

A Study of the Guided Discovery Method in Teaching Grade Nine Mathematics

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Abstract

The purpose of this research is to study the guided discovery method in teaching mathematics at the high school level. A quantitative research method was used to compare the mathematics achievement between the control group and the experimental group. The students from the control group were taught by formal teaching method. The students from the experimental group were treated with guided discovery method. The designed adopted in this study was the posttest only control group design. The effects of the guided discovery method were tested in Basic Education High School (Branch) Alantapo, Hlegue from Yangon Region. Learning materials were selected from Grade Nine Mathematics textbooks. Independent samples *t*-test was used to analyze whether there were significant differences between the two groups. The result showed that the students who received the treatment by guided discovery method were significantly better than those who received formal teaching method for BEHS (Branch) Alantapo, Hlegue ($t=3.154$, $P<0.01$) in their mathematics achievement. Research findings proved that guided discovery method has positively contributed to the improvement of mathematics teaching at the high school level. The results revealed that the students' mathematics achievement had significant differences on the comprehension and application not on the knowledge level questions. According to the results, formal teaching method can bring about the improvement of students' ability to remember previously learned lessons. Teaching mathematics by guided discovery method develops higher order thinking skills. Moreover, students get the ability to solve problems of Grade Nine Mathematics. It can be concluded that guided discovery method has positive contribution to the improvement for mathematics teaching.

Keywords: method, guided discovery method

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Introduction

The students need mathematics to develop the scientific thinking and aptitude, which is synonymous to mathematical thinking. Education is needed for human beings. Education is not a product. It is a never ending process.

In Myanmar Education, mathematics is one of the compulsory subjects. The high school mathematics curriculum has been revised in view of changes in the current international high school mathematics curricula. The success of this new curriculum will undoubtedly depend on systematic instruction in mathematics. Ideally, systematic instruction can be achieved only through the development of a system for mathematics education. Mathematics helps in creating international understanding. Mathematics is a very useful subject for most vocation and higher specialized courses of learning. Mathematics has got its cultural value, and this value is steadily increasing day by day. It is a very suitable subject for inculcating the spirit of economy. It deals with economy in time, money, speech and thought, and is bound to develop the corresponding attitudes in the individual. The study of mathematics helps the learners in the development of many intellectual traits like power of thinking and reasoning, induction, analysis, synthesis, originality, generalization, discovery, etc.

According to Sidhu (1995), every mathematical problem poses an intellectual challenge and is unique for mental exercise. The subject is taught for the development of power rather than knowledge. Mathematics develops the learners' powers of acquiring knowledge, thinking, reasoning, judgment and generalization. "How to Teach" is a really difficult for the teacher. Teaching is an art. Methods are the ways to understand and practice the art. Different methods of teaching have been proposed by different education thinkers or school of thought in education. Discovery method in teaching mathematics is also important to help students to discover concepts and to construct knowledge for themselves. In teaching mathematics by using guided discovery method, it is sure that the student's learning is easier than other ways.

Guided discovery teaching helps the students to acquire knowledge because they have to discover it themselves. This method helps students become more autonomous, self-directed and responsible for their own learning. Finding the meanings, organization, and structure of ideas are

involved in this method. Success in solving mathematical problems is not possible without the use of creative powers of the mind.

Purpose of the Study

The purpose of this research is to study the guided discovery method in teaching Grade Nine Mathematics.

Research Hypotheses

1. There is a significant difference in mathematics achievement between students who are taught by guided discovery method and those who are not.
2. There is a significant difference in performing knowledge level questions in mathematics achievement test between the students who are taught by guided discovery method and those who are not.
3. There is a significant difference in performing comprehension level questions in mathematics achievement test between the students who are taught by guided discovery method and those who are not.
4. There is a significant difference in performing application level questions of mathematics achievement test between the students who are taught by guided discovery method and those who are not.

Definition of Key Terms

Method

Method refers to the way of delivering knowledge and transmitting mathematical skill by the teacher to his pupils (Zubair, 2012).

Guided discovery method

Guided discovery is one of the teaching techniques represented by encouraging students to become more active in learning through answering a chain of questions or solving problems designed in order to reach the general concept (Mayer, 2003, cited in EI - Kahlout, 2010).

