Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.7, No.15, 2016

The Efforts to Improve Mathematics Learning Achievement Results of High School Students as Required by Competency-Based Curriculum and Lesson Level-Based Curriculum

Ropinus Sidabutar[1,2]
1.Mathematic Programs, STKIP Riama Medan, Indonesian
2.Mathematic Post-graduate Programs, State University of Medan, Medan, Indonesian

Abstract
The research was aimed to investigate the effect of various, innovated teaching models to improved the student's achievement in various topic in Mathematics. The study was conduct experiment by using innovated teaching with contextual, media and web which are the compared. with conventional teaching method. The result showed the innovation in the teaching by using media and webb were found very effective and improving the ability of the student to understand the concept of mathematics. Student achievement in the teaching of Mathematics with the aid of Contextual was found higher the teaching the same topic by using Conventional method. Where the data analysis has shown that two methods are significantly differences. Students achievement with another innovated teaching method by using of webb for the teaching distillation was found higher than that with conventional method, where the data analysis has shown that the two methods were significantly difference.
Keywords: Innovation, Contextual, media and Web

1. Introduction

The implementation of competency based curriculum and its continuance implementation to the newest curriculum from Department of education which is lesson level based curriculum in high school becomes a challenge for the mathematics teacher, especially in an effort to improve the learning process and students' achievement. One of the efforts that need an attention to grasp the lessons and improve student's achievement is through innovation of teaching models which is line with the material being thought that focuses on learning objectives as required by curriculum. Innovation in education is very urgent especially in producing new teaching model that yield better learning result, escalate teaching efficiency and effectiveness. Innovation in education is tacit with its renewal that originated from creative thinking, findings and modification that contains ideas and method used to address education problem. Good learning should be able to function as a communication tool in the delivery of course materials.

It often happens that a high school teacher is not equip with improved teaching methods in the classroom, most of them focus only on how to finish targets of the subject matter that are in the course syllabus, in which the basic concepts of mathematics is not completely relayed, also it makes the students get bored with the subject, and the required knowledge that should be mastered by the students becomes difficult to learn. Teachers just rely on the curriculum as the guideline to finish, their only concern is about mastery and pro founding of the lessons along with their experience in their field, so in effect, teaching mathematics in high school is not optimum (Tien, *et al*., 2004). In order to optimize learning mathematics in the class, teaching model for mathematics should be effective and selective, that is appropriate with the subject matter in improving the achievement of the student so every mathematics teacher in the class should be alert about the lessons that he teaches in the class (Boyce, *et al*., 1997). With that, innovative teaching model is needed to improve students's achievement in mathematics that may shift from formal learning to independent learning (Talanquer, *et al*., 2003).

Innovative teaching in math is a teaching approach that provides the latest teaching model based on the needs of the current level of education. Innovative teaching in mathematics involves strategy, method and learning function that are being used in teaching mathematics. Innovative teaching in mathematics has advantages in three (3) aspects, namely, (1) teaching by problem solving, (2) teaching by experience, (3) teaching by individual and teamwork. This learning will bring student to real situations that can lead them to build knowledge and skills beyond self-studying. Teaching by experience is to explain the learning experience of the teacher to the students. This learning is imparted by teacher to students through demonstrating his knowledge in doing academic activities. Teaching by individual and teamwork is done to help students understand the concepts of the subject matter that is difficult especially for students with different academic ability. This teaching method gives chance to the students to finish their task given by their teacher. Innovative teaching model in mathematics is indispensable in improving high school student's achievement. Innovative teaching model is very urgent in producing new learning model that gives a better result in studying mathematics, improve teaching efficiency and effectiveness.

