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AN INVESTIGATION INTO THE IMPACT OF EXTENDED READING EXERCISES FOCUSING ON TEXT STRUCTURE ON LEARNERS OF ENGLISH AS A FOREIGN LANGUAGE*

Khaing Ei Phyu Tun[1] and Soe Than [2]

Abstract

The main objective of this research was to develop the reading exercises focusing on text structure and to investigate the impact of these exercises on learners' reading and writing skills. As foreign language learners, students in Myanmar learn mainly two English language skills: reading and writing. Reading is the major activity for them to obtain an unlimited amount of knowledge. Thus, teachers should find out and teach exercises that can enhance both students' reading and writing skills. The text structure exercise is one of the ways to improve these skills. To investigate the effects of text structure exercises, a sample of (314) Grade Nine students from four Basic Education High Schools was used. A quasi-experimental research design was applied. Five text structure exercises: Description, Collection, Compare and Contrast, Cause and Effect and Problem and Solution were taught in the pilot group, first. After necessary changes had been made, they were used in the experimental groups. To see whether the groups which received the extended reading exercises and those which did not were the same at the beginning of the study, a pretest was administered. After 5 months' treatment, the sample students were administered a series of posttests to see whether the exercises were really effective in their reading and writing skills. According to the findings, it was found that the performance of students who received the extended reading exercises was better than that of students who did not, in all the selected sample schools. Thus, it was concluded that the text structure exercises contributed to the improvement of students' reading and writing skills.

Key words: impact, extended reading exercises, text structure, description, collection, compare and contrast, cause and effect

Introduction

In Myanmar, English language is regarded as a foreign language. For foreign language students, English, a world language, can be learned mainly at school."The Grade Nine English Text aims to develop students' reading and writing skills and at the same time provide opportunities their speaking and

1. Dr. Senior Assistant Teacher, No.5 Basic Education High School, Mayangone, Yangon.

2. Dr, Professor, Head of the Department of Methodology, Yangon University of Education.

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listening skills" (Ministry of Education, 2016). Although the aim of language learning is to develop four language skills, "the thrust of the revised ELT curriculum in basic education schools is the development of reading and writing skills" (Myo Myint & Poe Poe, 2003, as cited in Kam & Wrong, 2003). So, learners are studying English with little opportunity to speak it or hear it, then, reading is the only activity that gives them access to unlimited amount of the language. Jordan (2000) states that reading is a skill that is normally linked with writing. Thus, the teacher should find out extra-curriculum activity to improve their reading skill as well as writing skill.

Three approaches were chosen to relate reading and writing skills; explicit teaching of knowledge of text structure and its associated signal words, drawing graphic organizer and writing summary about the given paragraph. Generally, there are two major types of text structure: narrative and expository. Although basically there are two types of text structure, only expository text structure will be involved in this research. Based on Meyer (1999) five expository text structures exercises: description, collection, compare and contrast, cause and effect and problem and solution are developed in this research. Knowledge of text structure, signal words, and graphic organizer will enhance students' ability to construct meaning during reading and will give them insight about what should be organized during writing. Moreover, by summarizing, the students will have opportunities to apply basic knowledge of text structure in their writing. It helps students learn the construction of written text in general. By providing students with the exercises focusing on text structure, they can better understand how to make a piece of writing more effectively and increase their reading skill. Therefore, the extended reading exercises focusing on text structure will enhance students' reading skill as well as their writing skill.

Objectives of the Research

The major objectives of this study can be briefly described as follows:

1. To develop extended reading exercises focusing on text structures.
2. To investigate the impact of extended reading exercises on learners' reading skill.

3. To investigate the impact of extended reading exercises on learners' writing skill.
4. To give suggestions for improving learners' reading and writing skills.

Hypotheses

Hypotheses of this study are as follows.

H1: There is a significant difference in the reading skill between students who receive extended reading exercises focusing on text structure and those who do not.

H2: There is a significant difference in the writing skill between students who receive extended reading exercises focusing on text structure and those who do not.

Definitions of Key Terms

Extended Reading Exercises

Extended reading exercises is defined as the reading exercises focusing on text structure which is not included in the English Text in order to improve the reading and writing skills of students.

Impact

Impact refers to the effectiveness of the text structure exercises on students' reading and writing skills. There may be two kinds of effect: positive and negative. If the students' reading or writing skill is improved after teaching the text structure exercises, there will be a positive effect and vice versa.

Text Structure

Text structure refers to the internal organization of a text. As authors write a text to communicate an idea, they will use a structure that goes along with the idea (Meyer, 1985).

Meyer (1999) describes five organizations or patterns of text: description, collection, compare and contrast, cause and effect and problem and solution.

The Significance of the Study

The contribution of this study is that extended reading exercises or text structure exercises will help to improve students' reading and writing skills. Students will have better idea for their writing by learning the reading exercises. In addition, this study will provide with learning materials for teachers to improve students' reading skill as well as writing skill. For learners, these exercises would be a better way to learn the reading and writing skills and would provide ways to have success in their language learning. Therefore, this study would be a contribution to both language teachers and learners as it would provide necessary information about the way to teach the reading and writing skills effectively.

Review of Related Literature

In the literature review, types of expository text structure and its associated signal words that highlight the aspects of structural organization in text and graphic organizer, and Gradual Release Responsibility Model are described.

Text Structure

Text is written much in the same way a house is built. The writer begins with a basic blueprint that guides the overall design of the house, which is like the overall organization of a piece of text. Generally, there are two major types of text: narrative and expository. The blueprint for narrative text tends to be organized around literary elements such as setting, characters, plot, and theme. The blueprint for expository or information text tends to be based on a hierarchy of main ideas and subordinate main ideas, often reflected through the use of headings and sub-headings.

Text structures are authors' arrangements or organizations of ideas in texts. Meyer (1999) has described five organizations or patterns of expository text. These types of text structure can be represented by graphic organizers. They help students structure their learning, visualize the way information is organized in texts to improve comprehension. A graphic organizer can be defined as "a visual and graphic display that depicts relationships between facts, terms and ideas within a learning task" (Hall & Strangman, 2002). First, the following example represents the structure of **description**.

Example: *There are many kinds of birds in the world. All of them have wings and many of them can fly, but some cannot. Birds which cannot fly are called flightless birds. For example, penguins, ostriches, and emus are all flightless birds. They have wings but they cannot fly. Penguins are found along the shore of South Atlantic Ocean. They can neither fly nor run but they are very good swimmers. Ostriches are found in South Africa and Western Asia. They can run as fast as sixty miles per hour. Emus which are found only in Australia cannot fly either but they can run (Ministry of Education, 2016).*

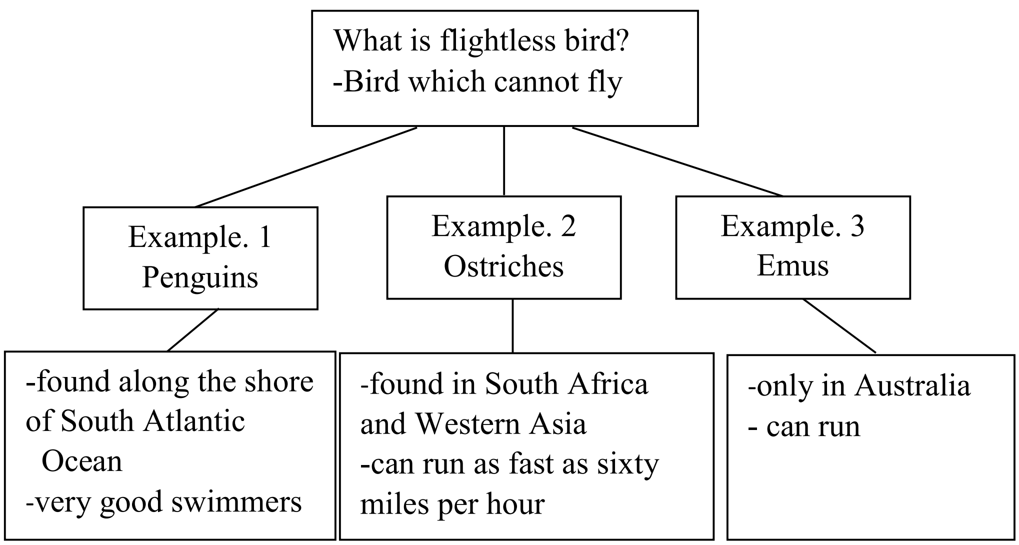


Figure 1: Descriptive Text Structure

In addition, **collection** text structure can be organized by the following graphic representation.

Example: *When you plan your week, you should make a list of things that you have to do. Otherwise, you may forget to leave enough time to complete an important task. After making the list, you should make a schedule of your time. First, fill in committed time eating,* *sleeping, dressing, school, meetings, and so forth. Then, decide on a good regular time for studying. Be sure to set aside enough time to complete the work that you are normally assigned each week (Ministry of Education, 2016).*

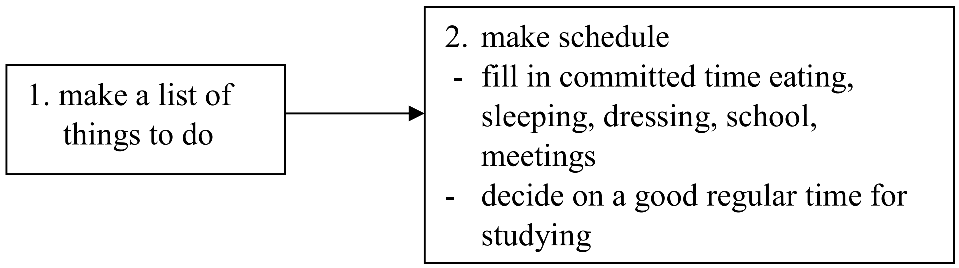


Figure 2: Sequence Text Structure

Furthermore, **compare and contrast** text structure can be represented by the following graphic organizer.

Example: *Both reptiles and mammals are included in the group of vertebrates. And also both of them are land animals although a few are aquatic. But, they have different characteristics. Reptiles are those animals with a dry skin covered with scales or bony plates. But, mammals' bodies are covered with hair. Reptiles are cold-blooded animals while mammals are warm-blooded animals. The distinct characteristic of mammals is that they feed their young with milk from milk glands (adapted from Ministry of Education, 2016).*

Reptiles	Similarities	Mammals
- dry skin covered with scales or bony plates - cold-blooded animals	- Vertebrates - Land animals (a few aquatic)	- covered with hair - warm-blooded animals - feeding their young with milk

Figure 3: Compare and Contrast Text Structure

And also, the following graphic organizer represents the structure of **cause and effect**.

Example: *After an earthquake happens, people can die from lack of food, water and medical supplies. The amount of destruction caused by an earthquake depends on where it happens, what time it happens, and how strong it is. It also depends on types of buildings, soil conditions, and populations. Of the 6000 earthquakes in the world each year, only about fifteen cause great damage and many deaths (Ministry of Education, 2016).*

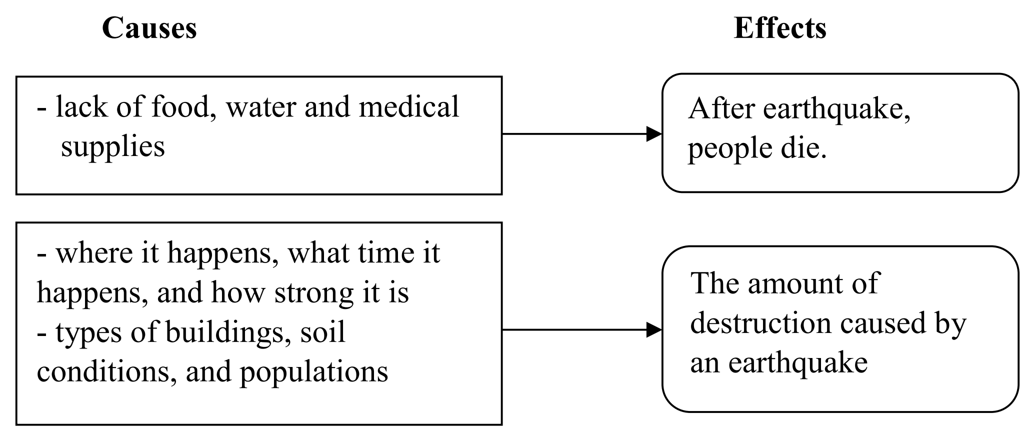


Figure 4: Cause and Effect Text Structure

Moreover, the graphic representation of **problem and solution** can be found in the following structure.

Example: *Recognizing the importance of traditional medicines, in 2003, WHO (World Health Organization) introduced a Traditional Medicine Strategy. According to this strategy, there were several areas of concern. The first area of concern is safety. WHO recommends more scientific testing on traditional medicine - not all the traditional medicines are helpful and some can actually be harmful (Ministry of Education, 2016).*

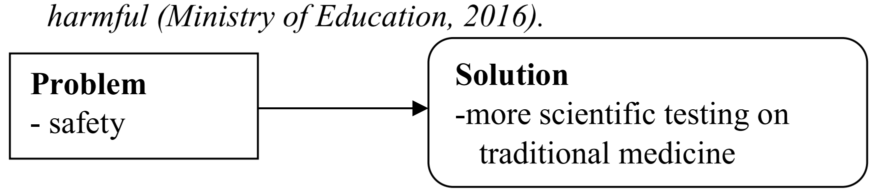
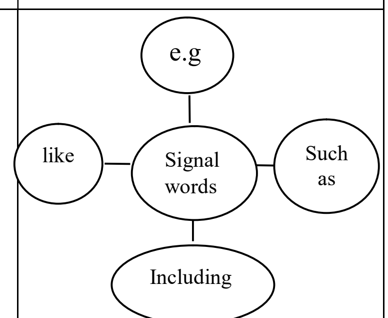


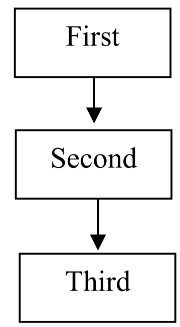
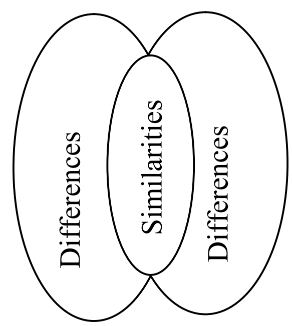
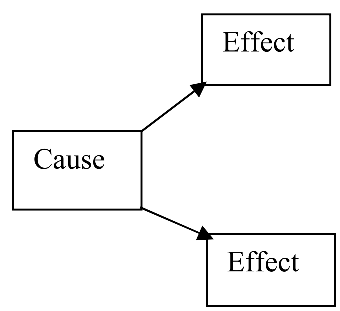
Figure 5: Problem Solution Text Structure

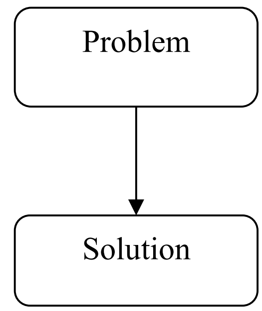
In each type of the expository text, there are words which serve as signals for the particular type of text. Meyer (1985) defines "the signals as stylistic writing devices that highlight aspects of semantic content or structural organization. Signaling is information in text that does not add new content in a topic but gives emphasis to certain aspect of the semantic content and points out the aspect of the structure of the content". Based on their signaling function, Meyer (1985) has also introduced four types of signaling: words that state the relational structure among main propositions of the text, preview statements, summary, and pointer words. The signal words in this study refer to the words that state the relational structure among main propositions of the text as signals.

In the text structure exercises, the students have to learn about the text structure, signal words and graphic organizer, but they have to write a summary of a paragraph by using the information in the graphic organizer. Summarizing does not follow the actual rules of summary writing. It is only a way of practicing to write a text by using the text structure and the information presented in the given text. It is assumed that these factors: identifying text structure and signal words, drawing graphic organizer and summarizing will help to improve the students' reading and writing skills. Five expository text structures, their associated signal word and graphic organizers are described in the following table.

Table 1: Five Expository Text Structures and their Associated Signal Words

Text Structure	**Description**	**Signal words**	**Graphic organizer**
Description	The author describes a topic by listing characteristics, features, attributes and examples	• For example • Characteristics • For instance • Such as • Is like • Including • To illustrate	

Text Structure	**Description**	**Signal words**	**Graphic organizer**
Collection (listing, sequence)	The author lists items or events in numerical or chronological sequence.	• First • Second • Third • Later • Next • Before • Then • Finally • After • Later • Since • Now • Previously	1.________ 2. ________ 3. ________ 4. ________ 
Compare and Contrast (Comparison)	Information is presented by detailing how two or more events, concepts, and things are alike or different	• However • Nevertheless • But • Similarly • In contrast • Different • Alike • In the same way • Either or • Likewise • In comparison	
Cause and Effect (causation)	The author presents ideas, events as causes and the resulting effects that happens as a result of the events.	• If / then • Reasons why • As a result • Therefore • Because • So that • For • Hence • Due to • Thus • This lead to	

Text Structure	Description	Signal words	Graphic organizer
Problem and solution	The author presents a problem and one or more solutions to the problems	• Problem is • Dilemmas is • Difficulty • Need to prevent • Danger • Threat • Solution • In response • Recommended • Suggest • Reply	

Gradual Release of Responsibility Model (GRR Model)

The gradual release of responsibility is a research-based instructional model developed by Pearson and Gallagher (1983). In this optimal learning model, the responsibility for task completion shifts gradually over time from the teacher to the student. This model emphasizes that the teacher shifts from assuming all the responsibility for performing a task to a situation in which the students assume all of the responsibility.

Based on the ideas of the Russian educational theorist Lev Vygotsky, Pearson and Galagher (1983) envisioned instruction that moved from explicit modeling and instruction to guided practice and then to activities that positioned students into becoming independent learners. Based on Pearson and Gallagher's (1983) model, Fisher and Frey (2008) take the model a step further by defining the specific stages in greater detail. According to them, four interactive (or interrelated) components of a gradual release of responsibility model are: Focus lessons (I do it), Guided instruction (We do it), Collaborative (You do it together) and Independent (You do it alone). These four instructional arrangements are shown in the following figure.

