application of CTL models in learning activities will encourage students to actively participate during mathematics lessons. Moreover, CTL's learning activities encourage students to connect the material studied with their 'outside' daily lives. This approach also motivates students to actively involve themselves in the learning process so that they can develop their understanding of the topics being studied. The results show that there was a positive and significant correlation between mathematical learning and the learning achievement for both control and conventional groups. The relationship pattern between the two variables was based on significant regression analysis and a linear pattern, indicating that when there is an increase in mathematical learning, it will be followed by an improvement in students' learning achievements. Therefore, the higher the mathematical learning, the higher the students' overall learning. On the other hand, when there is a decline in mathematical learning, the lower the students' achievements more widely. Moreover, this study also shows students' achievements in the CTL group were higher than for the conventional group. This finding concurs with that of Khotimah and Zuhdi (2013), who noted that the application of a CTL model can improve student learning outcomes. It seems that the use of CTL in learning matemathics offers a better contribution since this approach helps students to improve their understanding as well as their achievement.

Conclusion

The ability to develop mathematical learning modules based on CTL is a great effort in improving students' achievements. The development of the learning module is evidence how serious the teacher is to improve the quality of the school learning process. To ascertain the relationship between the development of CTL modules and students' achievements, mathematic learning between the experimental and control group is analysed. The development of mathematical learning modules with CTL approaches is suitable and can offers a valuable contribution to mathematics lessons as the study shows that the improvement of learning outcomes for the CTL group was higher than for the control group (PK). This is very helpful for teachers to improve the quality of mathematics learning and to facilitate students to be independent learners with good problem solving skills. Mathematical learning with the CTL approach provides the broadest opportunities for students to engage directly in the learning process and build their own knowledge. Moreover, the CTL approach supports students to develop their creative thinking as well their problem solving skills. The improvement and enhancement of the learning process using CTL requires the construction of a quality CTL learning module as such an endeavor will directly affect classroom learning activities.

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