It often happens that a mathematics teacher in a classroom lacks of sufficient lessons because he is

concerned with the mastery and deepening of his knowledge of the lesson along with his experience on the field, of which, the result is not communicative to the high school students and because of their limited capabilities, it made them difficult to understand mathematics. In order for the lesson to be easily absorbed by high school students, the teaching model in mathematics should be more effective that is in accordance with the subject being taught to improve student's achievement. As usually encountered, many students consider that mathematics is difficult to learn, so the students anticipated that they are unable to learn (Wilson, *et al*., 2005). This thing happened maybe because of the way the teachers present the subject matter, is, maybe less interesting, boring, difficult and frightening, so the students cannot master the basic concepts of mathematics that they are studying, and finally mathematics subjects becomes unattractive to most high school students. There are several factors that cause lack of mastery of the subject matter these are (1) systematic and sequence of the lessons that cannot motivate students because the teacher immediately teach difficult lesson without explaining the necessary basic knowledge, (2) students often learn by memorizing without understanding the basic and main concepts for math lessons being studied, (3) the math subject matter taught is floating and questionable on the mind of the students, so they cannot find the "key" to understand the subject matter being studied, and (4) math teachers are less able to convey the concept of knowledge to the students in order to master the material being taught because they lack proficiency in teaching model that is suitable for teaching mathematics (Sztajn, 2003).

The innovative model of teaching mathematics has developed in line with the advancement and development of technology. Some of the innovated model of teaching that has successfully used in learning mathematics are: (a) model of contextual teaching, (b) model of teaching through the use of media, and (c) model of teaching based on information technology (web). Each of these learning models will be briefly described below.

Learning contextual teaching model is a conception of studying materials that help teachers relate with real-world situations and motivates students to connect knowledge with everyday life as a member of the family and society (Sears and Susan, 2000; Johnson, 2002). The use of contextual learning has the potential to expand the realm of knowledge, skills, attitudes, values, and creativity in solving problems related to everyday life (Susilo, 2001). The main components of learning that underlies the application of contextual teaching in class is constructivism, ask (questioning), find (inquiry), learning community, modeling, reflection, and the actual assessment (Huffman and Kalnin, 2003). A class is said to be using contextual learning when it applies the seven components in learning (Nurhadi, 2002; Nurhadi and Senduk, 2003). Constructivism is the foundation for thinking (philosophy) in contextual learning. Asking (questioning) is the essence of contextual learning, the beginning of knowledge and a critical aspect of learning. Asking is a common teaching strategy and can be applied in learning, the use and development of questioning techniques will improve the learning quality of student. The inquiry is the core of contextual learning activities that consist of steps to formulate problems, collect data through observation, analyze and present the results in writing, drawings, reports, charts, tables, and other works, as well as communicating or presenting the work to the reader, a classmate or another audience (Nurhadi and Senduk, 2003). Modeling can take the form of demonstrations, give examples of concepts or learning activities. Reflection is a way of thinking about what we have done in the past. Assessment of contextual learning is called authentic assessment that aims to provide the correct information and mutually agree on what students know and can do. Learning through media can be used to build understanding and mastery of learning objects, such as print media. The print media is widely used for explaining and understanding complex subject matter, it is a supporter of the textbook. Other media used in learning is mind-mapping. Mind-mapping is an educational medium that elaborates systematic science concepts, from the beginning of the problem to its support section that have relations with one another, where it may form knowledge and facilitate understanding of a certain topic. Mind-mapping media aims to build students knowledge to study systematically, that is, a technique to enhance students' knowledge in the mastery of the concept of learning and problem solving (Pandley, *et al*., 1994).

Advances in communications and information technology had facilitated human beings to be interconnected to one another with fast, easy and affordable with potentials for innovation on learning models. The discovery of various types of technology that can be used as educational facilities such as computers, CD-ROM and LAN has encouraged the use of innovative teaching models. With the use of new technologies, combined with learning theory, it gave birth to the so-called e-learning pedagogy (Rosenberg, 2001). E-learning is identical to the use of Internet technology in conveying course material. Innovation teaching model through information technology based begins from the use of computers in an offline manner and with the use of online web in learning.

2. Research Methods

In general, the research methodology used is empirical approach that emphasizes on data collection and analysis. Populations are the high school students and high school math teachers living in North Sumatra province. Schools involved in this research are selected proportionally from its representative city and county high schools

in the region of North Sumatra. The sample were high school students that were selected purposively based on the level (*strata*) of the selected school, then grouped by level of basic academic skills of students taken from math achievement test through National Final Examination for Junior high school, so students are grouped into (a) students with high academic ability *(KT)*, if it has a relatively high grades from the national final examinations and, (b) students with low academic ability *(KR)* if it has a relatively low grades from national final examinations. Data collection tools are (1) pre-test evaluation, (2) post test evaluation 1, (3) post test evaluation 2.

