

A Study of the Effects of Discussion Method on Students' Achievement in Chemistry at the High School Level

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Abstract

The purpose of this research is to study the effects of discussion method on students' achievement in Chemistry at the high school level. A quantitative research method was used to compare the students' Chemistry achievement between the experimental and control groups. Two sample schools, No (4) Basic Education High School, San Chaung and No (6) Basic Education High School, Insein were selected by using simple random sampling method. The size of sample was (120) grade nine students from selected schools. There were two groups in each school and each group consisted of (30) students. Learning materials were selected from Grade Nine Chemistry Textbook; Chapter (15) and other extended learning materials from journals, videos and photos that are relevant to the lessons. The design adopted in this study was posttest only control group design of experimental research. The independent samples *t*-test was used to compare whether there were significant differences between two groups. The result showed that the students who received the treatment by using discussion method were significantly better than those who received formal instruction in BEHS, San Chaung ($t = 6.015$, $df = 58$, $MD = 7.8$, $p < .001$) and in BEHS, Insein ($t = 5.088$, $df = 58$, $MD = 5.8$, $p < .001$) Research findings revealed that teaching by discussion method had a positive contribution to the improvement of Chemistry teaching. It was concluded that teaching by discussion method was effective in raising students' Chemistry achievement at the high school level.

Keywords: Discussion method, science, achievement, formal instruction

Introduction

Education is one of the fundamental needs of human beings. In the history of man-kinds, education has formed a continuum and a basis for the development of human society. Education empowers minds that will be able to conceive good thoughts and ideas. Now, the world is constantly changing. In society, there will always be problems to be solved. One of the

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very useful outcomes of learning science is the development of problem-solving skill. The study of the science brings behavioral change in the learner and enriches learners' character and personality. Further, science is a subject where ideas can be experimented upon and verified (Das, 1985).

Chemistry is the branch of science that deals with the identification of the substances. Teaching of Chemistry is different from teaching other conventional disciplines, as applied or practical aspect is equally important in chemistry teaching besides the theory. So, Chemistry as considered an important subject in school curriculum as many professional and applied courses, directly or indirectly use the knowledge of Chemistry. Chemistry in school is part of the total education provision and the Chemistry content is gained so as to enhance learning in the cognitive, personal and social domain. Therefore, it is essential to know the importance of Chemistry in every life. So, in teaching Chemistry, discussion method is more suitable for fostering interest in current events because students participate in such matters more effectively. If the teacher desires to develop the power of critical thinking, problem solving ability and attitudinal change, the discussion method is superior. So, discussion is an excellent tool for developing students' reasoning skills because it gives students access to their thought process and an opportunity to guide student to a higher level of thinking.

Purposes of the Study

The main purpose of this study is to investigate the effects of discussion method on students' achievement in learning Chemistry at High School Level. The specific purposes are as follows:

- To compare the academic achievement between the students who receive discussion method and those who do not
- To explore the effects of discussion method in teaching Chemistry
- To give suggestions concerning discussion method in teaching Chemistry to teachers

Research Hypotheses

- There is a significant difference in student's academic achievement between Grade Nine students who receive discussion method and those who do not.

- There is a significant difference in performing knowledge level questions between Grade Nine students who learn by discussion method and those who do not.
- There is a significant difference in performing comprehension level questions between Grades Nine students who receive discussion method and those who do not.
- There is a significant difference in performing application level questions between Grade Nine students who learn by discussion method and those who do not.

The Scope of the Study

The following points indicate the scope of the study.

- This study was geographically restricted to Yangon Region.
 - Participants in this study were all Grade Nine students from the selected schools within the school year (2017-2018).
 - Participants are selected by using random sampling method.
 - This study is limited to the content area of Chapter (15), Carbon and its Compound from Grade-Nine Chemistry textbook prescribed by Basic Education Curriculum, Syllabus and Textbook Committee.