A Structure for Successful Instruction

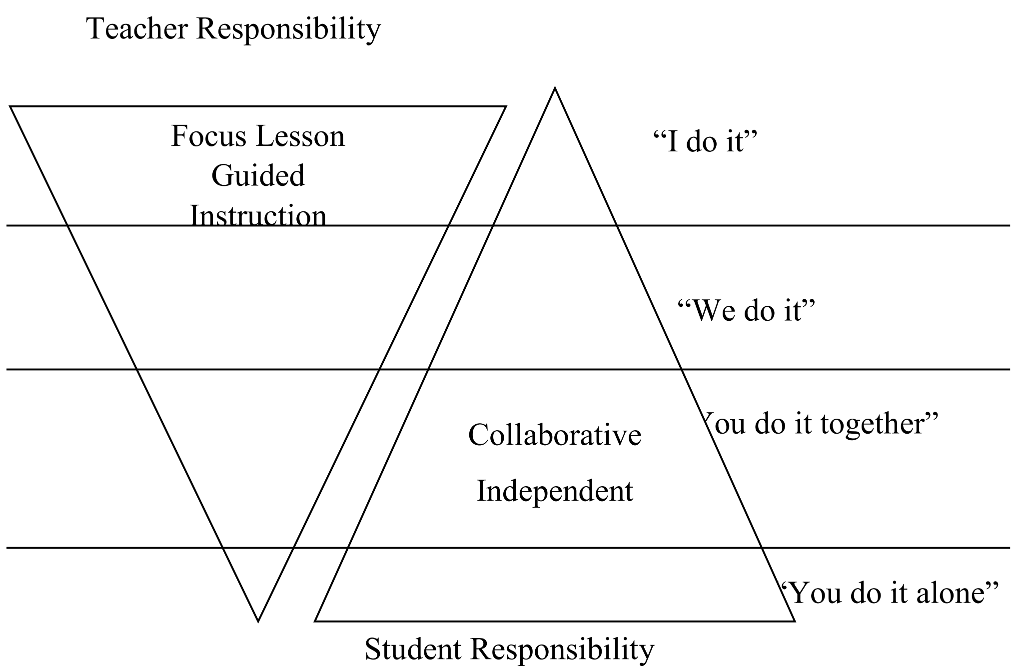


Figure 6: Gradual Release Responsibility Model (GRR Model)
Source: Fisher and Frey (2008)

Methodology

I. Sample of the Study

Participants for this study were chosen by using the stratified random sampling method. The sample of this study were (314)Grade Nine students from four Basic Education High Schools: B.E.H.S (1) Mingalardon, B.E.H.S (3) Mingalartaungnyunt, B.E.H.S (5) Mayangone and B.E.H.S (6) North Okkalapa (see Table 2).

Table 2: Sample Size in the Research

BEHS	Pretest			Posttest		
	Control Group	**Experimental Group**	**Total**	**Control Group**	**Experimental Group**	**Total**
BEHS (5) Mayangone	43	51	94	42	45	87
BEHS (3) Mingalartaung-nyunt	39	40	79	37	35	72
BEHS (1) Mingalardon	43	35	78	37	34	71
BEHS (6) North Okkalapa	41	44	85	41	43	84
Total	**166**	**170**	**336**	**157**	**157**	**314**

II. Research Instruments

1. Pre-test

In order to determine whether the control and experimental groups were the same or not at the beginning of the study, the students were pretested. It includes two parts, one for reading and the other for writing. In achievement test for reading, the students are given two reading comprehension passages. After reading the passage, they have to answer some reading comprehensions. Achievement test for writing includes three items. Question No. I and II are to assess how much the students are familiar with signal words. In Question No. III, students have to write a paragraph by using the given prompts.

2. Post-test

The purpose of the post-test is to determine the impact of the extended reading exercises on students' reading and writing. There are five reading comprehension tests and five paragraph writing tests in posttest. In achievement test for reading, there are five items. The students are given five reading passages. Question No. I includes a descriptive reading paragraph, No. II is a paragraph with collection structure, No. III is a compare and contrast text, No. IV is a cause and effect paragraph and finally, No. V is a problem and solution paragraph. After reading the passage, they have to answer some reading comprehension questions. In achievement text for writing, there are also five items. The students have to write five paragraphs by using the given information in Question No. I, III, and IV.But, in Question No. II and V, students have to find out their own ideas in order to write a paragraph.

The pre-test and post-test were constructed under the guidance of supervisor and co-supervisor. As the tests were self-developed tests, the researcher asked five experts for the content validity. According to the suggestions of these experts, the tests were revised. Students had to sit for two hours in reading and two hours in writing.

3. Questionnaire

When the post-test had been done, in order to get the necessary information about the teachers' and students' attitude to the text structure exercises, a questionnaire was constructed. This questionnaire includes ten items concerning the effect of the extended reading exercises on the students' reading, writing and their opinion on teaching of these exercises and one open-ended question. It is constructed based on the five points Likert scale. The initial draft of the questionnaire was checked by the supervisor and co-supervisor.

4. Interview

After that, teachers and five students who were randomly selected from each school were interviewed in order to obtain the in-depth information of the way they apply text structure knowledge in their reading and writing and their attitude to text structure knowledge. The semi-structured interview was constructed in a way that the students must use their text structure knowledge in their reading and writing, the effectiveness of the text structure knowledge in their understanding and their attitude on teaching text structure exercises. The interviews with the teachers and students were recorded.

III. Experimental Design

There are two groups in this research. Both of the groups were not randomly formed. As the researcher had to use two intact groups, the design is a quasi-experimental design. Two existing groups were pretested at the start of the research. After that, the experimental group received a treatment. Both groups had to take the posttest to be compared by the scores and to determine the effectiveness of the suggested text structure exercises. As this producer does not involve the random assignments of subjects to groups, the design applied in this research is the Nonequivalent Control Group quasi-experimental design.

IV. Procedure

Before the extended reading exercises were used in teaching, the lesson plans for these exercises were developed. These exercises were used in the pilot study group, first. Then, they were used in the selected Basic Education High Schools.

1. Lesson Plan

Lesson plans for extended reading exercises are based on the Gradual Release Responsibility model developed by Pearson and Gallagher (1983). Based on Pearson and Gallagher's (1983) model, Fisher and Frey (2008) take the model a step further by defining the specific stages in greater detail. According to them, there are four interactive (or interrelated) components: Focus lessons (I do it), Guided instruction (We do it), Collaborative learning (You do it together) and Independent learning (You do it alone). According to these phrases, the lesson plan contains four stages. At the first stage, the teacher states the purpose of the task, explains when the task is used and demonstrates how the task is completed. In the guided instruction, the students are divided into small groups and work together under the guidance of the teacher. In stage three of the collaborative learning, the students are also divided into groups and different tasks are allocated to the group members. And then, they have to answer the way they think to decide the structure of text. In the final stage, the students have to work the task on their own.

2. Pilot Teaching

As an initial phrase of this study, a pilot study was carried out in June 2015. In order to know if the extended reading exercises were suitable or not to Grade Nine students, the students in School A were selected for the pilot study. There were (65) test takers: (36) test takers in the experimental group and (29) test takers in the control group. Both the pilot teaching groups were pretested, and the experimental group receives treatment. After teaching the text structure exercises, both groups were posttested. Based on the result of the pilot study, the researcher improved the weakness of wording in tests and modified the text structure exercises which were inappropriate.

3. Analysis of Pilot Teaching

According to the pre-test, there is no significant difference between the experimental group and control group. After the treatment, both the experimental and control groups were post tested in order to determine the effectiveness of the treatment. The scores of the post-test were analyzed by using the *t*-test for independent samples. After the post-test, the means of the two groups indicate that there is a significant difference between the experimental and control groups.

4. Teaching in the Selected Schools

When the pilot study was finished, a pre-test was administered in selected Basic Education High Schools. After the pre-test, it was found that the experimental and control groups were essentially the same at the beginning of the study. The experimental groups in four schools were taught the suggested extended reading exercises from August, 2015 to December, 2015. The experimental group in School A was taught by the researcher and the experimental groups in the other three schools were taught by the other three Senior Teachers who had learned about extended reading exercises. In January, 2016, both control and experimental groups had to take the posttest. The post-test was used to determine whether there was a significant difference between the experimental and control groups.

After the post-test, a questionnaire for the teachers' and students' attitude on the text structure exercises was used. After that, in order to obtain the in-depth information of the way they apply text structure knowledge in their reading and writing, teachers and five students from each school were interviewed. Both the questionnaire and interview were conducted only in experimental groups. Teachers and every student in the experimental groups had to respond to the questionnaire and five students who were selected randomly in each experimental group were requested to participate in the interview study.

Findings

I. Findings from Quantitative Study

To be able to compare the differences between the experimental group which received extended reading exercises and the control group which did not, the scores for post-test were analysed by using the independent samples *t*-test.

1. *t* Values for Post-test Scores on Reading Questions

In all the reading questions, there is a significant difference between the experimental and control groups. Therefore, it can be interpreted that the groups which received the extended reading exercises did better than the groups which did not receive these exercises in reading comprehension skill (see Table 3).

Table 3: *t* Values for Total Post-test Scores on Reading Questions

School	Group	N	Mean	SD	*t*	*df*	*Sig. (2-tailed)*
A	Experimental	45	37.64	4.9	6.707	85	.000***
	Control	42	29.62	6.223			
B	Experimental	35	35.69	4.44	7.980	70	.000***
	Control	37	25.65	6.138			
C	Experimental	34	34.74	5.059	7.484	69	.000***
	Control	37	25.59	5.183			
D	Experimental	43	32.16	3.207	8.813	82	.000***
	Control	41	26.02	3.174			

Note: ***$p < .001$

2. *t* Values for Post-test Scores on Writing Questions

In all writing questions, the probability value of test score was less than .001 for all schools. Therefore, it can be concluded that the groups which received extended reading exercises performed better in writing skill than the groups which did not (see Table 4).

Table 4: *t* Values for Total Post-test Scores on Writing Questions

School	Group	N	Mean	SD	*t*	*df*	*Sig. (2-tailed)*
A	Experimental	45	33.38	3.749	13.316	85	.000***
	Control	42	22.26	4.037			
B	Experimental	35	30.06	3.233	7.196	70	.000***
	Control	37	22.78	5.083			
C	Experimental	34	30.12	3.444	7.676	69	.000***
	Control	37	23.32	3.966			
D	Experimental	43	27.12	2.970	12.273	82	.000***
	Control	41	18.27	3.627			

Note: ***$p < .001$

II. Findings from Qualitative Study

In order to obtain the students' opinion on and attitude towards whether text structure exercises are beneficial for them or not, the questionnaire and interview study was conducted.

1. Findings from Survey Questionnaire

The questionnaire can be divided into two main parts: reading and writing. According to their answers, it was found that most of the students agreed that text structure knowledge can enhance to see the main idea of a text. For the second item, most of the students strongly agreed that text structure knowledge can enhance to select the important points of a text. And also, most of them strongly agreed on the fact that signal words enhance to understand a text. Most of the students strongly agreed on the fourth item that graphic organizer enhance to understand the structure and the content of a text. Moreover, they had confidence in understanding the content of a text by using text structure knowledge. They strongly agreed that text structure knowledge enhance to remember the content of a text. For writing, most of the students strongly agreed that text structure knowledge provides them basic pattern of writing. They also strongly agreed on eighth item; signal words enhance to present their writing effectively and ninth item; drawing graphic organizer enhance to organize their idea. Finally, they did strongly agree on the fact that they feel confident to organize their writing well by text structure knowledge.

2. Findings from Interview Study

In order to obtain the in-depth information of the students' opinion on teaching text structure exercises and the way they apply text structure knowledge in their reading and writing, five students who were randomly selected from each school were interviewed. Interview includes three main points: the way the students apply text structure knowledge in their reading, writing and their attitude towards teaching these exercises.

Interviews describe that students apply text structure knowledge in their reading and writing. Students have a better idea of the reading passages and how the information can be organized in their own writing. In reading, signals are the cues to decide the structure of the text. In addition, graphic organizer helps students to comprehend the structure of the text and main points presented in it. In writing, students can use signal words to highlight the main ideas of their writing. And also, graphic organizer shows ways to organize information in their own writing. To conclude that text structure, signal words and graphic organizer operate significant support for the students' clear reading and effectual writing.

Discussion and Suggestions and Conclusion

Discussion

According to the results of t-test, it is found that the extended reading exercises have a positive impact on students' reading and writing skills. In other words, these exercises can improve the reading and writing skills of students. Signal words are considered as cue words to decide the structure of the text in reading and also they can highlight ideas presented in the text if they are used in writing. With signal questions, students can focus on the important points in the text. By the use of graphic organizer, students not only recognize the structure of the text but also understand the main ideas presented in the text. In addition, writing summary provides students an opportunity to use the structure of the text that they had read in organizing their own writing.

This result is consistent with the following findings. Kara (2013) examined that the effect of explicit teaching of signal words on reading comprehension with EFL learners. The result indicated that teaching of signal words contributes to the reading comprehension. And also, Gaddy, Bkken, and Fulk (2008) conducted a study to determine the relative efficacy of text structure strategy instruction. The result indicated that the students in text structure strategy condition outperformed students in the traditional instruction. Carrell (1985) conducted a study to determine whether explicit teaching of text structure can facilitate reading for learners of English as a second language. The result showed that the overt teaching about the text structure can facilitate ESL students' reading comprehension. Furthermore, Newman (2007) examined the effects of explicit instruction of expository text structure incorporating graphic organizer on the comprehension of students. Findings from this study revealed that students receiving the intervention showed a statistically significant difference in their ability to comprehend expository texts. For writing, Hammann and Stevens (2003) conducted a study for instructional approaches to improving students' writing compare and contrast essay. The result indicated that the students receiving text structure instruction had significantly higher score on compare and contrast structure.

All these findings are in line with the quantitative result of this study which is also supported by the following qualitative result. From the questionnaire and interview, students express that text structure knowledge enhance them to see the main idea of a text. In addition, text structure knowledge also help them to see how to select the content of a text (e.g. description, sequence, comparison, etc.). This finding is supported by Sanders and Noordman (2000). They found that linguistic markers (signal words) guided the reader in selecting the right coherence relation. After teaching text structure, signal words and graphic organizers, students have confidence in understanding the content of a text and remember the content of a text longer. This is consistent with the finding of Gaddy, Bakken, and Fulk (2008). Their finding indicated that text structure strategy instruction improves long-term comprehension rather than sort-term rote memorization. In addition, Armbruster, Anderson, and Ostertag (1987) also found that text structure training group recalled more information of the essay test on the main idea of a problem and solution passage. For writing skill, text structure knowledge enhances students to see the basic patterns of writing. Moreover, they have confidence in organizing their writing well by using text structure knowledge. This finding is in line with Hammann and Stevens (2003) who found that text structure instruction helped students meet the demands of organizing the content to be presented in a compare and contrast structure. This finding expresses that students have positive attitude towards the extended reading exercises and they apply text structure knowledge in their reading and writing.

Suggestions

By the findings discussed above, the following suggestions are to be made.

- ❖ As it is found that students' reading and writing skills are related, teachers and curriculum developers need to develop plans to support the students' reading ability as well as writing skill. So, it is suggested that to be able to improve the students' reading and writing skills, teachers should use text structure exercises.
- ❖ Teachers should explain students both the purpose and function of the signal words and graphic organizers and the way to use them in both reading and writing.
- ❖ Teachers should explicitly explain students the various functions of the signal words in order to enhance their comprehension as well as writing skill.
- ❖ Teachers should give emphasis to the use of the graphic organizers to guide both reading and writing. Then, students will have a better idea of the organization of a text and how the information can be organized in their own work. Moreover, at advanced level, the students will be able to carry out more complex assignments successfully because the graphic organization provides way to maintain more complex sets of information

and makes accurate comparisons and syntheses across related sources of information on a theme.

- The next suggestion is that when the students see the organization of a text that they read, they should use that knowledge in their own writing. Summary writing is an effective way to organize information presented in text. To be an effective summarization instruction, students should be explained that summarizing passage supports the students understanding of the material in the text, their identification of the main ideas and their memory of this information. In addition, the students should be told that being able to summarize would help them with a primary challenge in writing: what to say and text structure knowledge would provide them how to write.
- Moreover, it should also be suggested that before the students are able to write a summary, the guidelines for writing a summary of a particular text structure should be given first and then they should write a summary of a passage on their own. They should practise to compose a paragraph or an essay that reflects a single text structure so that they have chance to use the text structure knowledge in their own writing.
- Moreover, the passages used in the texts should be structured and signaled texts. When students recognize the way the structured texts are arranged and organized, they will understand the basic patterns of writing and will apply this knowledge in their writing.
- So, it is suggested that the extended reading exercises should be used in texts at different grade levels by varying length and difficulty. In addition, it is also suggested that students will quickly see the power of the ideas of the text structure knowledge if the instruction is done well and done regularly.
- The final suggestion is the use of instructional procedures included in the gradual release responsibility model. As the purpose of the model is to help students become independent learners, the teacher gradually shifts the responsibility for task completion to the students. This model can be applied in all subject areas and at all grade levels.

Conclusion

The main objective of this research is to develop the extended reading exercises focusing on text structure and to investigate the impact of these exercises on learners' reading and writing skills. Based on the idea of Meyer (1999), five text structures exercises: Description, Collection, Compare and Contrast, Cause and Effect and Problem and Solution are constructed in this research. After the text structure exercises were developed, based on the gradual release responsibility model developed by Pearson and Gallagher (1983), lesson plans for these exercises were developed. They were taught in the pilot group, first. After necessary changes had been made, exercises were used in the experimental groups in four Basic Education High Schools. The schools were selected from Yangon Region by using the stratified random sampling method. As two classrooms from each school were randomly selected, the quasi-experimental design was used in this study. The exercises were taught to the experimental groups in all the selected schools. The post-test only control group design was used in this study and pre-test scores were used only to see whether there is a significant difference between the experimental and control groups or not at the beginning of the study. According to the quantitative results of the research, it was found that both in the reading and writing skills, there was a statistically difference between groups which received the extended reading exercises and those which did not. Similarly, the qualitative result of the research proved that the students have positive attitude towards the extended reading exercises and apply these knowledge in their reading and writing. Extended reading exercises can provide an effective way to improve the reading and writing skills of students. Therefore, the suggested extended reading exercises should be used as a reference for teachers and will be one of the significant contributions to the improvement of students' reading and writing skills.