3. Results and Analysis

Learning Outcomes Using Teaching Model by Experiment

Experimental teaching model has been carried out on six (6) parallel classes, each model of teaching mathematics used two (2) parallel class, that is, one for experimental group and one for control group. Studies on the effectiveness of learning models on student's achievement in teaching high school mathematics used 6 parallel classes, each of 3 classes for experimental and 3 classes for the control group. To determine the effectiveness of innovative teaching model in improving student's achievement in learning mathematics, studies have been conducted using several types of innovation in teaching model, namely: (1) teaching model using contextual methods, (2) teaching model using media, (3) teaching model using the web (modification). The average results of student's achievement based on pre-test, post-test 1 and post-test 2 for three types of teaching models are summarized in Table 1. From the research, it was out found that innovative learning outcomes can improve learning achievement of high school students in teaching mathematics.

Table 1. Average Achievement Results of High School Students by Experiment for Using Various Types of Innovative Learning Model for Mathematics

Class	Types of Learning	Student Group	Average High School Grade		
			Pretest	Post test 1	Post test 2
A1-1	Learning by Contextual	Experiment	20.72(1,06)	75.48(10.55)	62.19(17.69)
		Control	20.81(0.96)	66.76(9.03)	49.09(12.55)
A1-2	Learning by Media	Experiment	22.18(1.91)	80.53(8.53)	66.96(15.96)
		Control	22.09(1.74)	72.31(8.06)	54.05(12.51)
A2	Learning through Web	Experiment	22.58(3.42)	82.86(11.78)	67.83(17.06)
		Control	22.53(3.19)	67.74(9.91)	51.56(13.99)
Average		**Experiment**	**21.46(1.97)**	**79.62(16.91)**	**65.66(28.60)**
		Control	**22.47(1.60)**	**68.94(14.04)**	**51.57(32.53)**

Description :
A1 = Senior High School Sumbul
A2 = Senior High School Medan

Data analysis results shown in Table 1 shows that the average learning achievement attained by high school students in postest-1 using various teaching models for group experimental (M = 79.62 ± 16.91) was higher than the achievement of high school students under control group (M = 68.94 ± 14:04). The high achievement of high school students from experimental group were due to learning by using model of innovation that lead high school students to study systematically and increase self-motivation for learning by high school students because the provided guide to study is very clear, systematic and easy to understand.

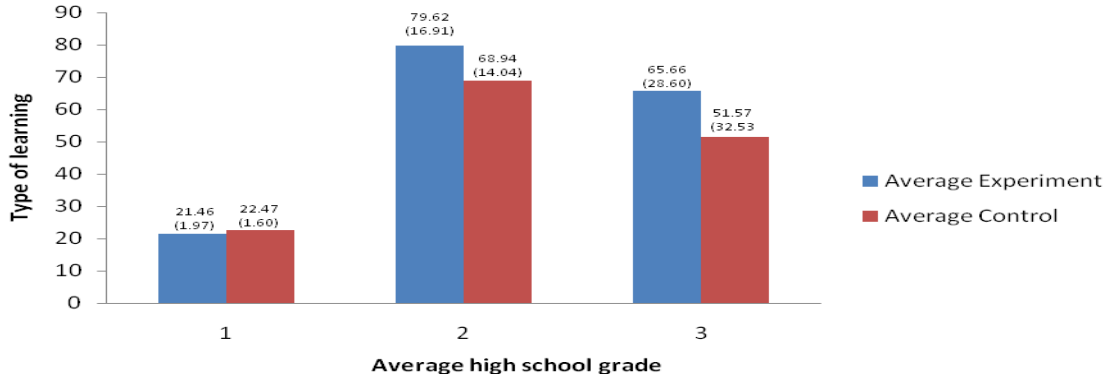

Figure 1. Average high school grade on the type of learning (1=learning by contextual, 2=learning by media, and 3=learning by web