Definition of Key Terms

Discussion Method

Discussion is a type of activity, which involves breaking the class into small groups for effective talking on a topic, a problem or issue. It is thinking together process in which pupils talk freely to the teacher. It is a student-centered method in which students participate actively (Yusuf, 2016).

Science

Science is the system of knowing about the universe through data collected by observation and controlled experimentation (Carin & Sund, 1989).

Achievement

Achievement is the ability to demonstrate accomplishment of some outcome for which learning experiences were designed (Ozdemir, 2006).

Formal instruction

Formal instruction is education normally delivered by trained teachers in a systematic intentional way within a school or university.

Review of Related Literature

Discussion Method

Discussion method is a type of teaching method that involves conversation between teacher and pupils in a class or among pupils in small group. It is a type of learning activity whereby pupils exchange idea or opinion through discussion among themselves under the guidance or facilitation of a teacher.

Thus discussion is also a learning activity related with the exchange of information among the pupils. Discussion enables pupils to compare, analyze, interpret various ideas or possible solutions, learn from each other, and adopt the best for self-improvement.

Every teaching method has its own characteristics, strengths and limitations. The concern is not about deciding which instructional methodology is the best, or with substitution one for another. The concern is about the merits of diversity, which seeks to enrich education rather than constraint it, through a search for an optimum way of doing diverse teaching. Hussain (1994, cited in Rahman, Khalil & Ajmal, 2011) quotes Bloom as the value of lecture method depends on the specific objective of the teacher. If the teacher wishes to communicate information, lecture method is reasonable efficient, but if the teacher desires to develop the power of critical thinking, problem solving ability and attitudinal change, the discussion method is superior. Some of the researchers were of the view that discussion is important to learning in all disciplines because it helps students' process information rather than simply receive it. Discussion differs from lecture in two ways;

- a. The students can be more active and
- b. There can be more personal contact.

In discussion method group members have reciprocal influence over each other. The learning of one student is affected by the behavior of other students in the group. While lecture method is much less dependent on reciprocal influence among students to facilitate learning a question posed during lecture may stimulate students to think for a few second but a provocative question in a group discussion can stimulate thinking for several minutes.

Characteristics of Discussion Method

1. Experiential Learning

- Student can learn best when they are actively involved in the learning process.
- Using the discussion method, a student's concrete, personal experiences are followed by observation, reflection, and analysis of these experiences. This process leads to formulation of abstract concepts and generalizations, which, in turn, leads to hypotheses to be discussed and tested in future experiences

2. Emphasis on Students

- Students' experiences serve as the basis for the discussion
- Although the teacher must have a specific goal in mind and a general framework for teaching the goal, student input determines the specific direction the discussion takes

3. Focus on Critical Thinking

- Developing critical thinking skills involves consideration of three areas: instructional design, a focus on learning by doing, and strategic teaching.

Procedure of Discussion

Discussion method can produce the desired results if the teacher and student representatives do considerable planning. The whole process may be divided into three steps-preparation, discussion and evaluation.

Preparation: Thorough preparation of discussion is necessary. Prepare the material conscientiously. Points to be discussed should be arranged logically.

First, the teacher carefully considers goals. The goals would likely be the acquisition of a cognitive or social skill, rather than the learning of a specific concept or generalization.

Second, the teacher must decide if the activity would be best implemented in discussion.

Third, the teacher must consider the experience and development of the student.

Fourth, a clear task that requires the students to produce something concrete in a short time period can help considerably with the problem.

Finally, the discussion should result in a specific product such as summary, list, and series of conclusions. The teacher in the planning stage must carefully consider the product so directions can be explicitly and thoughtfully provided.

Conduction of discussion: While conducting the discussion, the teacher should see that it is disciplined. Through discussion the teacher can challenge the students to discover things for themselves by setting up situations that can stimulate and prompt them to ask questions, assimilate and analyze information, and draw their own conclusion. Teachers who are not threatening to their students, present a relaxed atmosphere, and can withhold their opinions will be successful at using this method. The arrangement of seats should ensure face to face talk. Since the strength of the discussion is obtained from the information and viewpoint of all members of the group, it is necessary that all contribute to its progress. It is a thinking-together process which breaks down if one member of the group dominates it. The teacher must see that every member of the group. He should be sincere, courteous, and good-natured. He should encourage sincere questions and comments.