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Appendix

Five Text Structure Exercises

I. The Example of Descriptive Text Structure

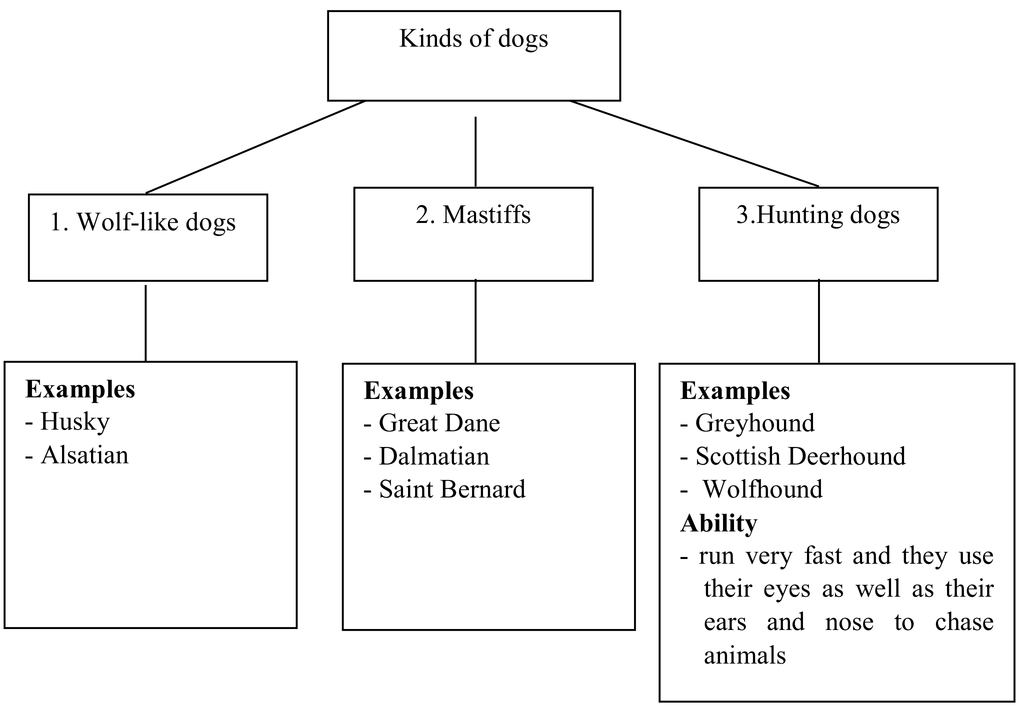
Dogs

All of us have seen dogs, but only a few of us know all the things about dogs. There are **different kinds** of dogs. Some dogs are very much like wolves. Such dogs are called wolf-like dogs. The Husky and Alsatian are **good examples** of wolf-like dogs.

There is another group of dogs called the Mastiffs. The Great Dane, the Dalmatian, the Saint Bernard are all Mastiffs.

Some kinds of dogs are used in hunting, that is, catching animals. Hunters usually keep hunting dogs and take them along when they go out hunting. **For example,** the Greyhound, the Scottish Deerhound and the Irish Wolfhound are all hunting dogs. They can run very fast and they use their eyes as well as their ears and nose to chase animals which their masters, the hunters want to catch (Ministry of Education, 2016).

1. Describe three kinds of dogs with examples, using the following graphic organizer.



2. Write a summary of the paragraph mentioned above by using signal words.

There are different types of dogs such as wolf-like dogs, Mastiffs and hunting dogs. Husky and Alsatian are good examples of wolf-like dogs. Examples of Mastiffs are Great Dane, the Dalmatian, and the Saint Bernard. The Greyhound, the Scottish Deerhound and the Irish Wolfhound are examples of hunting-dogs. They can run very fast and use their eyes as well as their ears and nose to chase animals.

II. The Example of Collection Text Structure

Methods for shampooing dogs

There are two methods that can be used to shampoo your dog. **The first method** is the 'outside tub' method. To wash your dog outside the house, you will need a tub, some warm water, a large towel and of course, your dog, if you can find him.

In the second method, the 'inside house' method, you will need to use your bathtub. The bathtub should not be filled too full and the amount of shampoo used should not be large because an active dog can spray water and shampoo all over your bathroom.

In each of two methods, there are several steps to follow. **First**, fill the tub with 10 cm of warm water. **Then,** take the dog's color off and put him in. **Third,** shampoo the dog's back, legs, feet and head. **Fourth,** rinse off the shampoo. **Next,** take the dog out of the tub and let him shake. **Finally,** dry him off with a towel (Gordon, 1990).

1. List the methods that can be used to shampoo a dog.

1. Inside house method
2. Outside tub method

2. Draw a graphic organizer for the steps of shampooing a dog.

Fill the tub with 10 cm of warm water

Take the dog's color off and put him in

Shampoo the dog's back, legs, feet and head

Rinse off the shampoo

Take the dog out of the tub and let him shake.

Dry him off with a towel

3. Write a summary of the paragraph mentioned above by using signal words.

To shampoo a dog, there are two methods: inside tub and outside tub methods. Both of these methods have to follow several steps. First, fill the tub with 10 cm of warm water. Then, take the dog's color off and put him in. Third, shampoo the dog's back, legs, feet and head. Fourth, rinse off the shampoo. Next, take the dog out of the tub and let him shake. Finally, dry him off with a towel.

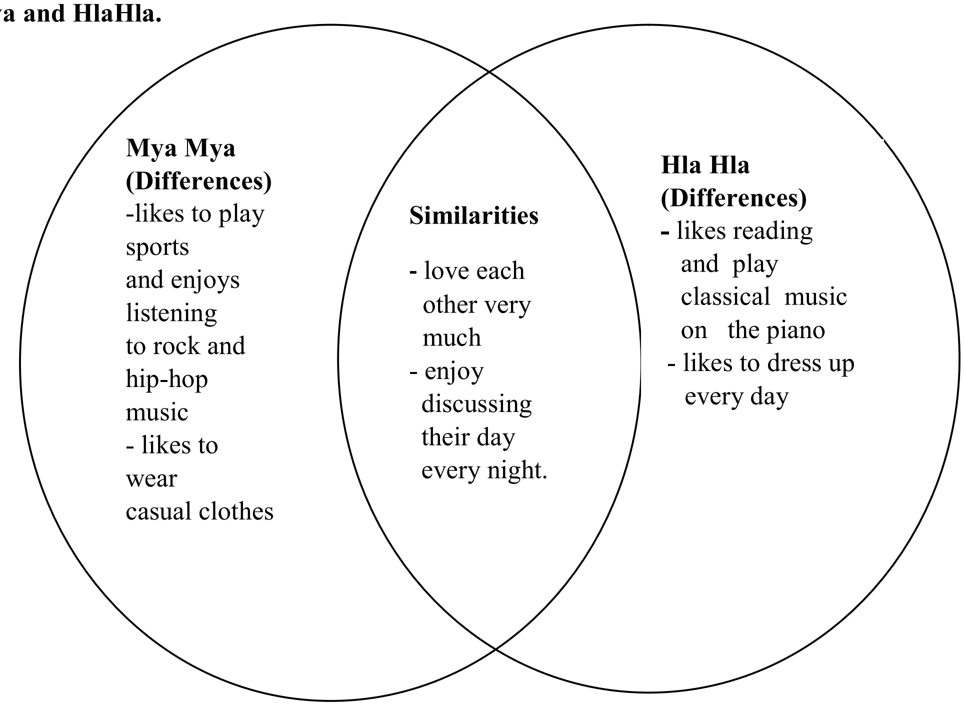
III. The Example of Compare and Contrast Text Structure

Twins

Mya Mya and Hla Hla are identical twins. Although they look exactly alike, everything else about them is **different**. MyaMya likes to play sports and enjoys listening to rock and hip-hop music. **Unlike** Mya Mya, Hla Hla would much rather read and play classical music on the piano with her free time. They dress **differently**, too. Mya Mya likes to wear casual clothes, **but** Hla Hla prefers to dress up every day. Even though they lead very **different** lives, **both** My aMya and Hla Hla love each other very much and enjoy discussing their day every night.

1. With the help of the following graphic organizer, describe the similarities and differences between Mya

Mya and HlaHla.



2. Write a summary of the paragraph mentioned above by using signal words.

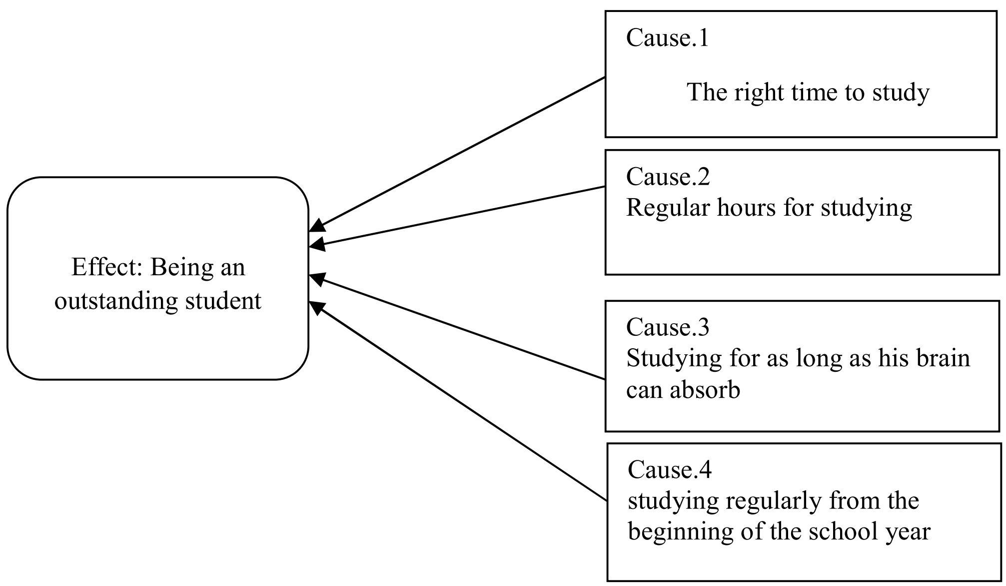
Mya Mya and Hla Hla are identical twins. Both of them love each other very much. And also both of them enjoy discussing their day every night. But, there are differences. Mya Mya likes to play sports and enjoy listening to rock and hip-hop music. Unlike Mya Mya, Hla Hla likes reading and play classical music on the piano. In addition, while Mya Mya likes to wear casual clothes, Hla Hla likes to dress up every day.

IV. The Example of Cause and Effect Text Structure

Outstanding Student

Not all the students in a class are outstanding. **Why?** There are many **causes** to be an outstanding student. First **reason** is the right time to study. A student should study when he is fresh and his head is clear in order to absorb well what he or she is trying to learn. Second, an outstanding student keeps regular hours for studying. Third, he studies for as long as his brain can absorb. This means that one should not study when his brain becomes exhausted. Relaxing is very important. Finally, he studies regularly from the beginning of the school year. All these are **reasons** for being an outstanding student.

1. Describe the causes of being an outstanding student, with the use of following graphic organizer.



2. Write a summary of the paragraph mentioned above by using signal words.

There are many reasons to be an outstanding student. The first reason is that an outstanding student has the right time to study. Second, he keeps regular hours for studying. Third, he studies for as long as his brain can absorb. Finally, he studies regularly from the beginning of the school year.

V. The Example of Problem and Solution Text Structure

Penicillin

Bacteria are microbes which attack our body and cause illness. In our body, there are very small red and white cells. The white cells fight the microbes which cause diseases. If the white cells lose the fight, the person becomes seriously ill and may even die. Doctors use antiseptics to kill dangerous microbes. The **problem** is that the antiseptics also killed the white cells. In order to **solve this problem**, Alexander Fleming worked hard to find out something which would kill only the microbes, not the white cells. He found a mould which killed only the microbes. He named this mould penicillin. For his work, he was given the title of "Sir". Penicillin is the **best solution** to kill microbes and to save the countless number of lives all over the world (adapted from, Ministry of Education, 2016).

1. Describe the problem and solution of the paragraph in the following graphic organizer.

Problem
Antiseptics kill dangerous microbes and also white cells which can fight the microbes.

Solution
Alexander Fleming found a mould, named penicillin which killed only the microbes.

2. Write a summary of the paragraph mentioned above by using signal words.

In our body, there are two types of cells: red and white cells. The white cells are very important because they fight the microbes which cause diseases. Doctors use antiseptics to kill microbes. The problem is that the antiseptics also killed the white cells. In order to solve this problem, Alexander Fleming worked hard and found a mould, named penicillin which killed only the microbes. Penicillin is the best solution to kill microbes and to save the countless number of lives all over the world.

AN INVESTIGATION INTO THE IMPACT OF PROCESS APPROACH TO TEACHING WRITING IN MYANMAR LANGUAGE AT THE HIGH SCHOOL LEVEL

Yin Nwet[1] and Myo Win[2]

Abstract

In the middle and high schools in Myanmar, the role of essay writing has been changed from lessons to be practiced to lessons to be memorized because of the teaching practices which focus on the completed essay and neglects how students write essays. So, a systematic approach to teaching writing is needed in Myanmar Language teaching to promote the students' writing skill. This study is concerned with the adaptation and adoption of process approach in teaching writing. To investigate the effect of using process approach to teaching writing, an experiment was conducted. The participants were (394) Grade Nine students from four selected schools in Yangon Region. In this study, one of the quasi-experimental designs, non-equivalent control group design, was used. At the beginning of the study, a pretest was administered to know whether there were significant differences in writing skill between the experimental and control groups. And then, the experimental groups were taught writing through the proposed process approach by using the learning materials developed by the researcher. The control groups were taught through teacher-led instruction. The treatment period was from August, 2016 to November, 2016. At the end of the treatment period, both the control and experimental groups were compared by a posttest. According to the statistical data obtained from the posttest, it was found that there were significant differences between the groups who were instructed through the proposed process approach and the groups who were instructed through teacher-led instruction in each school on the scores of writing achievement. Therefore, it can be interpreted that the proposed process approach model and learning materials positively contributed to the improvement of students' writing skill. It is believed that this study can solve the problems teachers and students are facing in teaching and learning essay writing.

Keywords: process approach, prewriting, drafting, revising, editing and sharing

1. Dr, Assistant Lecturer, Methodology Department, Yangon University of Education
2. Dr, Professor, Methodology Department, Yangon University of Education

Introduction

In Myanmar education, according to the Education Sector Study (ESS) (1993), rote learning is still the method preferred by teachers and students. Classroom practices also do not allow for analytical, creative thinking or free discussion. Mg Khin Min (2013) also points out that writing essay is not in its right place, training ground for students' writing skill because many students read others' readily written essays by heart. This issue is not a new one. It was also discussed in the meeting held by Basic Education Curriculum Syllabus and Textbook Committee, and Myanmar Language Commission in November, 1975. In this meeting, senior and junior assistant teachers who teach Myanmar stated that students read essays by heart for exam and some teachers also asked students to do so. As a result, students found it difficult to write even a page of essay themselves. They also said that the idea of teaching essay writing varied from school to school depending on teachers. They viewed that all these issues of teaching and learning essay writing in schools were because of the lack of guide book which explain how to write essay and how to teach essay. Zawgyi also recognized this requirement (Than Htut, 2003). Unfortunately, these problems still remain unsolved completely till now. At present, teachers are teaching essay writing in the same way and students are learning essay writing in the same way as before.

It is obvious that for teachers, to give students only topics to practice essay is not enough to produce a good product. Even giving outlines to write about a subject is not enough to promote students' writing skill. The ability of writing calls for more than cutting and copying from others' readily written essays and rearranging these pieces of writing. They can study other's essays to learn their style of writing. They must be able to write their thought and ideas in their own words effectively and efficiently.

The reason is that in teaching writing, product is considered to be the end. The process how to write or produce a good product is ignored. As a result, many students find it difficult to write an essay themselves. The role of the teacher is to show students how to catch fish for their whole life time and to refuse giving fish to students for a meal.

Now in Myanmar language teaching, a systematic approach to teaching writing is needed to promote students' writing skill and to help teachers to overcome their difficulties in teaching writing. Whether it is written in Myanmar language or in English language, the nature of writing is the same. So this study is concerned with the adaptation and adoption of process approach in teaching writing.

Objectives of the Research

The major objectives of the study can be briefly described as follows:

1. To develop learning materials based on process approach to teaching writing and the art of writing.
2. To develop a model for teaching writing through process approach
3. To investigate the impact of learning materials and the model on students' writing skill.

Research Hypotheses

H1: There is a significant difference in the improvement of overall writing skill between students who are taught through the process approach proposed by the researcher and those who are taught through product approach, teacher-led instruction.

H2: There is a significant difference in the improvement of basic writing skill between students who are taught through the process approach proposed by the researcher and those who are taught through product approach, teacher-led instruction.

H3: There is a significant difference in the improvement of paragraph writing skill between students who are taught through the process approach proposed by the researcher and those who are taught through product approach, teacher-led instruction.

H4: There is a significant difference in the improvement of essay writing skill between students who are taught through the process approach proposed by the researcher and those who are taught through product approach, teacher-led instruction.

Definition of the Key Term

Process Approach

According to Hoskisson and Tompkins (1987), in process approach, the emphasis in writing instruction is on the process involved in creating a product. The teacher's role has shifted from merely evaluating the end product to working with students throughout the writing process.

Scope of the Study

The following points indicate the scope of the study.

1. This study is geographically restricted to Yangon Region.
2. Participants in this study are all Grade Nine students from the selected schools in (2016-2017) Academic Year.
3. This study is limited to only six chapters of learning materials out of sixteen developed by the researcher. These six chapters are (1) Paragraph and process, (9) Narration, (10) Description, (12) Cause and effect, (13) Definition, and (16) Expanding paragraph into essay.

The seven chapters from (2) to (9) which are about the stages of writing process are excluded because there is time limit for teaching them and it is considered that they can be covered in teaching the selected chapters through the proposed process approach. The rest three chapters of writing strategies are also excluded because of the time limit. On the other hand, these writing strategies are not familiar to teachers and students. Therefore, the familiar ones mentioned above are selected.

Significance of the Study

The contribution of this study would be a new approach to teaching writing called process approach that is expected to help students perform better in Myanmar language essay writing. Moreover, this study would provide teachers with learning materials for teaching writing. This study will demonstrate that the process approach to teaching writing and the learning materials really work. That could be a ground-breaking approach to teaching writing in Myanmar language that will change the way the teachers teach essay writing which hinders students' creative power, thinking skill and writing ability. So, this study would be beneficial to both the middle and high schools Myanmar language teachers and students as this study would provide necessary information on how to teach writing effectively and how to write effectively through process approach.

Review of Related Literature

Process Approach to Teaching Writing

John Dewey (n. d., cited in Farris, 1993) extolled the values of allowing children to be active participants in their learning. Dewey referred to this as 'learning by doing'. Dewey's premise still holds true today. By emphasizing the learning process, teachers can serve as facilitators in the classroom as children enthusiastically engage in relevant language arts activities in which they are interested. This philosophy of Dewey also influences the pedagogy for language skills since many educators prefer process approach to product approach in teaching writing skill.

Elder (1990) states that writing is a process. It takes time and effort. Each writing project always takes more time and more effort than it is thought before starting to write it. Students should give each writing project their best effort and as much time as they can, and then feel good about it. People learn to write by writing. With practice and guidance, students will become better and better writers. Berlin considers writing as an art, a creative act in which the process – the discovery of the true self – is as important as the product – the self discovered and expressed (Farris, 1993).

From this process perspective, writing is a complex, recursive, and creative process or set of behaviors that is very similar in its broad outlines for first and second language writers. Learning to write entails developing an efficient and effective composing process. The process approach treats all writing as a creative act which requires time and positive feedback to be done well.