The using teaching methods that is innovated contextually. Conveyance of math lessons on high school

students using effective innovated contextual learning was also studied in research instrument trials, that is, the use of innovative learning. Effectiveness of the learning model on student achievement for high school lesson can be known by posttest-2 against the experimental group and control group, a month after the implementation of the postest-1 by using similar questions. The average high school student achievement results using various innovative learning models are shown on the table above. It shows the average achievement of high school students on experimental groups (M = 65.66 ± 28.60) was higher than the control group (M = 51.57 ± 32.53). Achievement of learning outcomes is relatively low as compared to the results of postest-1. Through this result, the effectiveness of teaching model towards improving the achievement of the students by comparing the percentage of achievement of high school students for both groups. The results indicate that the percentage of achievement of high school students in the postest-2 in the experimental group (82%) is higher than the control group (75%), it means that the model of learning can improve memory of high school students toward mastery of a power point which is equipped with contextual measures stored in the computer, then prepare math material on the hard drive. Password is given to the experimental group in order to open the subject matter from the computer.

Furthermore, to determine the effectiveness of learning using contextual methods towards student achievement in teaching mathematics, it can be seen from the high school student achievement on the pretest, posttest 1 and posttest-2 as in Table 2. From the results of a pretest, it is known that a group of high school students who serve as research samples showed the achievement of learning outcomes compared to conventional learning. These results indicate that the model of learning is very effective and can improve learning achievement. This innovated teaching model can improve the overall impression of high school student longer than the conventional learning.

Effectiveness of Learning by contextual

To determine the effectiveness of learning methods from the test results prepared by researchers. Subject matter were prepared in a way to make nearly the same, namely the average achievement of high school students from the experimental group (M = 23.72 ± 1:07) is not much different from the average achievement of high school students in the control group (M = 23.81 ± 0.97). Variations in the value of high school students in the experimental group and control groups were also quite low, as convinced that the two treated groups were considered as homogeneous. Based on the results of the analysis shown in Table 2, it is known that the results of the experiment on different averages showed that there is no significant difference between experimental group and control group, as shown from the $t_{stat}<t_{crit}$.

Table 2. Learning Achievement of High School Students Based on Learning by Contextual at Senior High School Sumbul and Senior High School Medan.

Class	Group	Student Level	Student Average Grade		
			Pretest	Post test 1	Post test 2
A1-1	Experiment 2	KT	21.13(0.91)	84.07(10.05)	78.33(9.74)
		KR	20.80(0.76)	70.47(9.63)	59.27(11.87)
A1-2	Experiment 1	KT	21.07(1.38)	74.27(2.97)	58.47(3.60)
		KR	20.73(1.43)	65.07(7.15)	51.00(4.96)
Average	**Experiment**		**23.72(1.07)**	**75.48(10.55)**	**62.19(17.69)**
	Control		**23.81(0.97)**	**66.76(9.03)**	**49.09(12.55)**

Description:
KT= Student with National Final Examination Result that are Relatively High
KR= Student with National Final Examination Result that are Relatively Low