Review of Related Literature

'Mathematics' is essential for the numerical and calculation part of man's life and knowledge. It helps him to give the exact interpretation to his ideas and conclusions. It deals with quantitative facts and relationships as well as with problems involving space and form. It also deals with relationship between magnitudes. It enables the man to study various phenomena in space and establish various relationships between them. Mathematics studies abstracted from the particular objects and phenomena which exhibit it and in a generalized form.

Learning how to learn through the process of discovery and the exploration of knowledge coupled with the responsibility of the learner are the main features of guided discovery. This helps the learner to master the content needed for understanding (Spencer, 1999 cited in EI-Kahlout, 2010)

A context for students' learning is chosen to suit the learning outcomes. Students have responsibility for exploration of content necessary for understanding through self-directed learning. Study guides are used to facilitate and guide students during their learning. Understanding is reinforced through application in problem-oriented; task-based, and work related experiences. Guided discovery can be enhanced with various tools. One of these tools is simulation. Simulation happens when the teacher provides students with examples and hints help them to understand and continue in the instructions and reach discovery (Westwood, cited in EI-Kahlout, 2010).

Students are required to investigate a topic, issue or problem by active means, obtain pertinent information, interpret causes and effects for achieving important objectives in social studies, science, geography, history, health, environmental education and mathematics.

The general consensus regarding discovery learning is that it is most effective when the process is carefully structured. Students have prerequisite knowledge and skills and teachers provide any necessary support during the investigations. Reichert (2005, cited in EI Kahlout, 2010) suggested that scaffolds mean the necessary support and guidance provided by the teacher to the students as they engage in learning activities in order to reach the discovery in the form of conclusions and principles. For example, the teacher gives hints and advice, encourages and leads students to a conclusion and principles.

Linton (1998, cited in EI-Kahlout, 2010) said that in guided discovery, learning and developing depend on student's experiences as they are cognitively (the levels of thinking) active in their attempts to make sense of those experiences. Nowadays, teaching and learning process becomes student-centered. Despite that, the teacher still plays a great role in the process of interaction either it is between the teacher and the students or between students-students or the students and the classroom environment. Hardy, et al. (2006, cited in EI Kahlout, 2010) argued that students will often have misconceptions (wrong previous concepts students have about something) and do not know they have them. It becomes the teacher's job to draw these out and make them visible to the students. Without guidance, students will be unable to relate their discovery activity to their misconception and thus give up.

Adkisson & McCoy (2006, cited in EI-Kahlout, 2010) suggested that guided discovery is generally regarded as a motivating method. They suggested that students are motivated by total participation in the lesson. The teacher in guided discovery should pay a great intention to the appropriate order of the components of the lesson.

Blackburn, et al. (2001, cited in EI-Kahlout, 2010) summarized six stages.

1. **Introduction:** The students and the teacher work to generate excitement about the material or area to motivate a productive session of exploration.
2. **Generating Ideas:** The students list various uses for the item of area. Some may be traditional uses and some may be less obvious and more creative. The teachers demonstrate uses as they are suggested.
3. **Learners' Explore:** The students experiment with the material or are under the guidance of the teacher, thus allowing them to be active participants in leaning and affording them an opportunity to formulate any questions.
4. **Sharing:** The students have an opportunity to share the fruits of their exploration and point out aspects that they feel would be of interest to the group.
5. **Clean-up and Care:** The students suggest ways the material or area should be handled and maintained. This provides a framework for future classroom expectations.

6. **Extensions:** The students work alone, in pairs, or in groups to further explore the material or area and begin to put its use into practice.

Grounded on learning cycle, 5E learning cycle was developed by Robert Bybee. According to Bybee (1997, cited in Tuna & Kacar, 2013), the foundation of this learning cycle is affected by works of German philosopher, Freidrich Herbart. Furthermore, in this view, this cycle is based on the ground of John Dewey and Jean Piaget. As a very frequently used model in constructivist learning approach, 5E learning cycle model's name comes from the number of its phases and the initials of each phase. These five phases are engagement, exploration, explanation, elaboration and evaluation. The phases of 5E learning cycle model are schematized as below:

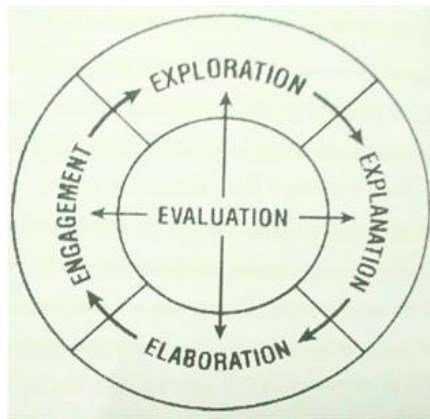


Figure1. The 5E Discovery Learning Cycle Model

Source: From Tuna & Kacar (2013)