Nation (2009) states that the main idea behind a process approach is that it is not enough to look only at what the learners have produced. In order to improve their production, it is useful to understand how it was produced. In essence, process approach to teaching writing focuses on the writing process rather than the final product.

Stages of Process Writing

According to Hoskisson and Tompkins (1987), the writing process is a series of stages or activities that writers move through as they compose. The activities of writing generally fall into five stages: (a) prewriting, (b) drafting, (c) revising, (d) editing, and (e) sharing. In practice, the writing process is not a linear series of neatly packaged categories. Rather, the process is cyclical, involving cycles that recur throughout the stages.

Stage 1: Prewriting

Prewriting is the getting-ready-to-write stage. Prewriting is as crucial to writers as a warm-up is to athletes (Hoskisson & Tompkins, 1987). It takes most of the time spent on writing process. It provides the background for writing. At this stage, students choose topics, consider the purpose and audience, decide their role in writing, and take into account the form of writing. It is this stage that the students gather the ideas or find something to write about. It is notable that good product of writing depends on good process.

The teacher must allow students to participate in decisions about purpose, audience, topic, and form, and provide a variety of idea-gathering activities such as brainstorming, free writing, talking, note-taking, clustering and reading.

Stage 2: Drafting

In the process approach to writing, students write and refine their compositions through a series of drafts. During this stage, students focus on getting their ideas down on paper, with little concern about spelling, punctuation, and other mechanical errors. As students move through successive drafts, they delete sections of text, add others, and rearrange them. The role of the teacher is to provide support, encouragement, and feedback for ideas and problems but not to emphasize correct spelling and neatness (Hoskisson & Tompkins, 1987). It is the fastest part of the process, and the most frightening, for it is a commitment. When the students complete a draft, they know how much, and how little, they know. And the writing of this first draft– rough, searching, and unfinished– may take as little as one percent of the writer's time (Murray, 1972).

Stage 3: Revising

An important part of the writing process is looking back over what has been written. This is done to check what ideas have already been included in the writing, to keep the coherence and flow of the writing, to stimulate further ideas, and to look for errors. Poor writers do not review, or review only to look for errors. One way of encouraging learners to review their writing is to provide them with checklists containing points to look for in their writing. In peer feedback, learners read their incomplete work to each other to get comments and suggestions on how to improve and continue it. The learners can work in groups and read each other's compositions. They make suggestions for revising before the teacher marks the compositions.

Stage 4: Editing

Editing involves going back over the writing and making changes to its organization, style, grammatical and lexical correctness, and appropriateness. Like all the other parts of the writing process, editing does not occur in a fixed place in the process. Writers can be periodically reviewing what they write, editing it, and then proceeding with the writing. Thus, editing is not restricted to occurring after all the writing has been completed. Learners can be encouraged to edit through the feedback that they get from their classmates, teacher and other readers. Such feedback that focuses only on grammatical errors will not help with editing of content. Teachers need to look at their feedback to make sure it is covering the range of possibilities (Nation, 2009).

Stage 5: Sharing

Students read their writing to classmates, or share it with larger audiences through hardcover books that are placed in the class or school library, class anthologies, letters, newspapers, plays, or puppet shows. In each of these cases, students are communicating with a genuine audience. Again and again researchers report that although teachers are the most common audience for student writing, they are one of the worst audiences because they often read with a red pen in their hands (Lundsteen, 1976, cited in Hoskisson & Tompkins, 1987). As students share their writing with genuine audiences, they develop a greater appreciation of audience and its role in the writing process (Hubbard, 1985, cited in Hoskisson & Tompkins, 1987).

Review of Related Studies

A number of research studies related to the implementation of the process approach in teaching writing have been conducted in different parts of the world.

In 1992, the National Assessment of Educational Performance (NAEP), the largest nationally representative and containing assessment of American students in mathematics, reading, science, writing, the arts, civics, economics, geography and U.S history, concluded that students who were more often exposed to the writing process: planning, defining the audience and purpose, using outside resources, and composing more than one draft _ scored higher than those students who used the techniques less often. Based on the research of the NEAP, it was concluded that higher than average writing scores were a result of writing techniques defined as the writing process (Greenwald et al., 1999).

In Hong Kong, Belinda Ho (2006) investigated how effective process writing is in helping about (200) students at the upper primary school level and the lower primary school level to improve their writing skills and their attitudes towards writing. It was found that the program brought about positive results across all classes in both the upper and lower levels. According to Belinda Ho's study, process writing seems to be a feasible solution to heightening the writing abilities and confidence of students.

Vanderpyl (2012) experimented with the process approach as writing instruction in two greatly varying contexts: the Republic of the Union of Myanmar and the Kingdom of Saudi Arabia. The participants were students form American Center English language classes, and North Star *Reading and Writing* (2008) and *Speaking and Listening* (2008) textbooks were used as learning materials. It was found that the process approach is effective in improving students' writing skill.

Therefore, it would be worthwhile to adopt process approach for teaching Myanmar essay writing in Myanmar schools and examine its effectiveness in the improvement of students' writing skill.

The Proposed Learning Materials and Teaching Writing Model

Based on the art of writing and writing process, learning materials and proposed teaching writing model were developed by the researcher.

Learning Materials

There are sixteen chapters altogether written by the researcher as learning materials. They are as follow.

1. Paragraph and Process
2. Purpose and Audience
3. Finding a Topic
4. Writing a Topic Sentence
5. Discovering Details
6. Organizing
7. Revising
8. Editing
9. Narration
10. Description
11. Example
12. Cause and Effect
13. Definition
14. Comparison and Contrast
15. Classification
16. Writing an Essay by Expanding a Paragraph

Teaching Writing Model

A proposed model for teaching writing is developed based on the five general stages of writing process suggested by Hoskisson and Tompkins (1987): prewriting, drafting, reviewing, editing and sharing. In this model, there are six main stages. These are presentation, prewriting, writing, revising, editing and sharing. The activities in each step can be seen in the following figure.

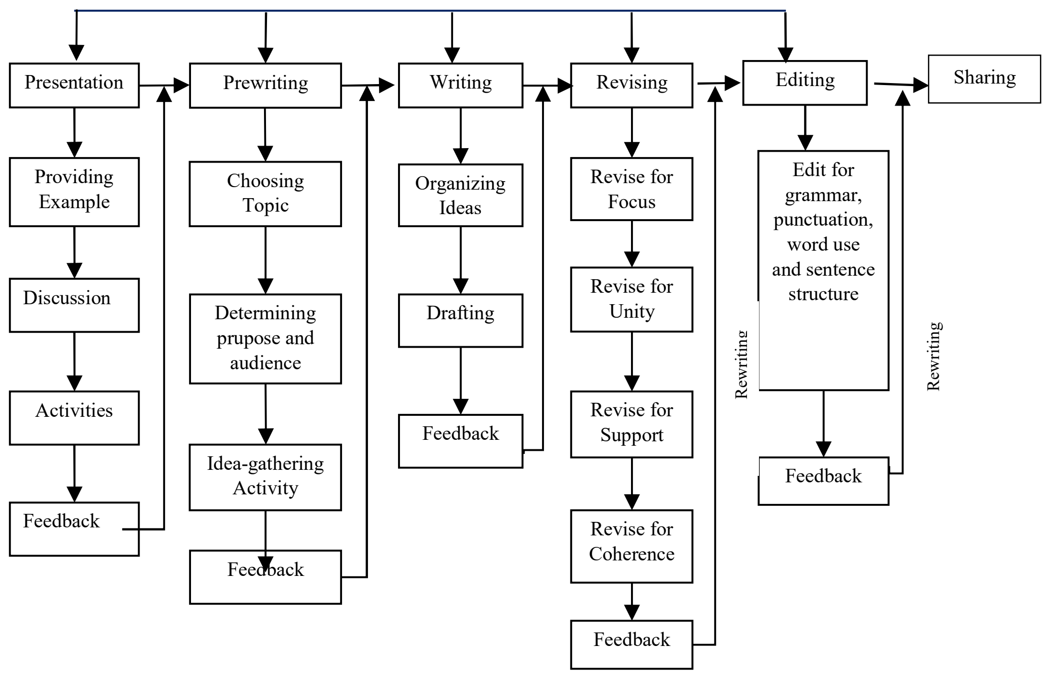


Figure 1: Proposed Model for Teaching Writing

Research Method

To investigate the effectiveness of the developed learning materials and model, a quantitative study, an experiment, was conducted. A qualitative study, a questionnaire survey, was also conducted to find out students' attitudes towards the new teaching approach.

Quantitative Research Method

Population and Sample Size

The research was carried out in Yangon City Development Area (YCDC) including thirty-three townships. These townships are divided into four strata: Inner City, Inner-Suburb, Outer-Suburb and Satellite. One township from each stratum was selected at random. And then, one high school from each township was chosen by using simple random sampling method. For experimenting the new teaching writing approach and conducting a questionnaire survey, (91) students from B.E.H.S (2), Lanmadaw, (89) students form B.E.H.S (3), Sanchaung, (87) students from B.E.H.S (6), Insein and (125) students from B.E.H.S (6), Hlaingthayar were selected.

Research Design

The research design applied in the quantitative study is the nonequivalent control group design which is one of the quasi-experimental designs.

Instruments

Since this study is aimed at investigating the impact of process approach to teaching writing in Myanmar language at the high school level, the researcher constructed a pretest and a posttest, and the marking schemes for them. The pretest and posttest are the same in form, but different in content. The posttest is slightly more difficult than the pretest. Both tests consist of seven items: the first five items to measure the basic writing skill, item (6) to examine paragraph writing skill and the last one to check essay writing skill. The total score of each test is (50) and the time allowed for both test is (1:30) hours. According to the pilot study, the internal consistency (Cronbach's Alpha) of the pretest was (.686) and (.715) was for the posttest.

Learning Materials

There is no prescribed textbook specialized in teaching writing. So, learning materials have been developed based on process approach to teaching writing and the arts of writing. Among the sixteen chapters written, only six chapters were chosen for teaching experiment because of the time limit. The first chapter was paragraph and process. The next four chapters were strategies for writing paragraphs: narration, description, cause and effect, and definition. The sixth chapter was writing essay by expanding a paragraph.

It is assumed that these six chapters can cover all the writing skills at the high school level. This is because among the six chapters, the first one is aimed at understanding the process approach to writing, the next four chapters includes the most familiar writing strategies in high schools and the last deals with the essay writing. To teach writing by using these learning materials, a teaching writing model was developed and lesson plans for the six chapters chosen to be taught were written based on the developed model.

These learning materials and activities were examined carefully by five expert teachers in both methodology and academic fields in February, 2016. They made valuable suggestions and recommendations from their different points of view for the improvement of the learning materials and activities. Their critical comments and suggestions regarding style, format, appropriateness and wording were very helpful. At their valuable suggestions, necessary modifications in learning materials were made. Some words are replaced by more understandable words.

Key Variables

The independent variables in this study were the different approaches to teaching writing. Therefore, the independent variable for experimental groups was instruction, using process approach and for control group was instruction, without using it. The dependent variable was student's score on the posttest.

Procedure

Firstly, in order to evaluate the feasibility and reliability of the instruments for full-scale study, pilot experiment was conducted at Practising High School (TTC), Yangon University of Education from 20th June to 8th August 2016. The time taken for teaching including testing before and after was (22) periods which last (45) minutes each. The study was carried out according to quasi-experimental design. The number of participants were (55) for experimental group and (46) for control group. In pilot study, three chapters out of six chapters selected for experimental study were taught. In the light of experiences of pilot study, necessary changes in testing and planning for experimental study were made. Before pilot study it was predicted to take (4) periods for teaching a chapter, but in reality, it took (6) periods for a chapter. So, time allocation was changed. Pilot teaching also gave better ideas of sharing, the final stage of process approach, to motivate students' interest in learning. Pilot teaching was very helpful for the better preparation of handouts and teaching aids for experimental study. In the light of pilot study, necessary changes were also made in lesson plans.

Conducting full-scale experimental study was started in all four selected schools in August, 2016. At the beginning of the study, all participants in both groups were administered a pretest to check the equivalence of the two groups. It took (1:30) hours, (2) periods. Then the experimental groups were treated with the developed process approach to writing while the control groups were taught through product approach, teacher-led instruction. The two experiment groups in B.E.H.S (2), Lanmadaw and B.E.H.S (3), Sanchaung were taught by the researcher. And the rest in B.E.H.S (6), Insein and B.E.H.S (6), Hlaingthayar were given treatment by other two Myanmar language teachers from these schools. They both have a B.Ed. in Myanmar language teaching and the one also has a M.A. in Myanmar language. They were given learning materials in advance to study. And then they had been advised how to teach writing according to process approach model and lesson plans. The total time taken for treatment was (27) hours, (36) periods. After the treatment period, a posttest was administered to all students in experimental groups and control groups to measure their writing skill achievement. The posttest took (1:30) hours, (2) periods. The experimental study finished in November, 2016.

Qualitative Research Method

Population and Sample Size

Only experimental groups from the selected schools were participated in qualitative study. So only (48) students from B.E.H.S (2), Lanmadaw, (44) students form B.E.H.S (3), Sanchaung, (43) students from B.E.H.S (6), Insein and (63) students from B.E.H.S (6), Hlaingthayar were participated.

Instrument

To examine the students' attitudes towards the developed process approach to teaching writing, a questionnaire was constructed. It was divided into two parts: attitudes towards the new teaching approach and attitudes towards the learning materials. The first part includes (20) items and the second one includes (10) items. Five-point Likert scale with (5) assigned to strongly agree and (1) assigned to strongly disagree, was used to indicate the attitudes towards each item. To establish the reliability of the instrument, a pilot study was conducted with (46) students at Practising High School (TTC), Yangon University of Education. According to the pilot study, the internal consistency (Cronbach's Alpha) of the questionnaire was (.782).

Procedure

Data collection process was carried out in November, 2016. The questionnaire was administered to all students participated in experimental groups in all four selected schools. The teachers gave help to distribute the questionnaires and collect the questionnaires in their schools. It took about (20) minutes to complete the questionnaire. It was completed at the last week of experimental teaching.

Data Analysis

The Statistical Package for the Social Science (SPSS) version (24) was used to analyze the quantitative data. The data were analyzed by the independent samples *t*-test to compare the differences between the experimental groups and control groups. For qualitative study, percentage of responses will be used to know the attitudes of the students involved in the experiment towards the new teaching approach after instruction.

Research Findings

Quantitative Research Findings

Analysis of Pretest Scores

Table 1 : *t* Values for Pretest Scores in Overall Writing Skill Achievement

School	Group	N	M	SD	MD	*t*	*df*	Sig (2-tailed)
S1	Experimental	48	20.65	4.715	1.42	1.424	89	.158 (ns)
	Control	43	19.23	4.740				
S2	Experimental	44	19.41	6.147	0.92	.734	87	.465 (ns)
	Control	45	18.49	5.679				
S3	Experimental	43	18.95	4.111	1.31	1.324	85	.189 (ns)
	Control	44	17.64	5.104				
S4	Experimental	63	16.24	4.173	1.24	1.748	123	.083 (ns)
	Control	62	15.00	3.728				

Note: ns = not significant

The results show that there were no significant differences between the experimental groups and the control groups for scores on pretest ($p > .05$) because the mean scores of the experimental groups and the control groups were nearly the same in all four schools. This means that the two groups in all selected schools were equivalent before the treatment. Therefore, their scores on posttest will be analyzed by using the independent samples *t*-test.

Analysis of Posttest Scores in Overall Writing Skill Achievement

Table 2: *t* Values for Posttest Scores in Overall Writing Skill Achievement

School	Group	N	M	SD	MD	*t*	*df*	Sig. (2-tailed)
S1	Experimental	48	31.38	5.782	11.57	11.241	89	.000***
	Control	43	19.81	3.942				
S2	Experimental	44	31.32	4.714	10.96	13.405	87	.000***
	Control	45	20.36	2.715				
S3	Experimental	43	27.42	6.437	8.42	7.023	85	.000***
	Control	44	19.00	4.615				
S4	Experimental	63	28.38	5.641	11.33	13.405	123	.000***
	Control	62	17.05	3.605				

Note: $^{***}p < .001$

In the above table, it can be seen that the mean scores of the groups who were instructed through the process approach were significantly higher than that of the other groups in each school (see Table 2). The independent samples *t*-test results indicates that there were significant differences between the experimental groups who were instructed through the process approach proposed by the researcher and the control groups who were instructed through product approach, teacher-led instruction in each school on the scores of the overall writing achievement ($p < .001$). Therefore, the hypothesis that students who are instructed through the process approach proposed by the researcher will exhibit significantly higher overall writing skill achievement than students who are instructed through product approach, teacher-led instruction was supported by this result.

Analysis of Posttest Scores in Basic Writing Skill Achievement

Table 3: *t* Values for Posttest Scores in Basic Writing Skill Achievement

School	Group	N	M	SD	MD	*t*	*df*	Sig. (2-tailed)
S1	Experimental	48	12.73	3.174	3.26	5.305	89	$.000^{***}$
	Control	43	9.47	2.631				
S2	Experimental	44	13.02	2.377	4.8	10.549	87	$.000^{***}$
	Control	45	8.22	1.882				
S3	Experimental	43	10.93	2.622	3.32	5.380	85	$.000^{***}$
	Control	44	7.61	3.112				
S4	Experimental	63	11.21	1.696	4.08	10.344	123	$.000^{***}$
	Control	62	7.13	2.608				

Note. $^{***}p < .001$

From the table, it is clear that the mean scores in basis writing skill achievement of the experimental groups whose teachers used the process approach were significantly higher than that of the control groups whose teachers did not use it in each school ($p < .001$) (see Table 3). It shows that there were significant differences between the experimental groups and the control groups in each school on the scores in basic writing skill achievement at the .001 level. This result supported the hypothesis that students who are instructed through the process approach proposed by the researcher will exhibit significantly higher basic writing skill achievement than students who are instructed through product approach, teacher-led instruction. But, the mean scores of both groups cannot be said to be excellent because even the mean scores of the students in experimental groups were approximately 12 out of 22.