The teacher must create a good atmosphere. A relaxed and informal climate is essential if desirable results are to be achieved. The teacher should see that the discussion is truly a cooperative experience, and not a competitive quarrel. Points should be written on the blackboard for guidance. Class discussion revolving around the significance of data derived from experiments or demonstrations can be among the most worthwhile activities of a science class.

Evaluation: The discussion must result in certain achievements as expanding information or lessening or removing prejudices, changing

attitudes or ideas, or increasing the range of his interests. At this point, or some time shortly after the class and check how much the students understand in the discussion. This review needs to be done for several reasons- to help in the judgment of them, to help get to know them better. Teachers use question-and-answer techniques to conduct reviews and oral summaries. Previous related researches on discussion method are followed.

Research Method

This study sought to find out the effects of discussion method on students' achievement in Chemistry at the High School Level. Quantitative research methodology was used to compare students' achievement between two groups: Experimental group and Control group.

Research Design

The design used in this study is one of the true experimental designs, such as the posttest only control group design. After using discussion method in schools, students' academic achievement was studied.

Table 1. Experimental Design

Group	Assignment	School		Treatment	Posttest
		S1	S2		
Experimental	Random	30	30	Discussion Method	CA
Control	Random	30	30	Formal Instruction	CA

Note: S1 = No. (4), Basic Education High School, San Chaung

S2 = No. (6), Basic Education High School, Insein

CA = Chemistry Achievement

In exploring the effects of discussion method on students' achievement, one of the experimental designs, the posttest only control group design was adopted. Participants included in this study were first

selected by random assignment, and then they were divided into two groups, an experimental group and a control group by using their mid-term marks. The experimental group was provided the treatment through discussion method while the control group was provided through formal instruction. The treatment period lasted for two weeks in each school. There were ten periods per week. Instructional time was one and half hours per day in each school. There were (30) students in the class and therefore five groups. The lesson plan for both control and experimental groups were prepared.

The learning materials were chosen from Grade Nine Chemistry textbook. The content area of the textbook was Chapter (15), Carbon and its Compounds. Extended materials were used for the students to understand the content.

Procedures for Discussion Method

Procedures for discussion method are as follows:

- Introduction
- Grouping students
- Giving the required materials
- Discussion prompts
- Performing Activity and Group Discussion
- Monitoring and Checking
- Collecting data
- Conclusion
- Evaluation

Procedures for Formal Instruction

Procedures for formal instruction are as follows:

- Introduction
- Presentation
- Conclusion
- Evaluation

Instrument

In this study, a posttest (achievement test) was used to find out the effects of discussion method on students' achievement in Chemistry at the High School Level.

Posttest

The posttest was used to investigate the effectiveness of discussion method in teaching Chemistry in Grade-Nine. The test items were based on Chapter (15) from the Grade Nine Chemistry Textbook. The test items were constructed for (30) marks. In the posttest, (5) items were TRUE/FALSE items, (5) items were completion items, (5) items were multiple choice items, (5) items were matching items, and (5) items were short questions. On the 5th January, 2018, a pilot test was conducted with (15) Grade Nine students at the No (3) BEHS, San Chaung Township. To show the internal consistency of the test, the reliability coefficient Cronbach's Alpha was computed and its values was (0.711). The table of specifications for posttest is presented in table (2).