In the 5E discovery learning, students take on much of the responsibility for learning as they construct knowledge through discovery, whereas in the formal teaching the teacher is responsible for dispensing information to be learned by the students. In the 5E learning cycle, the teacher as a guide: raising questions, providing opportunities for exploration, asking for evidence to support student explanations, referring student to existing explanations, correcting misconceptions, and coaching students as they apply new concepts. This cycle differs greatly from the

traditional format of lecturing, leading student step by step to a solution, providing definite answer, and testing isolated facts. The 5E learning cycle requires the students to take responsibility for their own learning. By using guided discovery method, Students can actively involve in the learning process. So, this research intends to study whether the guided discovery method has positive effects on mathematics teaching and learning processes at the high school level or not.

Research Method

The main purpose of this research is to study the guided discovery method in teaching Grade Nine Mathematics.

Sample of the Study

For this study, the selected school is B.E.H.S (Branch) Alantapo, Hlegue. Participants in this study are Grade Nine students from the selected school. There are (76) students who are learning mathematics in Grade Nine at B.E.H.S (Branch) Alantapo, Hlegue and (60) students were selected as participants.

Table 1. Population and Sample Size

Name of School	Population	Sample (No. of Students)
B.E.H.S (Branch) Alantapo, Hlegue	76	60

Instrument

Since this study is aimed at to study the guided discovery method in teaching mathematics at the high school level, a posttest was constructed. The achievement test (posttest only) was conducted on each group (control group and experimental group) after the treatment to measure the students' mathematics achievement.

The pretest was not used for this study. The scores of 2017 December test was used to check their basic mathematical knowledge. A

posttest was constructed to check the mathematics achievement of the students. Two sections were consisted in the posttest. Ten multiple choice items are included in section (A) and eight long questions in section (B).

Data Collection Procedure

According to the scores of 2017 December Test, the students were grouped into two groups: control group and experimental group. In the selected school, the control group is treated with formal instruction and the experimental group was treated with guided discovery method. The treatment period lasted about two weeks.

At the end of treatment period the posttest was administered to all selected students. The posttest is administered on January 15, 2018 in B.E.H.S (Branch) Alantapo, Hlegue. The allocated time for the posttest is (1:30) hours and the given marks are (50) marks.

The quantitative data were analyzed by descriptive analysis technique and independent samples *t*-test.

Data Analysis

The data were analyzed by using descriptive statistics (mean, standard deviation) and independent samples “*t*” test. The independent samples “*t*” test is used to compare the achievement of students who learned by guided discovery method and that of students who learned by formal teaching at knowledge, comprehension and application levels.

Research Findings

The data obtained from the posttest were recorded systematically. And then these data were analyzed by using the independent samples *t*-test to compare the differences between the control and experimental group.

Table 2 “*t*”-Values for Posttest Mathematics Achievement Scores

School	Group	N	M	SD	MD	<i>t</i>	<i>df</i>	Sig.(2-tailed)
BEHS	Experimental	30	36.93	8.056	6.233	3.154	58	0.003**
	Control	30	30.70	7.231				

Note. $**p < .01$

BEHS = Basic Education High School, Alantapo, Hlegue

The results showed that the mean score of experimental group is significantly higher than the mean score of control group in the selected school (see Table 2). It shows that there is a significant difference between the control group and experimental group on the overall mathematics achievement in the selected school (see Figure 2).