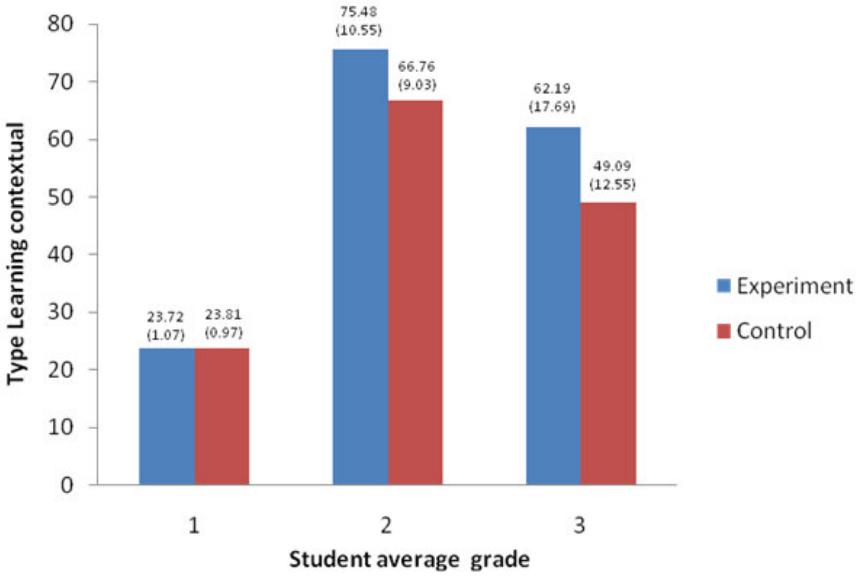

Figure 2. Average high school grade on the type learning contextual

The influence of teaching model by using computer towards high school student achievement is known from the average high school student achievement in postest-1 and-2 as summarized in Table 2. From the results obtained using model of contextual learning, it can be said that it improves student learning outcomes in studying mathematics. Results showed that the average high school student achievement through postest-1 for the experimental group (M = 75.48 ± 10.55) who were taught using contextual is higher than the achievement of high school students in the control group (M = 66.76 ± 9.03) who is being taught through lecture method alone. These results assured that innovation contextual teaching method is able to motivate high school students to learn mathematics more intensive, so the students score is higher compared to control group.

To find out if there is a noticeable difference between the achievement of high school students who are learning using contextual methods with the lecture method, a differential test (t-test) is done for each class and group KT and KR. From the analysis, it is noted that for all classes and groups of high school students showed $t_{stat} < t_{crit}$, which means achievement of high school students in the postest-1 differs significantly between high school student achievement in the experimental group who were given contextual teaching methods with a control group for high school students that belongs to high group (t_{stat} 3.9054 > t_{crit} 2.7632) and that belonged to low group (t_{stat} 4.3926> t_{crit}2.7632). To determine the effectiveness of the innovated learning model on student achievement in high school, then post-test 2 is performed after an interval of one month as shown in Table.2. From the results of the evaluation, it showed that the learning achievement of the experimental group who was taught through using computers (M = 62.19 ± 17.69) is higher than the achievement of the high school students in the control group who were given teaching method using lectures (M = 49.09 ± 12.55). This result is consistent with the achievement results of high school students that were obtained at post test-1, but a little lower, it is possibly caused by high school students are less likely to give attention to the subject matter that has been tested. Furthermore, the effectiveness of learning model using computer towards learning achievement of high school students are shown on the average student learning achievement, that is, the percentage of high school students achievement in post-test-2 compared to post-test-1, which is obtained at the experimental group (82%) is higher than the control group (74%), it means that learning model using computer improves the memory of high school students in learning mathematical lessons as compared to learning by lectures.

4. Conclusion and Recommendation

Based on the results of this study, it can be concluded that innovation in learning is needed in the improvement of students' mastery of mathematics lessons in high school. Contextual teaching using media can enhance student achievement in studying of mathematics courses. It is recommended that teachers of mathematics should innovate teaching model because it is very effective in improving student's math achievement in high school.

References

Arasasingham, R.D., Taagepere, M., Potter, F., Martorell, I., and Lonjers, S., (2005). *Assengsing the effect of web-based learning tools on student understanding of stoichiometry using knowladge space teory*. Journal of Chemical Education 82: 1251-1262

Botana, F., (2003). *A Web-based Resource for Automatic Discovery in Plane Geometry*. Journal of Computer for

Mathematical Learning 8(1):109-121

Boyce, L.N., VanTasselBaska, J., Burruss, J.D., Sher, B.T., dan Johnson, D.T., (1997). *A Problem-Based Curriculum: Parallel Learning Opportunities for Students and Teachers*. Journal of the Education of the Gifted 20: 363-379.

Haspekian, M., (2005). *An "Instrumental Approach" to Study the Integration of a Computer Tool Into Mathematics Teaching: the Case of Spreadsheets.* Journal of Computers for Mathematical Learning 10(2): 109 – 141.

Huffman, D., dan Kalnin, C., (2003). *Collaborative inquiry to make data-based decisions in schools, Teaching and Teacher Education* 19(6): 569-580.

Johnson, E.B. (2002), *Contextual Teaching and Learning*. California: Corwin Press, Inc.