Analysis of Posttest Scores in Paragraph Writing Skill Achievement

Table 4: *t* Values for Posttest Scores in Paragraph Writing Skill Achievement

School	Group	N	M	SD	MD	*t*	*df*	Sig. (2-tailed)
S1	Experimental	48	5.23	1.225	2.02	7.371	89	$.000^{***}$
	Control	43	3.21	1.390				
S2	Experimental	44	5.41	1.064	2.08	10.046	87	$.000^{***}$
	Control	45	3.33	.879				
S3	Experimental	43	5.02	1.422	1.25	4.533	85	$.000^{***}$
	Control	44	3.77	1.138				
S4	Experimental	63	4.67	1.513	1.65	7.473	123	$.000^{***}$
	Control	62	3.02	.878				

Note: $^{***}p < .001$

The above table shows that the mean scores in paragraph writing skill achievement of the experimental groups were significantly higher than that of the control groups in each school (see Table 4). It means that there were significant differences between the groups who were instructed using the process approach and the control groups who were instructed without using it in each school on the scores in paragraph writing skill achievement at the .001 level. This result also supported the hypothesis that students who are instructed through the process approach proposed by the researcher will exhibit significantly higher paragraph writing skill achievement than students who are instructed through the product approach, teacher-led instruction.

Analysis of Posttest Scores in Essay Writing Skill Achievement

Table 5: *t* Values for Posttest Scores in Essay Writing Skill Achievement

School	Group	N	M	SD	MD	*t*	*df*	Sig. (2-tailed)
S1	Experimental	48	13.44	2.982	6.30	11.446	89	$.000^{***}$
	Control	43	7.14	2.133				
S2	Experimental	44	12.89	2.517	4.13	9.151	87	$.000^{***}$
	Control	45	8.76	1.640				
S3	Experimental	43	11.56	3.990	4.04	5.721	85	$.000^{***}$
	Control	44	7.52	2.367				
S4	Experimental	63	12.48	4.295	5.54	8.765	123	$.000^{***}$
	Control	62	6.94	2.573				

Note: $^{***}p < .001$

The table indicates that the mean scores in essay writing skill achievement of the experimental groups were significantly higher than that of the control groups in each school (see Table 5). It means that there were significant differences between the groups who were instructed using the process approach and the control groups who were instructed as usual in each school on the scores in paragraph writing skill achievement at the .001 level. This result supported the hypothesis that students who are instructed through the process approach proposed by the researcher will exhibit significantly higher essay writing skill achievement than students who are instructed through product approach, teacher-led instruction.

Qualitative Research Findings

Attitudes towards the Learning Materials

The qualitative data analysis shows that most of the participants in the experimental groups were positive in their attitudes towards the developed learning materials and the process to teaching writing (see Appendix).

In short, the process approach to teaching writing has profound impact on the improvement of high school students' Myanmar language writing skill.

Discussion, Recommendations, Suggestions and Conclusion

Discussion

The major purpose of this study was to investigate into the impact of process approach to teaching writing in Myanmar language at the high school level. For this reason, learning materials and a teaching model for writing were developed, based on the process approach to teaching writing. To investigate their effectiveness, a quantitative research was conducted, hypothesizing that there is a significant difference in the improvement of writing skill between students who are taught through the process approach proposed by the researcher and those who are taught through product approach, teacher-led instruction. A qualitative research was also carried out to inquire the attitudes of students who participated in the experimental groups towards the process approach.

The results of the quantitative study support its original hypotheses. The means of all the experimental groups who were taught through process approach were significantly higher than that of all the control groups not only on the overall writing skill but also on individual writing skills: basic writing skill, paragraph writing skill and essay writing skill. It can, therefore, be interpreted that the use of process approach to teaching writing had significant effect on the writing skill achievement of the students. It can also be inferred that both the method of teaching writing and the materials have positively contributed to the learning and teaching writing in Myanmar language at schools.

The results of the study were consistent with the findings of previous research studies. The results of the study by Goldstein and Carr (1996) who examined the 1992 National Assessment of Educational Performance writing assessment indicated that process-related activities are strongly related to writing proficiency. Belinda Ho (2006) who studied the effectiveness of using the process approach to teaching writing in six Hong Kong primary classrooms also found that the program brought about positive results across all classes. The experiment with the process approach as writing instruction by Vanderpyl (2012) has found that the process approach is effective on several levels. The results of quantitative research are also consistent with the qualitative results and the teaching-learning theories in the following ways.

The results of qualitative study also support the results of quantitative study. They are also consistent with teaching-learning theories. Nearly all the students who participated in qualitative study were receptive to the proposed process approach to teaching writing. They liked the proposed process approach and learning materials. They agreed that every stage of writing process is essential and useful for producing a good product of writing. So it can be interpreted that the proposed process approach to teaching writing and learning materials had made positive contribution to the improvement of students' writing skill.

The two teachers who participated in experimenting teaching also expressed their experiences and opinions regarding the proposed approach. The difficulty level in implementing the process approach differed depending on class size. Although one of the teachers whose class size was over forty had no difficulty in using the process approach to writing, the other teacher who taught a large class of over sixty found this approach difficult to control students in doing group activities and to provide individual feedback. But they both believed that the study had brought about considerable benefits to all the participants, both teachers and students. Their teaching became improved and their students showed noticeable improvement in their writing by participating in the study. One of them remarked that this kind of study should have been done a long time ago.

However, it is unreliable to generalize the results of this study to all high school students in Myanmar as the study was conducted only in Yangon City Development Area and the sample size was too small for the total populations of high school students in Myanmar. But, the results of this study may throw new light on the method of teaching essay writing for all middle and high school students in Myanmar.

Recommendations

1. In this study, the sample schools were randomly selected from Yangon City Development Area. Therefore, it is recommended to conduct the similar research in other states and regions. Then, the research results will be more reliable than present results.

2. In this study, the participants were only high school students. Actually, essay writing is included in both middle and high school levels. So, the similar research on process approach to writing should be carried out at middle school level. Then, the research results will be generalized to a wider population.
3. Moreover, the impact of process approach should be studied for essay writing in English language teaching too.
4. In this study, students were asked to keep their writings in a portfolio which is a collection of students' work that demonstrates to the students and others their effort, progress and achievements in given areas. But their portfolios were not assessed. Instead, a posttest, product assessment which is incompatible with process approach, was used. So, in future research on process approach to writing, portfolio assessment which is a natural partner of process approach should be used and its impact on students' writing skill should also be studied.

Suggestions

The aim of essay writing is to enable students to express their own ideas and thoughts in their own words effectively. Essay writing serves as a training ground for this expressive ability. Essay question in exam is to inquire students' own personality, creative power, thinking skill and writing ability. Essay writing is the lesson to be practiced, not the lesson to be memorized. Firstly, both teachers and students need to understand this real aim of essay writing to achieve this.

But the current practices of teaching essay writing which focus on the completed essays, product, and which seems weak in encouraging students to write misinterpreted the meaning of essay writing and lead to the problem of plagiarism. So, teachers should abandon this traditional product approach to teaching essay writing and adopt the proposed process approach in their teaching of writing. From this study, it is clear that the process approach is an effective method of teaching. Adopting this new approach may be one of the solutions for teachers to overcome the problem of plagiarism, make real improvement of students' writing skill and make essay writing in schools meaningful.

Moreover, in order to teach writing effectively, there are some important things to be considered. Firstly, the class-size should be small enough whether the teacher uses the current teaching practices or the proposed approach. It shouldn't be more than forty. If the class-sizes are larger than that, teachers have difficulties to control and to provide feedback individually. But, peer feedback and group assignment, an alternative to individual assignment in the process approach can release teachers from over-workload of giving individual feedback. Teachers can give group assignment according to the experiences and interest of the students. For instance, when the teacher teaches narrative writing, individual work is more appropriate because different students have different stories. But group assignment is appropriate for cause and effect writing topics for which students can have common interest and knowledge.

Secondly, teaching writing classroom should have certain books for students and teacher. Reference books such as Myanmar dictionary and Myanmar orthographic text are the two essential requirements for teaching writing class. It is better to have a number of these two kinds of books for students to be able to use at the same time. They enable students do editing their own works and others' works. In addition to these reference books, readings such as Myanmar essay (100), (101), (102) and the writings of great Myanmar prose writers should also be available for students to study. There should also be well-stock school library for students to do research or search the required information for their essays.

Teaching writing should be related to other text teaching such as prose, poems and grammar. Teachers should enable students to apply the study of words and sentence structure in grammar, the characteristics of good prose and rhetorical composition in poems and prose in their own writings. Teaching writing should also be related to other subjects. For example, in teaching compare and contrast pattern writing, the sun and the moon in geography can be a good topic to compare or contrast. Moreover, the study of history can be useful in narration pattern of writing paragraph because all the stories in history texts are narrated. For instance, if students write about Bojyoke Aung San for the topic 'The person I admire most', they can learn about him from their Myanmar history text.

Moreover, it should be kept in mind that teaching students to write has started since the primary level. The reader, 'Myself' in Grade One Myanmar textbook, is aimed at enabling students to write about themselves by substituting their real lives in Mg Hla's. Similarly, the aim of teaching the reader, 'Letter to a friend' from Grade Two Myanmar textbook, should enable students to write a letter to their real friend, not to memorize the prescribed reader. Moreover, students should be given writing tasks such as paraphrasing and summarizing in teaching poems and prose.

The most important of all, before teaching essay writing, students should be introduced with paragraph writing first. At the middle level, strategies for writing paragraphs should be covered. The easiest strategies, narration, should be taught at the lowest grade, Grade Five, and the more difficult one, description and example should be added to Grade Six teaching writing. Cause and effect, and definition which call for thinking skills although they are familiar to Myanmar students because the above mentioned four types of writing used to be taught in teaching essay writing should be prescribed in Grade Seven. The unfamiliar ones which also require thinking skills, compare and contrast, and classification should be taught to Grade Eight students, the oldest at the middle school level. And then, at the high school level, students will be ready to learn how to write essays effectively. Teaching two strategies of writing through the process approach will take about (10) out of (18) periods allocated for teaching writing in an academic year. Therefore, students will have enough time to practice the newly learned writing strategies and the old ones. As a prescribed text or guide book, the learning materials which were already developed by the researcher can be used.

It is not suggested to use the proposed model for teaching writing and learning materials developed by the researcher exactly as they are. They can be adapted to meet the needs of the teachers and students. Teachers can replace certain paragraphs and essays in the learning materials with more appropriate ones. Learning materials can be widely available if teachers collect students' works or students are asked to keep their works at different stages of writing process in a portfolio. Students' excellent works can be used as learning materials as needed. Students' outstanding works can be used as models. Their drafts can be used to teach how to revise and edit.

According to Basic Education Curriculum Syllabus and Textbook Committee, in an academic year, the time allocation for teaching essay writing is (18) periods (45 minutes each) in each grade at the middle and high school levels. For each month, two topics are given for students to write. So, Students are supposed to write (18) essays in an academic year. But, if students are taught writing through the process approach, they cannot be expected to write many paragraphs or essays in an academic year like using the product approach. Every student can write at least (6) paragraphs or essays on the topics of their own choice in an academic year. Some students can write more. It depends on their ability. All these paragraphs or essays will be the students' original works. If quality education is preferred to quantity education, the process approach should be implemented in teaching writing.

Finally, in order to implement such writing program successfully, teachers who are change agents need to understand the process approach to teaching writing and the art of writing. So, the proposed process approach to teaching writing model should be added to the existing curriculum of teaching of Myanmar in universities of education and education colleges.

Conclusion

To conclude, the proposed model for teaching writing and learning materials seem to be a feasible solution to the problems that the teachers and students are facing in teaching and learning essay writing by fulfilling the requirements of the guide book which shows what to teach and how to teach. It is believed that they could place essay writing back in its right place, training ground. They will heighten the ability and confidence of both students and teachers in teaching and learning writing skills. The learning materials developed could be sources of reference for anyone who would like to learn how to write. It is hoped that with the help of the empirical evidence, process writing will soon become a part of school curriculum of Myanmar language teaching, so that students' interest and success in their writing will be enhanced more speedily and effectively than before. So this study was a worthwhile task although it was challenging.

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Appendix

Attitudes towards Learning Materials

No.	Statements	1	2	3	4	5
		F & %	**F & %**	**F & %**	**F & %**	**F & %**
1	Learning materials are interesting.	1	8	32	125	32
		.5	4	16.2	63.1	16.2
2	They are easy to understand.	1	10	38	113	36
		.5	5.1	19.2	57.1	18.2
3	Example paragraphs and essays help me understand the writing concepts.	-	5	29	102	62
		-	2.5	14.6	51.5	31.3
4	They are also helpful in considering topic to write.	-	4	25	106	63
		-	2	12.6	53.5	31.8
5	Activities or exercises make sure the understanding of the lesson.	2	5	35	104	52
		1	2.5	17.7	52.5	26.3
6	I enjoy doing these activities.	3	13	29	110	43
		1.5	6.6	14.6	55.6	21.7
7	It is easy to do these activities.	8	36	64	70	20
		4	18.2	32.3	35.4	10.1
8	Having learned them, I think I can write paragraph effectively.	1	24	83	76	14
		.5	12.1	41.9	38.4	7.1
9	Having learned them, I can write essay with confidence.	2	11	60	86	39
		1	5.6	30.3	43.4	19.7
10	Having learned them, I notice an improvement in my writing skill.	-	6	20	80	92
		-	3	10.1	40.4	46.2

Attitudes towards Process Approach to Teaching Writing

No.	Statements	1	2	3	4	5
		F & %	F & %	F & %	F & %	F & %
1	I like teaching writing through process approach.	2	9	22	111	54
		1	4.5	11.1	56.1	27.3
2	This approach enables me to write to serve the purpose of writing.	-	4	25	117	52
		-	2	12.6	59.1	26.3
3	This approach makes it possible for me to use appropriate language for the intended audience.	2	19	46	95	36
		1	9.6	23.2	48	18.2
4	I like having the right to choose topic.	-	3	12	70	113
		-	1.5	6.1	35.4	57.1
5	Activities like clustering, asking questions, brainstorming and free-writing are effective for idea gathering.	2	17	46	97	36
		1	8.6	23.2	49	18.2
6	This approach enables me to present my ideas in proper order.	-	9	44	115	30
		-	4.5	22.2	58.1	15.2
7	Drafting is essential stage to produce a good piece of writing.	-	2	10	85	101
		-	1	5.1	42.9	51
8	This approach makes me know how to revise my draft.	2	10	25	104	57
		1	5.1	12.6	52.5	28.8
9	In revising, feedback from others let me see my week points.	1	6	15	86	90
		.5	3	7.6	43.4	45.5
10	After revising, it is important to rewrite.	-	4	17	110	67
		-	2	8.6	55.6	33.8
11	This approach enables me to know how to edit.	-	6	25	97	70
		-	3	12.6	39	35.4
12	Peer editing is interesting and effective.	-	6	14	91	87

No.	Statements	1	2	3	4	5
		F & %	F & %	F & %	F & %	F & %
		-	3	7.1	46	43.9
13	Sharing my final product with others make writing meaningful.	-	5	28	82	83
		-	2.5	14.1	41.4	42
14	Sharing my essays or paragraphs with others is something to be proud of.	-	3	21	83	91
		-	1.5	10.6	41.9	46
15	This approach encourages cooperation between teacher and students, and between students.	-	6	4	96	92
		-	3	2	48.5	46.5
16	Having the right to read, listen to and give feedback to others' essays helps me improve my writing skill.	1	4	15	80	98
		0.5	2	7.6	40.4	49.5
17	Writing a topic in group also improve cooperation between students.	2	5	11	83	97
		1	2.5	5.6	41.9	49
18	This approach can provoke willingness to write.	3	5	26	98	66
		1.5	2.5	13.1	49.5	33.3
19	Learning through this approach enables me to present my ideas in my own words.	-	1	12	104	81
		-	.5	6.1	52.5	40.9
20	This approach contributes to the improvement of students' Myanmar language writing skill.	-	1	7	64	126
		-	.5	3.5	32.3	63.6

Note: 1 = Strongly Disagree 2 = Disagree 3 = Uncertain,
4 = Agree 5 = Strongly Agree F = Frequency

A STUDY OF THE TEACHING STYLES OF TRAINED AND UNTRAINED PRIMARY ASSISTANT TEACHERS

Su Hnin Mon[1] and Thida Wai[2]

Abstract

The purpose of this research was to study the teaching styles of trained and untrained primary assistant teachers. The participants of this research were primary assistant teachers from Yedashe Township. The researcher classified sample teachers into two groups, (150) trained teachers and (150) untrained teachers. The questionnaires consisted of (40) items of five points Likert-scale. The teaching style questionnaires for teachers were based on Anthony F. Grasha's teaching style inventory (1996). It includes five types of styles. They are expert style, formal authority style, personal model style, facilitator style and delegator style. A quantitative research method was used to analyze the teaching styles of teachers. The independence samples *t*- test and comparison of means were employed for the analysis of quantitative data. According to the research finding, there was a significant difference between trained and untrained teachers on personal model and facilitator teaching style. Moreover, untrained teachers preferred in formal authority teaching style and trained teachers preferred expert, personal model, facilitator and delegator teaching style. This showed that training is necessary for all teachers. This study has a positive contribution not only for teachers to be effective in their teaching but also for the improvement of education.

Keywords: teaching style, trained teacher, untrained teacher

Introduction

In the context of national development, education plays a vital importance role. To become a well-educated person, teaching is the most important thing that happens in schools. Teacher's teaching styles are expected to influence learning in students. Teaching styles of teachers represent personal qualities and behaviours that appear in how they conduct their classes. Teachers' teaching styles guide and direct the instructional process that has effects on learning process. Therefore, every teacher needs to know their teaching styles to help their students more effectively. Information

1. Assistant Lecturer, Bogalay Education College, Bogalay Township, Ayeyarwaddy Region
2. Dr, Lecturer, Department of Methodology, Yangon University of Education

about the styles of teachers must become an essential ingredient in conceptual base for teaching.

Moreover, Myanmar lags far behind the developed world in terms of educational standards. Improvement in quality of teachers is essential to quality education and positive student outcomes. The quality education can only be brought about by improving the status,quality, management, training of teachers and teaching styles. Thus the researcher thought to study the teaching styles of trained and untrained teachers.

Purposes of the Study

The study was conducted with the following purposes;

- To investigate the teaching styles of trained and untrained primary assistant teachers.
- To analyze the teaching styles of trained teachers according to their age, teaching experience, training experience, designation, and highest degree earned.
- To analyze the teaching styles of untrained teachers according to their age and highest degree earned.
- To give suggestion for the teaching styles of trained and untrained teachers.

Research Hypotheses

The hypotheses of the research paper as follows:

There will be a significant difference between the teaching styles of teachers who have teacher-training and those who do not have teacher-training.

Scope of the Study

This research has its own limitations. The present investigation includes the teaching styles of expert style, formal authority style, personal model style, facilitator style, and delegator style as dimensions of teaching styles. This research has two variables of trained and untrained teachers. The other limitation is that the participants of the study came from a particular area of the country – only schools from the Yedashe Township, Bago Region. So it may not be able to represent the whole country. And also, the duration was not long enough to carry out the research deeply and thoroughly. This research was conducted in the 2016-2017 Academic Year.