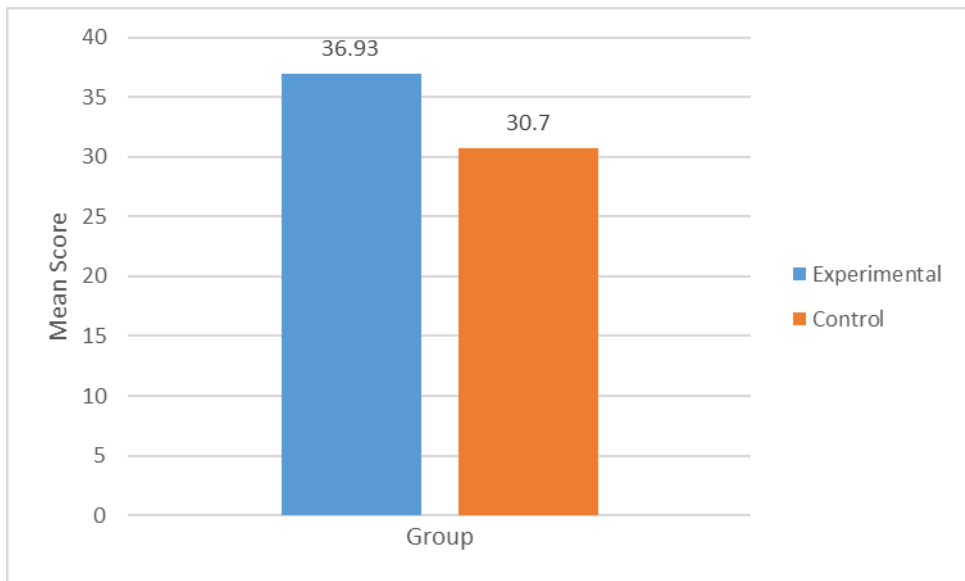


Figure 2. The Comparison for Posttest Mean Scores of Mathematics Achievement

This result can be interpreted that the use of guided discovery method has effectiveness on the mathematics achievement of the students. Moreover, teaching by guided discovery method positively contributed to the mathematics teaching at the high school level.

Finding of Knowledge Level Questions

Table 3. “t”-Values for Scores on Knowledge Level Questions

School	Group	N	M	SD	MD	<i>t</i>	<i>df</i>	Sig.(2-tailed)
BEHS	Experimental	30	6.17	2.245	0.07	0.115	58	0.909 (ns)
	Control	30	6.10	2.234				

Note. ns = not significant

BEHS = Basic Education High School, Alantapo, Hlegue

Result of knowledge level questions showed that there is no a significant difference for the scores on knowledge level questions between the control and experimental groups in the selected school. It means that the mean score at the knowledge level does not differ between the experimental group and the control group (see Table-3 and Figure-3).

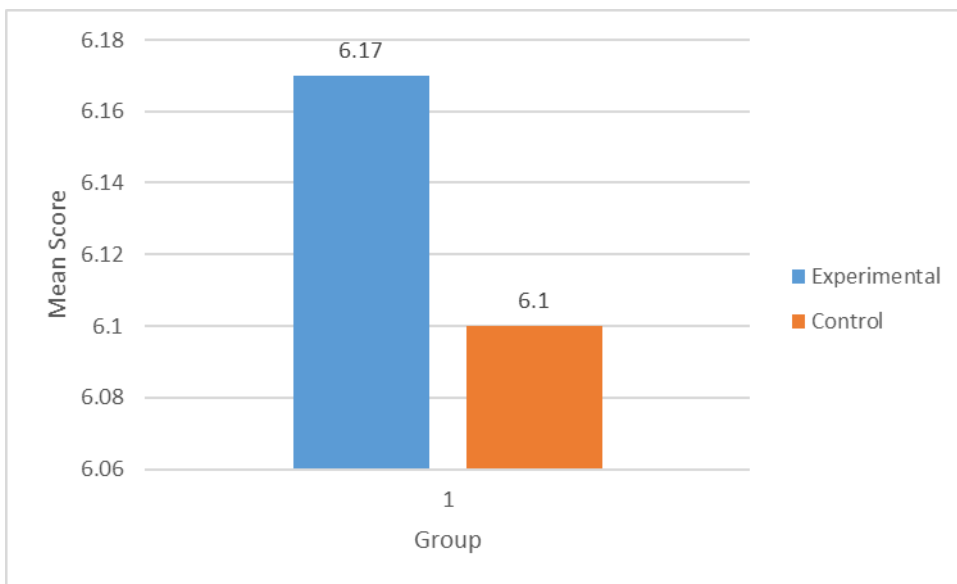


Figure 3. The Comparison of Mean Scores for Knowledge Level Questions

From this result, it can be interpreted that not only guided discovery method but also usual method could bring about the improvement to previously learned materials.

Finding of Comprehension Level Questions

Table 4. “t”-Values for Scores on Comprehension Level Questions.