Table 2. Table of Specifications for Posttest

Content		Chapter (15)
Knowledge Level	Number of Items	11
	Percentage	44%
Comprehension Level	Number of Items	11
	Percentage	44%
Application Level	Number of Items	3
	Percentage	12%

Population and Sample Size

This study was geographically restricted to Yangon Region. The townships in Yangon Region are stratified into four districts: East, West, South and North. Two districts from those districts are randomly selected for this study and two townships were selected; one township is from West

district and the other from the North. The required schools were selected by using simple random sampling method. The sample schools are No. (4), Basic Education High School, San Chaung and No.(6) Basic Education High School, Insein. There were totally (73) students who were learning Chemistry in Grade-Nine at No.(4), BEHS, San Chaung and (86) students who were learning Chemistry in Grade-Nine at No.(6), BEHS, Insein. Among them, (30) students for the experimental group and (30) students for the control group from each school were selected by using the simple random sampling method. The population and sample size are shown in the table (3).

Table 3. Population and Sample Size

School	Students	Participants	
		Experimental	Control
BEHS (4)	73	30	30
BEHS (6)	86	30	30

Note: BEHS =No. (4), Basic Education High School, San Chaung

BEHS =No. (6), Basic Education High School, Insein

Data Analysis

The data were analyzed by using descriptive statistics (mean, standard deviation, and percentage) and independent samples "*t*" test. The independent samples "*t*" test was used to compare the achievement of students who learned by discussion method and that of students who learned by formal instruction at knowledge, comprehension, and application level. In order to determine the significant differences, the independent samples "*t*" test was used with SPSS (20).

Research Findings

Experimental Research Findings

Table 4. “t” Values for Posttest Chemistry Achievement Scores

School	Group	N	M	SD	MD	t	df	Sig(2-tailed)
BEHS(4)	Experimental	30	22.63	4.759	7.80	6.015	58	.000***
	Control	30	14.83	5.272				
BEHS(6)	Experimental	30	22.53	4.150	5.83	5.088	58	.000***
	Control	30	16.70	5.714				

Note: ***p<.001

The mean scores of experimental groups were significantly higher than that of the control groups in each school (see Table 4). As shown in the table, there was a significant difference between the experimental and control group for the scores on the Chemistry achievement in each school.

Table 5. “t” Values for Mean Scores on Knowledge Level Questions

School	Group	N	M	SD	MD	t	df	Sig. (2-tailed)
BEHS(4)	Experimental	30	10.63	2.141	3.50	6.079	58	.000***
	Control	30	7.13	2.315				
BEHS(6)	Experimental	30	10.4	1.905	0.77	1.704	58	.094(ns)
	Control	30	9.63	1.564				

Note: ***p<.001

ns= not significant

Table 5 presents that the results of knowledge level questions. It showed that the mean scores of experimental groups were significantly higher than that of control groups in the BEHS (4), San Chaung. So, it can be concluded that there was a significant difference of mean scores on knowledge level questions in BEHS (4), San Chaung but there was not a significant difference in BEHS (6), Insein.

Table 6. “t” Values for Mean Scores on Comprehension Level Questions

School	Group	N	M	SD	M D	t	df	Sig (2- tailed)
BEHS(4)	Experimental	30	7.73	2.067	2. 10	3.88	5 8	.000***
	Control	30	5.63	2.125				
BEHS(6)	Experimental	30	7.63	1.629	2. 10	4.028	5 8	.000***
	Control	30	5.53	2.345				

Note: ***p<.001

According to the scores on the comprehension level questions, the mean scores of the experimental groups were significant higher than the mean scores of the control groups in both selected schools (see Table 6).

Table 7. “t” Values for Mean Scores on Application Level Questions

School	Group	N	M	SD	MD	t	df	Sig.(2- tailed)
BEHS(4)	Experimental	30	4.27	1.700	2.27	4.468	58	.000***
	Control	30	2.00	2.197				
BEHS(6)	Experimental	30	4.50	1.676	2.93	6.433	58	.000***
	Control	30	1.57	1.851				

Note: ***p<.001

As shown in table (7), the mean scores of the experimental groups were significantly higher than that of the control groups in both schools (see Table 7). It showed that there were significant differences between the two groups for the selected schools on the scores of the application level questions.