Definition of Key Terms

Teaching style is viewed as a particular pattern of needs, beliefs, and behaviors that faculty display in the classroom (Grasha, 1996).

Trained teachers can be defined as teachers who belong to teaching profession in government and private sector who have got formal training (Arshad, 2013).

Untrained teachers can be defined as those who did not get formal training (Arshad, 2013).

Significance of the Study

Myanmar has made the improvement of education standards a top priority and it is recognized that a motivated and well-trained teaching force is a prerequisite for quality education. Improvement in quality of teachers is essential to quality education and positive student outcomes. The quality education can only be brought about by improving the status, quality, management, training of teachers and teaching styles.

Teacher's teaching styles are a multidimensional construct that bases on the way how teachers act in the classroom (Grasha, 2002).Teaching style is a manner or mode of acting or performing. It should be based upon a conceptual base that forms the philosophy of teaching. Studies conducted abroad on teaching styles of teacher included studies on self-directed or teacher-directed class, whether teachers' instructional strategies tended to differ; whether instructors' teaching styles were congruent with their own learning styles; whether any relationship existed between matched student and teacher pairs and academic achievement and whether mismatches between student's and teachers' styles contributed to teacher stress and whether students' learning style preferences matched those of their teachers.

The findings of the present study are expected to have manifold implications. They are expected to be of use to teachers in enhancing their effectiveness by adopting teaching styles and bringing about changes in the nature of academic and interpersonal interactions with the students, if and when required. This would ultimately enhance the effectiveness as well as the efficiency of the primary schools in improving its results and reducing drop-out rates, wastage and stagnation. The efficacy with styles as teachers may have two effects on students. It may facilitate or hinder their ability to acquire content and skills and it influences the learning styles of students.

Review of Related Literature

Grasha's Teaching Styles

The late Anthony F. Grasha (1996) is credited with developing the classic five teaching styles. Grasha understood that schools must use a consistent, formal approach in evaluating a teacher's classroom performance. He recognized that any system designed to help teachers improve their instructional skills requires a simple classification system. He developed a teaching style inventory that has since been adopted and modified by followers.

Expert Style

Teacher of expert style possesses knowledge and expertise that students need. He or she strives to maintain status as an expert among students by displaying detailed knowledge and by challenging students to enhance their competence. Expert style teacher concerned with transmitting information and insuring that students are well prepared. Similar to a coach, experts share knowledge, demonstrate their expertise, advise students and provide feedback to improve understanding and promote learning. The advantage is that expert style share information, knowledge, and skills such individuals possess. The limitation is that if it is overused, the display of knowledge can be intimidating to less experienced students. It may not always show the underlying thought processes that produced answers.

Formal Authority Style

Formal authority style teacher possesses status among students because of knowledge and role as a faculty member. He or she concerned with providing positive and negative feedback, establishing learning goals, expectations and rules of conduct for students. He or she also concerned with the correct, acceptable, and standard ways to do things and with providing students with the structure they need to learn. Authoritative teachers incorporate the traditional lecture format and share many of the same characteristics as experts, but with less student interaction. Advantage of formal authority teaching style is that the focus on clear expectations and acceptable ways of doing things. The disadvantage is a strong investment in this style can lead to rigid, standardized, and less flexible ways of managing students and their concerns.

Personal Model Style

Personal model style of teacher believes in teaching by personal sample and establishes a prototype for how to think and behave. He or she oversees, guides, and directs by showing how to do things, and encouraging students to observe and then to emulate the instructor's approach. This style incorporates blended teaching styles that match the best techniques with the appropriate learning scenarios and student in an adaptive format. It is an emphasis on direct observation and following a role model. Some teachers may believe their approach is the best way leading some students to feel inadequate if they cannot live up to such expectations and standards.

Facilitator Style

In this style, the teacher emphasizes the personal nature of teacher-student interactions. The teacher guides and directs students by asking questions, exploring options, suggesting alternatives, and encouraging them to develop criteria to make informal choices. Overall goal is to develop in students the capacity for independent action, initiative, and responsibility. The teacher works with students on projects in a consultative fashion and tries to provide as much support and encouragement as possible. He or she designs participatory learning activities and manages classroom projects while providing information and offering feedback to facilitate critical thinking. The advantage of this style is that it can develop the personal flexibility, the focus on students' needs and goals, and the willingness to explore options and alternative courses of action. This type of teaching style is often time consuming and is sometimes employed when a more direct approach is needed. It can make students uncomfortable if it is not employed in a positive and affirming manner.

Delegator Style

Delegator style concerned with developing students capacities to function in an autonomous fashion. Students work independently on projects or as part of autonomous terms. The teacher is available at the request of students as a resource person. It organizes group learning, observes students, provides consultation, and promotes interaction between groups and among individuals to achieve learning objectives. It helps students to perceive themselves as a resource person. It may cause misread student's readiness for independent work. Some students may become anxious when given autonomy.

Method

Research Design and Procedure

The research design for this study was a descriptive research design, in which the researcher sought to study the teaching styles of trained and untrained primary assistant teachers, seeks to determine, whether and to what degree, a relationship of teaching styles exists between age, teaching experiences, training experiences, designation, and academic rank or highest degree earned of trained teachers, and to study whether and to what degree, a relationship of teaching styles exists between age and highest degree earned of untrained teachers. A quantitative method is used as a research technique that is used to gather quantitative data by using questionnaires.

Procedure

Firstly, the researcher formulated the study concerning with teaching styles of trained and untrained primary assistant teachers. Secondly, the researcher gathered the related literature study through books, journals and internet sources. The third procedure for this study was that the researcher developed the questionnaires under the guidance of the supervisor. A pilot study was carried out with twenty three teachers from No (8) Basic Education High School (Branch), Hlaingthaya Township, Yangon Region and Basic Education Post Primary School, Katokekama, Nyaung Tone Township, Ayeyarwaddy Region. After pilot testing, the weakness of the questionnaire was modified by using the ideas of the supervisor and experts. The questionnaire survey was conducted in January, 2017. Trained and untrained primary assistant teachers from Yedashe Township were selected for the research.

Instrument

A set of questionnaire was used as the instrument for this study.

Questionnaire

The major instrument for this study was a set of questionnaire that was concerned with teaching styles. The teaching styles questionnaire was based on Grasha's teaching styles inventory. There were five teaching styles; expert, formal authority, personal model, facilitator, and delegator. There were (8) items for each teaching style and a total of (40) item of five point Likert-scale were included in the questionnaire. These five points in the Likert-scale were rated as 1 = not at all; 2 = rarely; 3 = sometimes; 4 = often and 5 = always.

A pilot study was conducted to determine the reliability of the questionnaire used for the study. Cronbach's Alpha was used to measure the reliability of the questionnaires. According to the result, the reliability of the teaching styles questionnaire was (.701).

Population and Sample Size

The first step of sampling for this study was the selection of township. This study was conducted in Bago Region. The research area was in Yedashe Township. There are (255) schools in Yedashe Township. A total of fifty-six schools were selected by using a random sampling method. Table (1) shows the total number of schools and the selected schools.

Table 1: The Distribution of Schools and Selected Schools in Yedashe Township

Sr. No.	Basic education schools	No. of schools	No. of selected schools
1	BEHS	6	-
2	BEHS (branch)	6	1
3	BEMS (branch)	69	15
4	Post Primary School	134	37
5	Primary School	6	1
6	Primary School (branch)	34	2
	Total	**255**	**56**

Note: BEHS = Basic Education High School
BEMS = Basic Education Middle School

Questionnaires were distributed to (330) middle school teachers (primary level), primary school teachers and probationary teachers. The researcher chose 150 teachers from, middle school teachers (primary level), and primary school teachers as trained teachers and 150 teachers from probationary teachers as untrained teachers. Table (2) shows the population and the sample size.

Table 2: Population and Sample size

Sr. No.	Teachers	No. of teachers	No. of participants
1	Head of primary teachers	206	-
2	Primary teachers (middle level)	124	83
3	Primary teachers	340	67
4	Probationary teachers	561	150
	Total	**1231**	**300**

Data Analysis

The data was analyzed by using descriptive statistics. Research findings for this study will be presented in the next chapter.

Research Findings

Findings for the Teaching Styles of Trained and Untrained Primary Assistant Teachers

In this study, the finding of the means for the teaching styles of trained and untrained primary assistant teachers are presented in table (3).

Table 3: Means for the Teaching Styles of Trained and Untrained Primary Assistant Teachers

Groups of Teacher	**Number**	**Means**				
		Expert	**Formal Authority**	**Personal Model**	**Facilitator**	**Delegator**
Trained Teachers	150	32.03	31.01	32.79	32.04	30.07
Untrained Teachers	150	31.37	31.09	31.47	31.01	29.57
Total	**300**	**31.7**	**31.05**	**32.13**	**31.52**	**29.82**

In analyzing the means for the teaching styles of trained and untrained primary assistant teachers, it can be seen that the means of the expert style, personal model style, facilitator style and delegator style for the trained teachers were higher than that of untrained teachers. But the means for formal authority style of untrained teachers were higher than that of trained teachers.

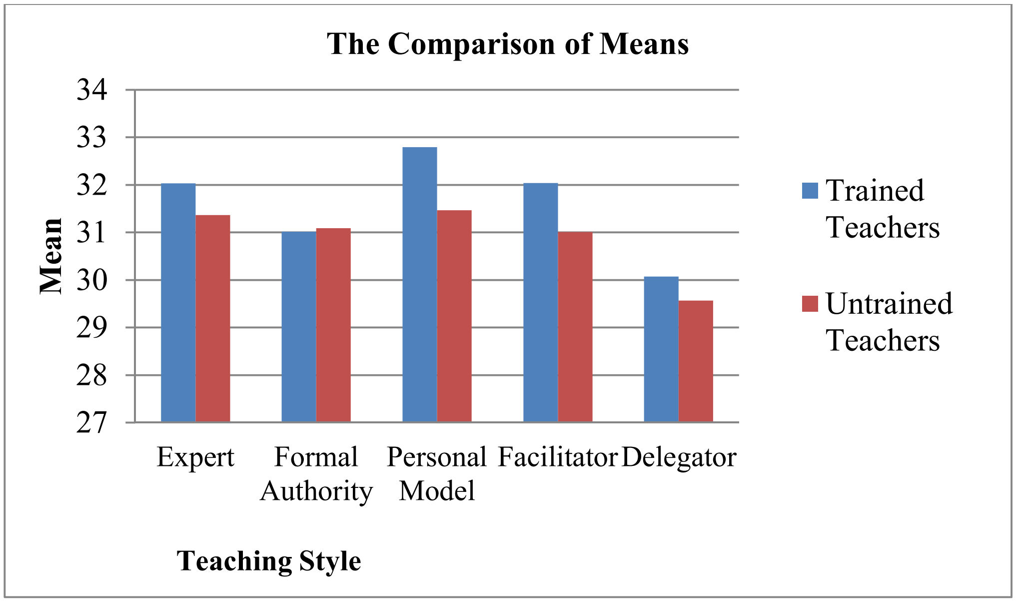

Figure1: Comparison of Means for Teaching Styles of Trained and Untrained Primary Assistant Teachers

Table 4: *t*-Values for the Teaching Styles of Trained and Untrained Primary Assistant Teachers

Teaching Styles	Training	Number	Mean	SD	*t*	*df*	Sig. (2 tailed)
Expert	Trained	150	32.03	4.07	1.38	298	.169 (ns)
	Untrained	150	31.37	4.31			
Formal Authority	Trained	150	31.01	4.24	-0.14	298	.886 (ns)
	Untrained	150	31.09	4.58			
Personal Model	Trained	150	32.79	4.23	2.84	298	.001**
	Untrained	150	31.47	3.85			
Facilitator	Trained	150	32.04	3.83	2.34	298	.020*
	Untrained	150	31.01	3.84			
Delegator	Trained	150	30.07	4.31	1.07	298	.284 (ns)
	Untrained	150	29.57	3.85			

Notes: ns = not significant, $^{**}p < .01$, $^{*}p < .05$.

According to the findings, the means of trained teachers in personal model and facilitator teaching style were significantly higher than that of untrained teachers. It showed that there was a significant difference between trained teachers and untrained teachers on personal model and facilitator teaching style. It can be interpreted that trained teachers preferred personal model and facilitator teaching styles (See Table 4).

Findings for the Teaching Styles of Trained Teachers

Table 5: Means for the Teaching Styles of Trained Teachers by Age

Age (Year)	Number	Means				
		Expert	Formal Authority	Personal Model	Facilitator	Delegator
18-24	28	31.39	30.50	32.00	30.71	29.07
25-29	44	31.73	30.84	32.10	31.84	29.32
30-34	32	31.56	31.28	33.84	32.44	31.13
35+	46	33.04	31.30	33.21	32.76	30.67

The researcher also tried to study the teaching styles of trained teachers by age. According to the results, the means for the personal model teaching style were the highest in all age groups. It can be seen that all the trained teachers of different age groups preferred personal model teaching style the most.

Table 6: Means for the Teaching Styles of Trained Teachers by Teaching Experience

Teaching Experience (Year)	Number	Means				
		Expert	Formal Authority	Personal Model	Facilitator	Delegator
1 - 5	73	31.58	30.81	32.12	31.60	29.63
6 - 10	29	31.48	30.52	33.03	31.34	29.66
11 - 15	14	33.43	33.64	35.36	34.21	33.14
16 - 20	13	32.23	30.85	31.77	31.92	28.23
21+	21	33.33	30.76	33.71	33.14	31.29

The means for the teaching styles of trained teachers according to teaching experience were shown in table (6). The result was that the means of teaching experience 1-5, 6-10, 11-15, and 21+ groups were the highest means in personal model teaching style. Teachers with teaching experience 16-20 group were the highest means in expert teaching style.

Table 7: Means for the Teaching Styles of Trained Teachers by Training Experience

Training Experience (Year)	**Number**	**Means**				
		Expert	**Formal Authority**	**Personal Model**	**Facilitator**	**Delegator**
One year in-service course	5	35.40	33.20	35.20	35.00	32.40
DTEd First Year	4	35.00	33.00	35.25	35.00	29.50
DTEd Second Year	32	31.69	31.00	32.91	32.19	29.41
DTEC	11	30.55	30.45	31.09	31.27	30.36
PPTT	4	29.25	30.50	32.75	30.75	29.00
Correspondence Course	68	31.97	30.81	33.26	32.12	30.41
Other	26	32.58	31.15	31.31	31.15	29.69

Note: DTEd = Diploma in Teacher Education,
DTEC = Diploma in Teacher Education Competency Course
PPTT = Pre-service Primary Teacher Training
Other = Other Training Course

Table (7) showed the results of the means of the teaching styles of trained teachers according to training experience. The results showed that the means of the expert teaching style was the highest for the teachers of one year in-service teacher training course and teachers with other training course. The means of personal model teaching style were the highest for teachers with DTEd first year, DTEd second year, PPTT and one year correspondence course. The means of facilitator was the highest for teachers with DTEC training course.

It can be concluded that teachers with one year in-service training course and teachers with other training course preferred expert teaching style.

Teachers with training course of DTEd first year, DTEd second year, PPTT and one year correspondence course preferred personal model teaching style. Facilitator style was preferred by teachers with DTEC training course.

Table 8: Means for the Teaching styles of Trained Teachers by Designation

Designation	Number	Means				
		Expert	Formal Authority	Personal Model	Facilitator	Delegator
Probationary	150	31.37	31.09	31.47	31.01	29.57
Primary Teacher	54	32.00	30.80	32.78	31.41	29.57
Primary Teacher (Middle Level)	96	32.05	31.14	32.80	32.40	30.35

In analyzing the means for each style, it was found that all the designation were highest in personal model teaching style. It can be said that all the designation most preferred in personal model teaching style.

Table 9: Means for the Teaching Styles of Trained Teachers by Highest Degree Earned

		Expert	Formal Authority	Personal Model	Facilitator	Delegator
BEHS	11	30.91	31.18	33.55	32.45	28.91
B.A	92	32.27	30.97	32.64	32.13	30.03
B.Sc	44	31.93	31.09	32.93	31.66	30.32
B.Ed	1	28.00	32.00	32.00	35.00	31.00
Other	2	31.50	30.00	33.00	32.50	32.50

Note: BEHS = Basic Education High School, B.A = Bachelor of Arts,
B.Sc = Bachelor of Science, B.Ed = Bachelor of Education, Other = Other Degree.

According to the results, teachers who passed BEHS, B.A, B.Sc and others had the highest means in personal model teaching style. However, teachers with B.Ed degree had the highest means in facilitator teaching style.

It can be concluded that teachers who passed BEHS, B.A, B.Sc and other degree holders preferred personal model teaching style. Teacher with B.Ed degree preferred facilitator teaching style.

Findings for the Teaching Styles of Untrained Teachers

Table 10: Means for the Teaching Styles of Untrained Teachers by Age

Age (Year)	Number	Means				
		Expert	Formal Authority	Personal Model	Facilitator	Delegator
18-24	64	31.64	31.02	31.58	30.63	29.75
25-29	82	31.20	31.15	31.29	30.38	29.41
30-34	4	30.50	31.00	33.25	29.00	29.75

Table (9) showed the means for the teaching styles of untrained teachers by age. The results showed that the means of the age group 18-24 were the highest in expert teaching style and the age groups of 25-29 and 30-34 were the highest in personal model teaching style. It can be concluded that teachers of age group 18-24 preferred expert teaching style and teachers of age group 25-29 and 30-34 preferred personal model teaching style.

Table 11: Means for the Teaching Styles of Untrained Teachers by Highest Degree Earned

Highest Degree Earned	Number	Means				
		Expert	Formal Authority	Personal Model	Facilitator	Delegator
B.A	109	31.37	31.23	31.59	30.58	29.73
B.Sc	39	31.62	30.87	31.28	30.33	29.26
M.A	1	25.00	28.00	30.00	29.00	32.00
Other	1	28.00	27.00	27.00	22.00	21.00

Note: B.A = Bachelor of Arts, B.Sc = Bachelor of Science, M.A = Master of Arts, Other = Other Degree

According to the results, teachers with B.A degree had the highest means in personal model teaching style. The mean of expert style was the highest for B.Sc and other degree holders. The M.A degree holder had the highest mean in delegator teaching style.

Discussion

The discussion of the research finding deals with a descriptive analysis of teaching styles. All teachers possess each of the five teaching styles in varying degrees. Untrained teachers used formal authority more than trained teachers. This is because untrained teahers want to have more control over students and want to prevent chaos in the classroom. Teachers with this style are likely to control the lesson contents. This type of teaching style sets a kind of classroom hierarchy because teachers believe that they possess knowledge and students need to learn from them.