School	Group	N	M	SD	MD	t	df	Sig.(2-tailed)
BEHS	Experimental	30	15.07	2.840	2.9	3.608	58	0.001**
	Control	30	12.17	3.364				

Note. **p < .01

BEHS = Basic Education High School, Alantapo, Hlegue

According to the scores of comprehension level questions, there are significant differences between the control and experimental group in the selected school. It means that the mean score of the experimental group is higher than that of the control group (see Table-4 and Figure-4).

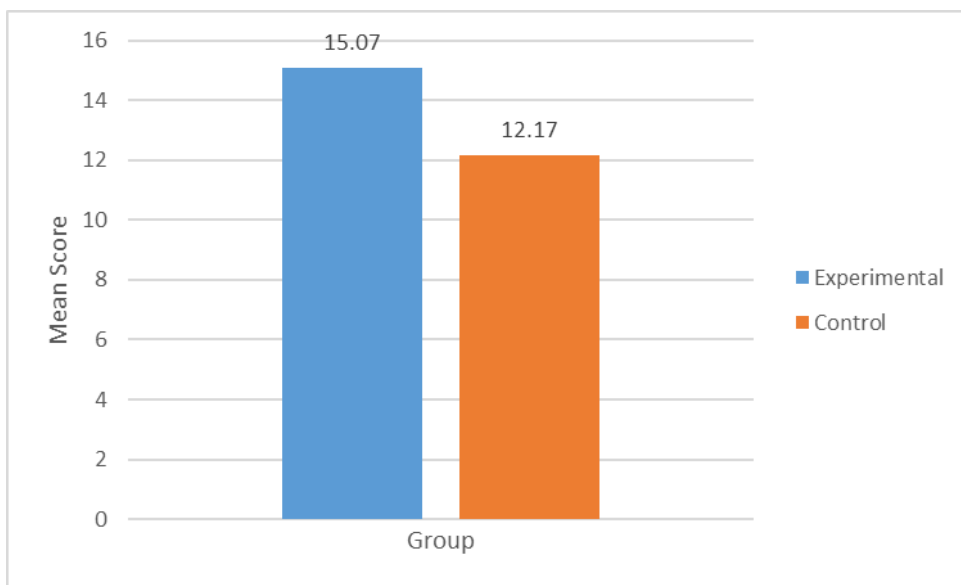


Figure 4. The Comparison of Mean Scores for Comprehension Level Questions

According to the results from the schools, the mean score of experimental group is higher than that of the control group for the application level questions. It can be interpreted that teaching by guided discovery method on high school level could bring about the effectiveness in teaching mathematics. Guided discovery method enhances the students'

ability to understand the concepts, facts and recognizes the information that has been learned in the teaching period. It can improve student's understanding that he or she made by himself or herself (see Table-5 and Figure-5).

Finding of Application Level Questions

Table 5. “t”-Values for Scores on Application Level Questions

School	Group	N	M	SD	MD	t	df	Sig.(2-tailed)
BEHS	Experimental	30	15.70	4.772	3.267	2.983	58	0.004**
	Control	30	12.43	3.636				

Note. **p < .01

BEHS = Basic Education High School, Alantapo, Hlegue

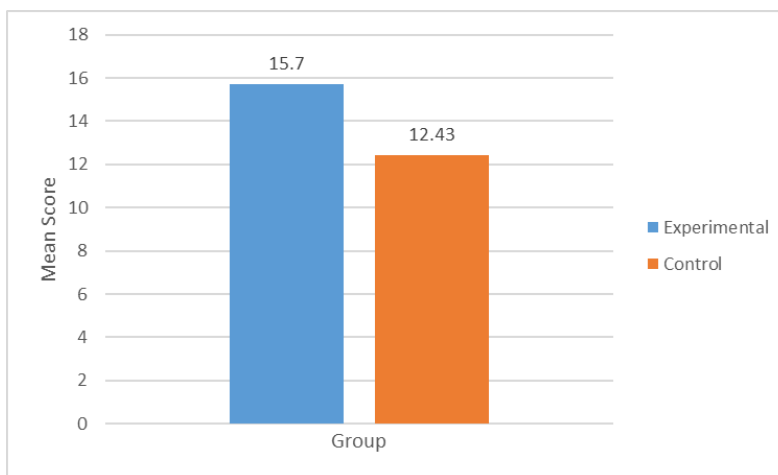


Figure 5. The Comparison of Mean Scores for Application Level Questions

The mean scores of experimental group are higher than the mean scores of control group in the levels of knowledge, comprehension, and application. The result of the selected school can be interpreted that guided discovery method could bring about the improvement of students' ability to apply knowledge and facts (see Figure-6).