Joice, B. dan Weil, M., (1980). *Models of Teaching,* 2nd ed. Prentice-Hall International Inc. Englewood Cliffs, New Jersey.

Karpen, M.E., Handerleiter, J., and Schaertel, A., (2004). *Integrating computational chemistry into the physical chemistry laboratory curriculum: A Wet Lab/Dry Lab Approach.* Journal of Chemical Education 81: 475-477.

Lagrange, J.B., (2005). *Curriculum, Classroom Practices, and Tool Design in the Learning of Functions Through Technology-Aided Experimental Approaches.* Journal of Computers for Mathematical Learning 10(2): 143 - 189

Nur, M., (2001). *Assessment in Teaching and Contextual Learning.* Papers Presented at the junior high Trainers, State University of Surabaya, 12 June to 6 July.

Nurhadi. (2002). *Contextual Approach.* Dirjend Basic and Secondary Education , Directorate of Junior High School. Ministry of National Education, Jakarta.

Nurhadi and Senduk, A.G., (2003). *Contextual Learning and Its Application in the CBC. Poor*: UM Press.

Pandley, B.D., Bretz, R.L., and Novak, J.D., (1994). *Concept maps as a tools to assess learning in chemistr.,* Journal of Chemical Education 71: 9-15.

Pratt, D., (2005), Visual Math: The Function Web Book" by Yerushalmy, M., Katriel, H., and Shternberg, B., (2002). *Published by CET, Ramat Aviv, Israel. www.cet.ac.il/math/ function/english.* Journal of Computers for Mathematical Learning 10(3): 251 – 258

Rajagukguk, W., Situmorang, M., dan Sinaga, M., (2006). *Effectiveness of Learning Innovation Models To Increase Student Achievement At the high school Basic Math Lesson*. Journal of Mathematics and Science Education 1(3): 114-119

Rajagukguk, W., (2003). *Media Effectiveness Map concept in Algebra Teaching in Secondary Schools,* Research Report, FMIPA Unimed.

Rajagukguk, W., (2004). *Basic Mathematical Ability relationships, attitudes toward Calculus, and Assessment of the Quality of Teaching High School Students with Learning Outcomes Calculus Lecturer Student, State University of Medan*, Dissertation, PPS University of Jakarta.

Rajagukguk, W., (2005). *Learning innovations in improving high school student mastery of the material calculus lecture*. Journal Educational Research. 12(2): 72-7.

Rosenberg, M.J., (2001). *E-Learning Strategies for Delivering Knowledge in the Digitalage*, McGraw-Hill, New York.

Sears, S.J. dan Susan, B.H., (2000). *Contextual Teaching and Learning: An Overview of The Project.*http/www.contextualorg/abs2.htm. Diakses 16 Oktober 2003.

Sherin, M.G., dan Han, S.Y., (2004). *Teacher learning in the context of a video club, Teaching and Teacher Education* 20(2): 163-183.

Rosenberg, M.J., (2001), *E-Learing Strategies for Delivering Knowledge in the Digitalage*, McGraw-Hill, New York.

Situmorang, M., (2003). *Effectiveness of Learning Model Against Increasing Student Achievement School, Research Reports*, FMIPA University of Medan.

Situmorang, M., (2004). *Innovation Models Sain Learning Sector To Improve Student Achievement*. *Proceedings KONASPI V Surabaya.*

Susilo, H., (2001). *Contextual Learning for Improved Understanding of Students.* Papers Presented at the Seminar on Learning with Constructivistic Philosophy in Jombang, 22 September.

Sztajn, P., (2003). Adapting Reform Ideas in Different Mathematics Classrooms: Beliefs Beyond Mathematics, *Journal of Mathematics Teacher Education* 6(1): 53 – 75

Talanquer, V., Novodvorsky, I., Slater, T., dan Tomanek, D, (2003). A stronger role for science departmens in the preparation of future chemistry teacher, *Journal of Chemical Education* 80: 1168-1171.

Tien, L.T., Roth, V., dan Kampmeier, J.A., (2004). A Course to Prepare Peer Leaders to Implement a Student-Assisted Learning Method, *Journal of Chemical Education* 81: 1313-1321.