Trained teachers had the styles of expert, personal model, facilitator and delegator styles. This can be interpreted that trained teachers have more collaborative, participantory and independent style. According to Grasha (1996), this style of teachers must exercise some control over the processes used in order to facilitate learning. But they should be less interested in controlling the specific details of the students. Some of what students will learn about the material in this mode of teaching that cannot be programmed in advance. There should be more interest in developing and practicing other skills such as ability to work with others and a broader range of content related skills such as critical and creative thinking.

Untrained teachers are prominent in the combination of the personal model, expert, and formal authority teaching styles. In these styles, students need to possess more knowledge than they would in a lecture class because they will frequently have to show what they know. It helps students possess participant, dependent, and colaborative learning styles and it is also flexible enough to develop. Bandures (1986) stated that this styles work nicely in learning environments where coaching and following the examples of role models are prominent. Teachers must have some interest in influencing how learners work to develop relationships. Research shows that effective models are typically people who are liked and well-respected (Grasha, 1996).

In analyzing the means for the teaching styles of teachers according to age, it was found that all the age groups of teachers preferred personal model teaching style. According to Grasha (1996), this style of teahers teach by using examples, activities, and demonstration. Teachers motivate students by providing examples and activities. In this way, students develop critical thinking skills. In personal model teaching style, students emulate the example that teachers provided. The teachers show students how and what to do in order to master course content. Finally, students begin to think like teachers.

Teachers who had teaching experience of 16-20 years preferred expert teaching style. In this teaching style, teachers use external rewards and incentives. Before being allowed to take the next module, students must demonstrate proficiency with the previous module. In the expert teaching style, teachers teach by rewards. Teachers want students to leave the first course well prepared for further work.

According to training experience, teachers with DTEC training course preferred facilitator teaching style. In this teaching style, making learning a social enterprise facilitates the acquisition and retention of information. In class, the teacher would place pupils into small groups of three and have them share what they found. Moreover, students are generally motivated to work with others. Everyone would then have to complete the study guide using information obtained from other group members. It can vary how content goals are taught. As consultants, teachers may provide specific advice and directions in response to student questions or concerns about classroom tasks, activities and projects.

In comparing the means for the untrained teachers according to highest degree earned, the teachers of M.A degree holders preferred delegator teaching style. This type of teaching is best when students have appropriate levels of knowledge and possess independent, collaborative, and participants learning styles. Their capabilities must include a willingness to take initiative and to accept more responsibility for their own learning. Students in this course engage in self-initiated, self-directed learning experiences.

In comparing trained and untrained teachers, the means of formal authority style for untrained teachers were higher than that of trained teachers. Untrained teachers used formal authority more than trained teachers. Teachers of this style are likely to control the flow of lesson contents. Teachers are supposes to provide positive and negative feedback and they are in charge of establishing learning goals. Teachers create a structured learning environment. Teachers emphasized clear goals and objectives for students. Moreover, teachers use feedback for students' performance. In formal authority teaching style, the teacher's responsibility is to define what students must learn. The teachers have specific goals and objectives to accomplish the learning goal. Teachers also give feedback when students' performance is unsatisfactory.

In summary, there was a significant difference between trained teachers and untrained teachers on personal model and facilitator teaching style. It can be interpreted that trained teachers are more preferred personal model and facilitator teaching style than untrained teachers. The teachers who have personal model teaching style can motivate student by providing examples and activities. The teachers who have facilitator teaching style know how to balance the directive and nondirective aspects of the role teachers. So students have opportunities to speak freely about a question or problem and to identify what they perceive as the major components of the issue before interjecting ideas. In this way, students can take responsibility for their learning. By doing so, students begin to think and develop critical thinking skills.

Suggestions

In many countries, primary teachers must have a bachelor's degree in education and a certificate to teach. In Myanmar, all basic education school teachers have the academic qualification which is higher than matriculation and they have attended one or more of the training courses in education such as a short capacity building training, a diploma, a bachelor degree or a master degree. But in 2014, to fulfill the requirement of teachers in basic education primary schools and to keep student-teacher ratio below 30:1, many bachelor degree holders have been appointed as probationary primary school teachers (Myanmar EFA review, 2015). So, all the probationary teachers have no training. Moreover, the primary teachers in this study have the minimum qualification in their teaching style. So, it is needed to update teacher education and the quality and effectiveness of teacher training courses.

And also the selection of teaching styles as teachers should be embedded in a conceptual context that includes principles of teaching and learning. Teacher beliefs, teaching style and teacher training are basic to the success of education. Enhancing teaching style involves exploring underlying attitudes, values, and assumptions about teaching and learning. There are many teaching behaviours that serve as guiding principles toward making teaching styles strong. The teachers should teach to honour children's unique learning style strengths. They should design structured lessons for high student interest and content value. They need to monitor student performance and growth.

The issue of modifying or enhancing one's teaching style is often approached with an eye towards adopting particular methods. Thus, wanting to adopt a particular method is equivalent to wanting to adopt a certain blend of the five teaching styles. If the teachers wanted to modify their style of teaching, the teachers have to consider the following factors. They are; are the teachers ready to change and how committed are the teacher to following through on their job? Are their proposed changes compatible with their philosophy of teaching? Can the teacher objectively assess where their students and the teacher stand on each of the four factors in the model? The four factors are that teachers should possess certain levels of sensitivity to the learning styles of students, the capability of their students to handle course demands, their own needs to directly control classroom tasks, and their willingness to build and maintain relationships with students.

Suggestions were presented for enhancing the teaching styles of trained and untrained primary assistant teachers. For the primary teachers' teaching styles of personal model, expert and formal authority, the important point is that the barriers to active learning and student involvement are not intrinsic to particular teaching processes. In this situation, the teacher should not give up or redirect control over classroom tasks and tends to use instructional processes that cater to a dependent learning style. In this way, there is a certain amount of comfort for both students and teachers.

All the teachers should know their teaching style and their students' learning styles. The most important thing is teachers should always adjust their teaching style with the goals of curriculum and with the students' learning style. Teachers who preferred expert, formal authority and personal model teaching style should teach by role modeling and coaching. The critical components of role modeling are motivation, attention, retention and testing. Motivation is strengthened when there is a clear and immediate need for applying the content or using a skill, the benefits are clearly stated and words of encouragement are offered.

Teachers should increase their attention to overview of what they will do and the reasons why particular steps will be employed is given. This does not need to be detailed. But, it establishes a particular set for what the student needs to watch. Thus an overview of what the student will see and a few statements will focus the learner attention on relevant issues and skills. Retention increased when the teacher insures that skills and tasks to be modeled are well organized. Teachers should help students in retention when they label important parts of what they do, call attention to relevant discriminations and summarize their previous steps before beginning something new. Whenever possible, good role models organize their action. The least difficult aspects are shown first before the more difficult parts. Observations of a model should be followed whenever possible by allowing students to perform what was observed.

This study has some limitations. The questionnaires used in this study were not enough to specifically identify teaching styles. If there are more items in questionnaires, this study can specifically identify teaching styles of teachers. It also needs to observe the teachers to identify their teaching style. Furthermore, the assessment system used in Basic Education was exam-oriented. This can hinder the use student-centered teaching style such as facilitator and delegator teaching styles. Exam questions for each grade of Basic Education test students on memorized facts. This encourages rote learning. So, teachers of Basic Education should be taught more teacher-centered teaching styles. The exam questions need to promote critical thinking. Students' learning achievement should be assessed throughout the teaching period. The assessment system should be appropriate with the child-centered approach and it needs to encourage teachers to teach more students oriented teaching styles.

Moreover, it is vital that teacher education needs to be upgraded to produce qualified teachers. As teacher education is a deep and gracious process, it needs to be continuously developed. In-service teacher training and continuous professional development programme should be given the opportunity to be created and to arouse the participants' interests, incentive programmes should be arranged.

It is hoped that the findings presented in this study will contribute to the improvement of teaching styles. And it will provide a foundation for future research. This study tried to investigate the teaching styles of trained and untrained primary assistant teachers. The conclusion was drawn based on findings from the questionnaires survey. It still shows the necessity to explore ways and means of improving teaching styles.

The research is conducted only in Yedashe Township. It is necessary to investigate the teaching style of teachers from other townships to represent the whole country. More research is needed to find a common theme by interviewing teachers or by using observations to analyze the teaching styles. And also, it is necessary to investigate the teaching styles of all teachers at the basic education level. Therefore, carrying out a research for all teachers from basic education is highly recommended to validate the results of the present research.

Conclusion

All basic education school teachers must have acquired academic qualifications higher than matriculation, and they need to complete attending one or more teacher education and training. In this study, it was found that untrained teachers preferred in formal authority teaching style and the mean scores of their teaching styles were lower than trained teachers. This showed that training is necessary for all teachers.

Education is the process of adjustment of environment and it aims at enabling the individuals to be in harmony with and well adapted to his surroundings. True education takes place when the nature, power and inclinations of the child are allowed to develop freely with a minimum of guidance (Ross, 1941). Students can be benefit from the skills such as critical thinking, oral and written communication, and working in teams from education that can be applied for their adjustment of the environment.

Quality of basic education depends on teachers' qualifications, competency, professional development and teaching styles. In trying to improve access to education and the quality of education, capacity building of teachers at different levels is essential. The establishment of the quality assurance system is critical to improve the education service delivery and outputs. The provision of quality inputs adequately and on an equity basis is also an important factor to produce quality outputs that could further contribute to the development of the country.

Moreover, teacher's attitude of willingness to work should be considered. As a nation whose only resource is its people, education in every country is taken very seriously. For this reason, education certificate, diploma in education or B.Ed degree holders should be appointed as teachers of each level of basic education. And the assessment system for each grade level should be improved. Exam questions for each grade of basic education should promote critical thinking. In this way, teaching styles of the teacher would be improved. In conclusion, this study has a positive contribution not only to teachers to be effective in their teaching but also to the improvement of education.

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THE IMPACT OF SCIENCE TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE ON STUDENTS' ACHIEVEMENT IN SCIENCE TEACHING AT THE MIDDLE SCHOOL LEVEL

Cho Thet Kyaw[1] and Wai Wai Oo[2]

Abstract

The purpose of this study was to investigate the impact of science teachers' pedagogical content knowledge on students' achievement in science teaching at the middle school level. A quantitative descriptive research method was used in this study. One township in each district in Yangon Region was selected. Two high schools and two middle schools were chosen in each township. A total of sixteen basic education schools were included in this study. The sample size of junior assistant science teachers was (75) and of Grade Six students was (630). The instruments used in this study were science teachers' pedagogical content knowledge questionnaire based on the Magnusson, Krajcik and Borko model of pedagogical content knowledge, students' achievement test based on the Grade Six General Science Text book and an interview form. The Cronbach's alpha coefficient for the teachers' pedagogical content knowledge questionnaire was (.833). Descriptive statistics, one-way ANOVA and Pearson-product moment correlation were used to analyze the data. One-way ANOVA results indicated that there were significant differences between science teachers' pedagogical content knowledge and students' science achievement among the selected schools. Thus, science teachers' pedagogical content knowledge and students' science achievement are different in the selected schools. Moreover, ANOVA results also pointed that there is a significant difference in science teachers' pedagogical content knowledge by science teaching services. So, science teachers who possessed more teaching services have higher pedagogical content knowledge than those who possessed less teaching services. Pearson-product moment correlation result revealed that a high level of science teachers' pedagogical content knowledge will bring about a high level of students' science achievement.

Key Words: pedagogical knowledge, content knowledge, pedagogical content knowledge, science, achievement

1. Tutor, Methodology Department, Yankin Education College
2. Dr, Lecturer, Methodology Department, Yangon University of Education

Introduction

Teaching has been existed before the beginning of human civilization. Human beings are relayed the ways of living such as hunting, gardening, and how to estimate the weather to their generations by instructing. They can grow and survive with the advices of their forefathers and then find innovative ways to fulfill the needs of their civilization. They all accepted that the instructions or the advices of their forefathers were worth and needed to maintain them. Later, they sent their descendants to learn these things to the wise person who can disseminate these knowledge to their children. They recognized that person who educated their children as 'teacher' and the transmission process of knowledge about the ways of living to the children was called 'education'. The heart of education is the instructional system or the teaching learning process. To get the successful teaching learning process, teachers must be competent in their respective subjects or content knowledge and be skillful in the transfer of knowledge to their students or teachers' teaching skills or pedagogical skills. Any effective teaching relies on the integration of how teacher combines the subject matter knowledge and pedagogical knowledge. In 1986, Lee Shulman proposed the pedagogical content knowledge (PCK) which are the amalgam of pedagogical knowledge (PK) and content knowledge (CK) in knowledge base teaching to create the successful learning environment. Many researchers come to believe that PCK is a significant part in science teaching since Shulman proposed the concept of PCK. Moreover, high levels of teachers' PCK will predict high levels of students' achievement (Abell, 2007). This study focused on the impact of science teachers' PCK on students' achievement in science teaching and it is also essential to improve instructional practices in teacher training programs.

Purposes

The main purpose of this study is to investigate the impact of science teachers' pedagogical content knowledge on students' achievement in teaching science at the middle school level. The specific purposes of this study are as follows:

- To investigate the science teachers' pedagogical content knowledge from selected schools.

- To study students' science achievement from selected schools.
- To find out whether there is a relationship between science teachers' pedagogical content knowledge and students' science achievement.
- To give suggestions for upgrading middle school science teaching.

Research Hypotheses

1. There is a significant difference in junior assistant science teachers' pedagogical content knowledge among the selected schools.
2. There is a significant difference in Grade Six students' science achievement among the selected schools.
3. There is a significant difference in junior assistant science teachers' pedagogical content knowledge by teaching experience.
4. There is a relationship between teachers' pedagogical content knowledge and students' achievement in science teaching at the middle school level.

Review of Related Literature

Pedagogical content knowledge (PCK) has been developed by Lee Shulman in 1986.He and his colleagues identified the pedagogical content knowledge (PCK) as the teachers' specialized knowledge. He believed that pedagogical content knowledge (PCK) is the significant part in knowledge base for teaching. Pedagogical content knowledge (PCK) is generally assumed as a construct of several components associated with how to transform content knowledge into pedagogically powerful strategies (Peng, 2013). PCK is also a unique knowledge based on the subject matter understanding of teachers, integration of the suitable teaching methods and then transform the more convenience form for the purpose of teaching.

The history of science can be said to have begun with the history of human existence (Das, 1985). To establish human civilization, people began to acquire the greatest contribution of science in many areas such as medicine, the art of building, smelting, time-telling and use of metals. Many inventions and innovations are made to get more convenience ways in livings. Science was introduced to teach as subject in schools of England in (1895) and also encouraged to teach in secondary schools level. Collette and Chiappetta (1989) described science is the most ideal subject to help improve students' thinking ability, for it emphasizes inquiry, which in turn permits students to construct their own knowledge through active investigation of objects and events. When people are becoming known that the science teaching is essential in education, many educators are started to find about the requirements of science teaching for teachers and students. Magnusson, Krajcik and Borko (1999) proposed the components of pedagogical content knowledge (PCK) for science teaching.

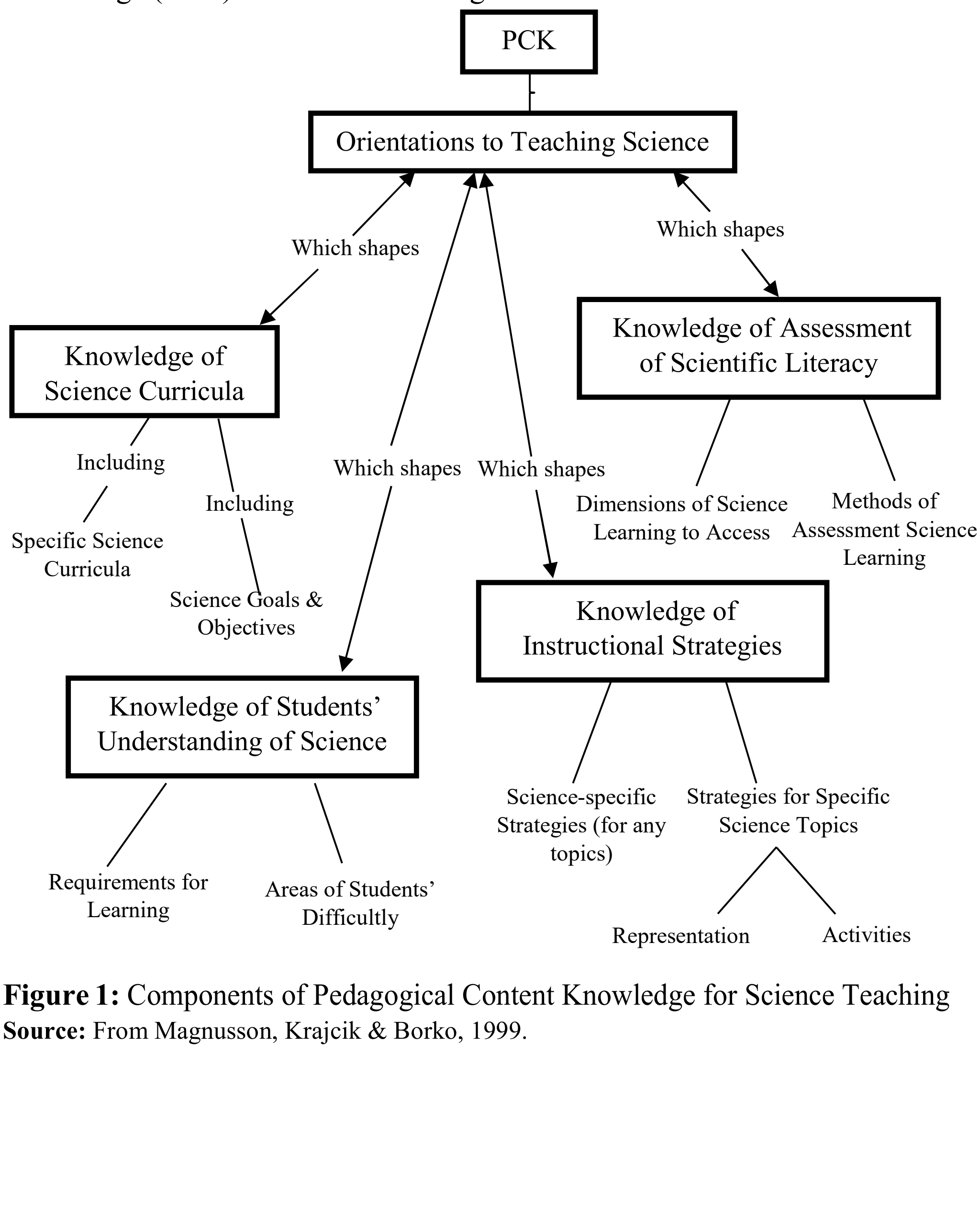

Figure 1: Components of Pedagogical Content Knowledge for Science Teaching
Source: From Magnusson, Krajcik & Borko, 1999.