Discussion, Suggestions and Conclusion

Discussion

The main purpose of this study was to investigate the effects of discussion method on Grade-Nine students' achievement in teaching Chemistry. Results from the study showed that the posttest mean scores of experimental groups were significantly higher than the mean scores of control groups in two selected schools. This result supports the research hypotheses: there is a significant difference in students' academic achievement between Grade-Nine students who receive discussion method and those who do not. According to the finding of the study, the experimental group got the mean scores higher than the control group in performing knowledge, comprehension, and application level questions.

During discussion, learners are not passive recipients of information that is transmitted from a teacher. Rather, learners are active participants. And discussion method is more suitable for fostering interest in current events because students participate in such matters more effectively.

According to the comparison of mean scores on knowledge level questions for both selected schools, the findings showed that the achievement of experimental group was significantly higher than that of control group in BEHS (4). It can be interpreted that discussion method could bring about the improvement of students' ability to remember the basic Chemistry knowledge. This study also found that the achievement of experimental group was not significantly higher than that of control group in BEHS (6). It can be interpreted that formal instruction could also bring about the improvement of students' ability to remember the basic knowledge as discussion method.

According to the comparison of mean scores on comprehension level questions in two selected schools, the findings pointed out that there were significant differences between experimental group and control group. The students are actively involved in processing information and ideas in discussion. Teaching by discussion can be an effective mean of helping students apply abstract ideas and think critically about what they are learning. Seweje (2000, cited in Yusuf, Guga & Ibrahim, 2016) explained that a teacher is expected to be a facilitator whose main function is to help learners to become active participants in their learning and thereby making

meaningful connection between prior knowledge, new knowledge and the process involved in learning.

According to the comparison of mean scores on application level questions in two selected schools, the result pointed out that there were significant differences between the control and experimental groups. It can be concluded that the students from the experimental groups improve higher order thinking skills and can transfer what they have learned at school to real life situations. The teacher can motivate the students for learning if he/she focuses on solving problems which the students are facing. If the teacher is able to formulate a well-planned discussion, it may provide an opportunity for cooperative problem solving.

Discussion is a useful teaching method for developing higher order thinking skills that enable students to interpret, analyze and manipulate information. Discussion increases attention and motivation that ultimately enhance memory. Increased arousal and motivation are the essential ingredients for learning and are often more important for retention than intelligence.

The present finding is in harmony with the findings of (Rhaman & Khalil, 2011) who stated that the mean score of students taught by the discussion method was higher than the mean score of the students taught by the formal instruction. The researcher concluded that the gro

up taught with discussion method performed better than the control group which indicated the usefulness of discussion method in teaching of social studies at secondary level. Every student participates cooperatively and democratically and the competition among the students is reduced. And they can extend their own thinking to be congruent with the questions.

In discussion activity, the teacher encourages students to build their own knowledge of the subject matter, not just memorization and exposing students to multiple perspectives. Discussion method of teaching engages both the teachers and students in thinking. And, discussion method captured students' attention and increased their involvement in the class. Discussion creates a collaborative climate in an environment of trust and cohesiveness, which encourages an open and lively exchange of ideas among members. According to the findings, it can be concluded that students from the experimental group improve not only academic performance but also social

and communication skills. So, in this study, discussion method is effective in improving teaching learning process of Chemistry.

Suggestions

Every teaching method has its own characteristics, strengths, and limitations. The concern is not about deciding which instructional methodology is the best, or with substituting one for another. The concern is about the merits of diversity, which seeks to enrich education rather than constrain it, through a search for an optimum way of doing diverse teaching. Teachers also need several different kinds of knowledge i.e., knowledge about the subject matter; knowledge about curriculum goals; knowledge about the challenges students are likely to encounter in learning these ideas; knowledge about how ideas can be represented effectively; and knowledge about how students' understanding can be assessed.

According to the results of this research, discussion method has a positive contribution to students' Chemistry achievement. Discussion method motivated the students to learn in a small group. Bridges (1988, cited in Yusuf, Guga & Ibrahim, 2016) noted that discussion is concerned with development of knowledge, understanding or judgment among those people taking part in it. The students in small groups are willing to express their knowledge, share their ideas, reflect their thinking and improve group participation. Learning environment should be active, dynamic and interactive so that learning becomes joyful and long lasting.