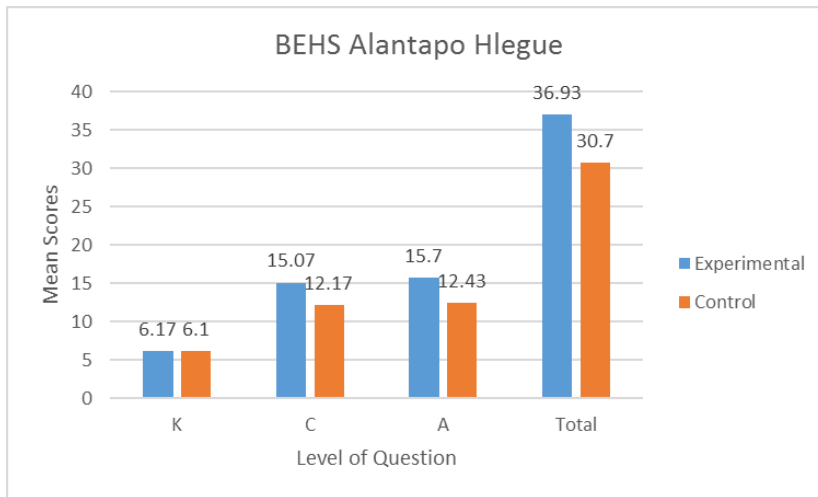


Figure 6. The Comparison of Mean Scores on Posttest for BEHS Alantapo, Hlegue

Note. K = Knowledge, C =Comprehension, A =Application, T = Total

Conclusion, Discussion and Recommendations

Conclusion

The main purpose of this research was to study the guided discovery method in teaching Grade Nine Mathematics. Total of (60) students from the selected high school in Yangon Region participated. The major findings of this study and discussions are as follows.

There is a point to consider that every teaching method is not effective in every learning situation and for the needs of every student. It is important to decide how instructional method should be used in a given context. Mathematics teacher should be skillful in all teaching methods like guided discovery methods.

The teacher needs to be able to listen carefully and structure situations in which students talk about their experiences in order to ensure the student understands both the “how” and the “why”. This study showed that guided discovery method is useful for improving of students’ achievement and positive attitudes towards mathematics. It can also develop students’ thinking ability. Therefore, guided discovery method surely has positive contribution to the mathematics teaching at the high school level.

Discussion

According to the posttest mean scores on mathematics achievement in this study, Grade Nine students who were trained by the teacher using guided discovery method is better than those who were trained by the teacher using formal teaching method. The results showed that the posttest mean scores of the experimental group were significantly higher than that of the control group in selected school. This may have been achieved by the higher level of students' participation in learning activities. All the students in guided discovery learning group performed in solving problems which are presented in the classroom and give the benefits of all members of the group. When learners are confronted with problems which they must solve, they are forced to reason and think critically in order to solve the problems. The activities of guided discovery method are very active, interesting and enjoyable for the students. This also could be better the student's scores on the posttest. The results of this study reveal that the experimental group using guided discovery method achieves higher scores than the control group in the posttest. The experimental group using guided discovery method can also bring about the improvement of student's higher order thinking skills and can express their own opinions more than the control group. In the discovery learning process, the students draw on their past experiences and existing knowledge to discover facts and relationships and new truths to be learned. Students interact with the world by exploring and manipulating objects and performing experiments (Okwute, 2015).

Findings and discussions presented in this research will contribute to the improvement of mathematics teaching at the high school level in Myanmar. Therefore, teachers should consider how to prepare learning environments in which students will be active in accordance with their characteristics and then present these environments to students. The teachers should use guided discovery method at the high school level because it can bring about the positive effects on mathematics. Students should have enough time to explore because this method needs more learning time than the preparation time. Teachers should consider students' developmental levels and make them able to use their prior knowledge as they gain new thought processes, develop higher levels of thinking, and their own reasoning.

Recommendations for Future Research

In this study, the research tried to study the effects of guided discovery method in teaching mathematics at the high school level. The sample of the students was chosen only from one basic education high school in Yangon Region. If possible, future research should be carried out by selecting students from other regions and states in Myanmar.

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