There is convincing national and international research evidence that highlights the crucial role to be played by teachers in the successful implementation of the reforms outlined in the National Educational Strategic Plan (NESP). For example, in the basic education sub-sector teachers will play a key role in the successful roll out of the new curriculum as well as adoption of new interactive pedagogy and application of a new assessment system. Therefore, teachers have been placed at the centre of the NESP goal.

Effective use of this method to teach Chemistry can provide students the opportunity to participate in the activities and maximize individual potentials in learning the subjects. Therefore, educators need to emphasize and aware the importance of discussion method. In order to use discussion

method effectively in school subjects, the teacher needs to consider the following points.

- Before implementing discussion method, the teachers should know the procedures of discussion technique that they will use to meet the needs of students.
- The teachers should be explained that the discussion is not just a matter of teachers' communication with students; it is a chance for them to share ideas.
- The teachers should create and develop a proper climate for effective discussion. Students feel shy and scared in asking questions, raising problems and providing answers and solutions. If the teacher starts from the beginning with proper climate then only students will participate in discussion.
- The teachers should provide necessary information before hand to the students so that they could participate in discussion fruitfully.
- The teachers should guide the students in expressing their opinions and ideas with a view to identifying and solving problems collectively.
- The teachers should carefully manage classroom conditions to reduce time constraints.
- Students should have an equal opportunity to contribute, do not dominate the discussion and wait his/her turn and take part about as much as everyone else.

The result pointed out that classroom condition is one of the most important factors that need to be considered in the teaching-learning situation.

According to research, time was a problem. Discussion method consumed much time to discuss than teacher-centered instruction. Moreover, the potential difficulty of using discussion teaching method in large class is the seating arrangement and perhaps the single greatest barrier is the risk that students will not participate. So, the teachers should play as a director to keep the teaching learning process flowing smoothly and efficiently.

Conclusion

Teaching is a set of activities which is designed and performed to achieve certain objectives in terms of changes in pupil behavior. Science teaching requires a sound knowledge of the subject and a real interest and ability in sharing this knowledge with others. The child's thinking and learning about phenomena of the natural world which are clearly central to good quality science teaching. So, choosing specific teaching methods that best achieves course objectives is one of the most important decisions a teacher faces. (Nayak & Singh, 1997, cited in Rahman, Khalil & Ajmal, 2011). Besides, the teaching procedure should be flexible and the methods employed should flow easily from one to the other.

Teaching methods such as lecture and discussion are on the opposite ends. A lecture is a narrative technique of delivering verbally a body of knowledge according to pre-prepared scheme of action as cited by international dictionary of Education (1991, cited in Rahman, Khalil & Ajmal, 2011). Teaching by discussion can be an effective mean of helping students apply abstract ideas and think critically about what they are learning. Discussion method captured students' attention and increased their involvement in the class.

Discussion is the effort of a group of individuals who talk informally together in order to solve commonly recognized problems or to arrive at an understanding of values. The strength of the discussion is obtained from the information and viewpoint of all members of the group. While students may experience anxiety in speaking in a large class, group discussion allows them to share thoughts first among a small number of peers.

By using discussion method, group members have reciprocal influence over each other. The learning of one student is affected by the behavior of other students in the group. While lecture method is much less dependent on reciprocal influence among students to facilitate learning a question posed during lecture may stimulate students to think for a few second but a provocative question in a group discussion can stimulate thinking for several minutes. The major purpose of using discussion is to encourage students to evaluate events, topics, or results, to clarify the bases for their judgments, and to become aware of other points of view.

Discussion method can enhance students' understanding, broaden student perspectives, highlight opposing viewpoints, reinforce knowledge,

build confidence and support community in learning. To sum up, according to results of this research, it is revealed that effective use of discussion method has significant effect on Chemistry achievement of the students. Therefore, discussion method has positive contribution to the Chemistry teaching at the high school level.

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