It composed mainly five dimensions: orientation toward science teaching, knowledge of science curriculum, knowledge of students' understanding of science, knowledge of instructional strategies, and knowledge of assessment of scientific literacy. Each component is specifically expressed as follows:

Orientation to teaching science: This term means 'knowledge and beliefs about the purposes and goals of science teaching at a given level of education'. Magnusson et al. stated that this component of PCK served as the 'conceptual map' that guides instructional decisions about issues such as daily objectives, the content of student assignments, the use of textbooks and other curricular materials, and the evaluation of student learning (Gess-Newsome & Lederman, 1999). Magnusson et al. (1999) described nine specific orientation to science teaching. They are process, academic rigor, didactic, conceptual change, activity driven, discovery, project based science, inquiry and guided inquiry. Friedrichsen (2002) proposed didactic and academic rigor including in teacher-centered orientation and process, activity driven, conceptual change, discovery, project based science, inquiry, guided inquiry including in student-centered orientation. An orientation represents a general way of viewing or conceptualizing science teaching (Magnusson et al., 1999). The PCK model of Magnusson, Krajcik and Borko presented the section of orientation whether a science teacher holds student-centered orientation or teacher-centered orientation.

Table 1: Orientation to Science Teaching

Teacher-centered Orientation	Student-centered Orientation
Didactic, Academic Rigor	Process, Activity Driven, Conceptual Change, Discovery, Project-based, Inquiry, Guided Inquiry

Source: From Friedrichsen, 2010.

Knowledge of science curricula: Curricular knowledge references teacher understanding of the goals and objectives for student learning and the scope and sequence of the scientific concepts to be taught. Teacher knowledge of curriculum consists of two categories: (a) the mandated goals and objectives and (b) specific curricular programs, resources, and materials (Magnusson et al., 1999).

(a) Knowledge of Goals and Objectives

This category of the curriculum knowledge component of pedagogical content knowledge includes teachers' knowledge of the goals and objectives for students in the subjects they are teaching, as well as the articulation of those guidelines across topics addressed during the school year. Grossman (1990) stated that it also includes the knowledge teachers have about the vertical curriculum in their subjects; that is, what students have learned in previous years and what they are expected to learn in later years (Magnusson et al., 1999).

(b) Knowledge of Specific Curriculum Program

This category of teachers' knowledge of science curriculum consists of knowledge of the programme and materials that are relevant to teaching a particular domain of science and specific topics within that domain. Teachers' knowledge of curricula such as these would include knowledge of the general learning goals of the curriculum as well as the activities and materials to be used in meeting those goals (Magnusson et al., 1999).

Knowledge of students' understanding of science: This component of PCK includes (a) teacher knowledge of the requirements for student learning of specific scientific concepts and (b) potential learning difficulties student may encounter when learning the concept(s).

(a) Knowledge of Requirements for Learning

This category consists of teachers' knowledge and beliefs about prerequisite knowledge for learning specific knowledge, as well as their understanding of variations in students' approaches to learning as they relate to the development of the knowledge within specific topic areas. Teacher knowledge of prerequisite knowledge required for students to learn specific concepts includes knowledge of the abilities and skills that students might need (Magnusson et al., 1999).

(b) Knowledge of Areas of Student Difficulty

This category refers to teachers' knowledge of the science concepts or topics that students find difficult to learn. There are several reasons why students find learning difficulty in science, and teachers should be knowledgeable about each type of difficulty. For some science topics, learning is difficult because the concepts are very abstract and they lack any connection to the students' common experiences. Teachers need to know which topics fall into this category and what aspects of these topics students find most inaccessible. Other topics are difficult because instruction centers on problem solving and students do not know how to think effectively about problems and plan strategies to find solutions. In these cases, it is important for teachers to be knowledgeable about the kinds of errors that students commonly make, and the types of 'real - world experiential knowledge' that they need to comprehend novel problems (Magnusson, 1999).

A third type of difficulty students encounter when learning science involves topic areas in which their prior knowledge is contrary to the targeted scientific concepts. Knowledge of this type is typically referred to as misconceptions and misconceptions are a common feature of science learning. Scientific concepts for which students have misconceptions can be difficult to learn because misconceptions are typically favored over scientific knowledge because they are sensible and coherent and have utility for the student in everyday life (Magnusson, 1999).

Knowledge of instructional strategies: Teachers' knowledge of the instructional strategies component of pedagogical content knowledge is comprised of two categories: (a) knowledge of subject specific strategies, and (b) knowledge of topic-specific strategies. Strategies in these categories differ with respect to their scope. Subject-specific strategies are broadly applicable; they are specific to teaching science as opposed to other subjects. Topic-specific strategies are much narrower in scope; they apply to teaching particular topics within a domain of science.

(a) Knowledge of Subject-Specific Strategies

Teachers' knowledge of subject-specific strategies is related to the 'orientation to teaching science' component of pedagogical content knowledge in that there are general approaches to science instruction that are consistent with the goals of particular orientations. A number of subject-specific strategies have been developed in science education, many of them consisting of a three or four phase instructional sequence. The best known of the subject-specific strategies is the 'learning cycle' such as '5E learning cycle' including engagement, exploration, explanation, elaboration, and evaluation. Teachers' knowledge of subject-specific strategies for science teaching consists of the ability to describe and demonstrate a strategy and its phases (Magnusson et al., 1999).

(b) Knowledge of Topic-specific Strategies

Teachers' knowledge of topic-specific strategies are useful for helping students comprehend specific science concepts. There are two categories of this type of knowledge: representations and activities.

(i) Topic-specific representations: this category includes a teacher's ability to invent representations to aid students in developing understanding of specific concepts or relationships. Representations can be illustrations, examples, models, or analogies.

(ii) Topic-specific activities: this category refers to knowledge of the activities that can be used to help students comprehend specific concepts or relationships; for example, problems, demonstrations, simulations, investigations, or experiments. Pedagogical content knowledge of this type also includes teachers' knowledge of the conceptual power of a particular activity; that is, the extent to which an activity presents, signals or clarifies important information about a specific concept or relationship (Magnusson et al., 1999)

Knowledge of assessment*:* This component of PCK consists of (a) knowledge of the dimensions of science learning important to assess and (b) knowledge of assessment strategies and methods through which students' learning can be assessed (Magnusson et al., 1999).

(a) Knowledge of Dimensions of Science Learning to Access

Teachers' knowledge of this aspects of students' learning that are important to assess within a particular unit of study. Champagne (1989) stated that National Assessment of Educational Progress (NAEP) identified conceptual understanding, interdisciplinary themes, the nature of science, scientific investigation, and practical reasoning as important dimensions of science learning to assess (Magnusson et al., 1999). Thus, effective teachers should know what dimensions or aspects of a dimension of scientific literacy should be assessed in a particular unit.

(b) Knowledge of Methods of Assessment

This category of pedagogical content knowledge refers to teachers' knowledge of the ways that might be employed to assess the specific aspects of student learning that are important to a particular unit of study. There are a number of methods of assessment, some of which are more appropriate for assessing some aspects of student learning than others. Teachers' knowledge of methods of assessment includes knowledge of specific instruments or procedures, approaches or activities that can be used during a particular unit of study to assess important dimensions of science learning, as well as the advantages and disadvantages associated with employing a particular assessment device or technique (Magnusson et al., 1999). Methods of effective assessment include informal, formative, and summative evaluations implemented to reveal student understanding implemented to assess students' understanding of scientific concepts.

Magnusson, Krajcik and Borko (1999) model showed that effective teachers need to develop knowledge for science teaching. In this study, this model is used to evaluate the PCK of science teachers at the middle school level.

Research Method

Research Design

In order to investigate the science teachers' pedagogical content knowledge and the relation between students' achievement and teachers' pedagogical content knowledge, a descriptive research design was used to collect the data about the middle school science teachers' pedagogical content knowledge. Quantitative research approach was used as the primary method, and the interview form was also used to evaluate and interpret the quantitative results.

Sample of the Study

The total of (75) junior assistant teachers and (630) Grade Six students were randomly selected sixteen basic education middle and high schools from four Townships (Yankin, Mayangone, Dala and Hlaingtharyar) in Yangon Region during (2016-2017) as participants for this study.

Instruments

The instruments used in this study were a questionnaire of teachers' pedagogical content knowledge based on the Magnussson, Krajcik & Borko Model, a science achievement test based on the Grade Six General Science Textbook, and an interview form.

Procedures

First, the relevant literature about the study was explored and then constructed the questionnaire that is based on the Magnusson, Krajcik and Borko model of pedagogical content knowledge under the supervision of the supervisor. Expert review was conducted for the validation of questionnaires by seven teacher educators of Methodology Department in Yangon University of Education. After getting the validation, a pilot test was conducted with (22) junior assistant science teachers from Mingalardone Township in 13 December, 2016.The items were modified under the guidance of the supervisor. The data obtained from the pilot study was used to calculate Cronbach's alpha coefficient. The internal consistency for the teachers' pedagogical content knowledge questionnaire was (.833). The real data collection was done in the first week of January 2017. Achievement tests were administered to Grade Six students in each selected school. After two weeks, the completed questionnaires were collected from each school. Interviews were done in each high school and middle school in each township.

Research Findings

Findings of Science Teachers' Pedagogical Content Knowledge in Selected Schools

Table 1 described the means of science teachers' pedagogical content knowledge in selected schools.

Table 2: Means of Science Teachers' Pedagogical Content Knowledge in Selected Schools

School	N	Mean	Mean Percentage (%)	Std. Deviation
S1	3	154.67	84.98	.577
S2	4	148.75	81.73	2.217
S3	3	126.33	69.41	6.429
S4	4	151.75	83.38	1.258
S5	8	148.25	81.46	4.713
S6	10	149.70	82.25	4.832
S7	2	133.50	73.35	.707
S8	4	135.50	74.45	2.517
S9	4	138.50	76.10	3.109
S10	7	148.86	81.79	3.024
S11	3	150.00	82.42	1.00
S12	4	141.25	77.61	3.594
S13	6	140.83	77.38	5.345
S14	6	152.33	83.70	4.033
S15	3	151.67	83.33	5.033
S16	4	155.50	85.44	5.568
Average	**75**	**146.45**	**80.47**	**7.989**

According to the means of science teachers' pedagogical content knowledge, the average mean was (146.45) and the standard deviation was (7.989). The highest mean was (155.50) and the lowest mean was (126.33). This result indicated that the science teachers' pedagogical content knowledge of No. (6) Basic Education Middle School Hlaingtharyar was the highest and No. (2) Basic Education Middle School Yankin was the lowest in selected schools (see Figure 2).

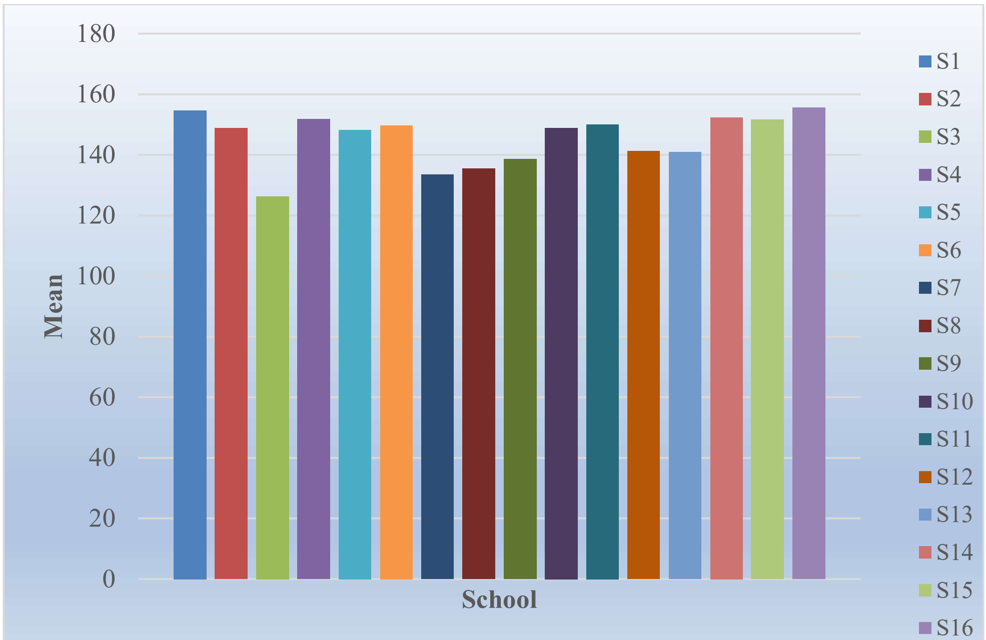

Figure 2: Comparison of Means for Science Teachers' Pedagogical Content Knowledge by Schools

One-way ANOVA was used to explore the significant level of science teachers' pedagogical content knowledge in selected schools. The result indicated that there was a significant difference in science teachers' pedagogical content knowledge among schools, (F (15, 59) = 15.014, $p < .001$) (see Table 3).

Table 3: ANOVA Results of Science Teachers' Pedagogical Content Knowledge in Selected Schools

	Sum of Squares	*df*	Mean Square	F	Sig.
Between Groups	3742.213	15	249.481	15.014	.000***
Within Groups	980.374	59	16.617		
Total	**4722.587**	**74**			

Note. ****p* < .001

According to the mean percentage of science teachers' pedagogical content knowledge, the degree of dimensions that have influenced the teachers' pedagogical content knowledge can be seen. The mean percentages of each dimension were (80.08%), (82.67%), (79.28%), (75.73%) and (85.78%) respectively (see Table 4). It was found that the knowledge of students' understanding of science was the highest and knowledge of instructional strategies was the lowest effect on teachers' pedagogical content knowledge.

Table 4: Mean Percentages of Science Teachers' Pedagogical Content Knowledge for each Dimension

Dimension	N	Mean	Mean Percentage (%)	Std. Deviation
Orientation towards Science Teaching	75	40.04	80.08	3.652
Knowledge of Curriculum	75	41.33	82.67	3.155
Knowledge of Assessment	75	39.64	79.28	3.228
Knowledge of Instructional Strategies	75	15.15	75.73	2.386
Knowledge of Students' Understanding of Science	75	10.29	85.78	1.136

In addition, means of teachers' pedagogical content knowledge was divided into three parts: high, moderate and low to analyze the level of teachers' pedagogical content knowledge by school (see Table 5). According to the percentage level of teachers' pedagogical content knowledge, science teachers' pedagogical content knowledge was mostly found at the moderate level. Two schools were at high level, eleven schools were at moderate level and three schools were at low level of pedagogical content knowledge.

Table 5: Level of Teachers' Pedagogical Content Knowledge by School

Level of Teachers' Pedagogical Content Knowledge	**No. of Schools**	**Percentage (%)**
High	2	12.5
Moderate	11	68.75
Low	3	18.75

Findings of Science Teachers' Pedagogical Content Knowledge in terms of Science Teaching Service

In order to investigate the significance level of science teachers' pedagogical content knowledge and science teaching service, one-way ANOVA was used. The results pointed out that there was a significant difference between science teachers' pedagogical content knowledge and science teaching service, (F (2, 72) = 7.861, $p < .01$) (see Table. 6).

Table 6: ANOVA Results for Science Teachers' Pedagogical Content Knowledge in terms of Science Teaching Service

Science Teaching Service	**N**	**Mean**	**Std. Deviation**	***df***	**F**	**Sig.**
1-10 years	50	144.34	1.087	74	7.861	.001**
11-20 years	16	148.69	1.719			
≥ 21 years	9	154.22	1.942			
Total	75	146.45	.922			

Note. $^{**}p < .01$

Table 6 indicated that the pedagogical content knowledge of science teachers who have accumulated more science teaching service was significantly higher than the science teachers who have less science teaching services. The means of science teaching service (1-10) years, (11-20) years and (≥ 21) years were (144.34), (148.69), and (154.22) (see Figure 3).

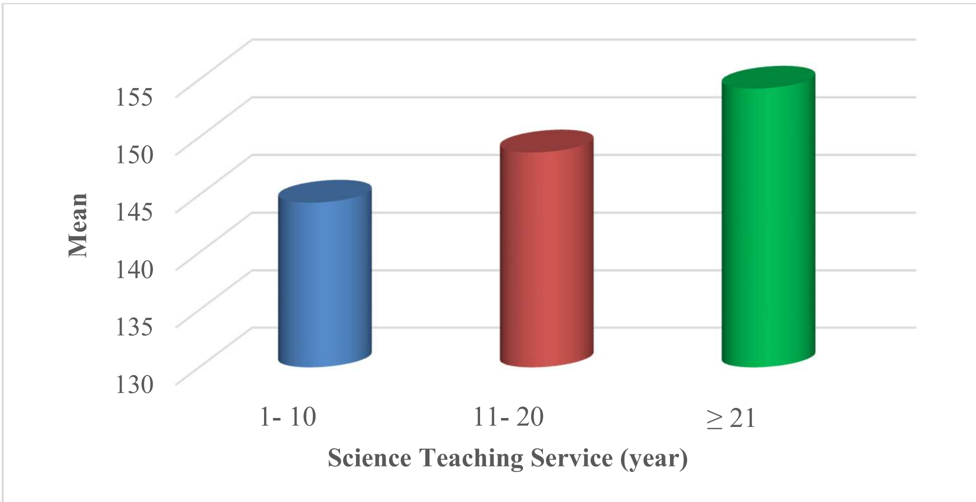

Figure 3: Comparison of Means for Science Teachers' Pedagogical Content Knowledge in terms of Science Teaching Service

Thus, it was found that the more science teaching service, the teacher had the higher pedagogical content knowledge in science teaching.

Findings of Students' Achievement in Selected Schools

A descriptive statistics was applied to study the differences in science students' achievement.

Table 7: Means of Students' Science Achievement in Selected Schools

School	N	Mean	Std. Deviation
S1	40	18.25	3.136
S2	40	17.02	2.636
S3	40	12.83	3.137
S4	34	18.12	3.179
S5	38	16.50	2.755
S6	40	17.17	3.335
S7	39	13.23	2.995
S8	36	13.39	3.073
S9	41	16.51	2.420
S10	40	17.03	2.769
S11	40	17.38	2.467
S12	40	16.60	2.447
S13	40	16.57	2.352
S14	40	18.13	2.643
S15	40	17.45	2.754
S16	34	19.98	1.387
Average	**630**	**16.65**	**3.297**

Table 7 described the means of students' achievement from selected schools. The average mean of students' achievement is 16.64 and standard deviation is 3.298. According to the means of students' achievement, the highest mean was (19.98) and the lowest mean was (12.83). Thus, the means indicated that No. (6) Basic Education Middle School Hlaingtharyar was at the highest and No. (2) Basic Education Middle School Yankin was at the lowest level (see Figure 4).

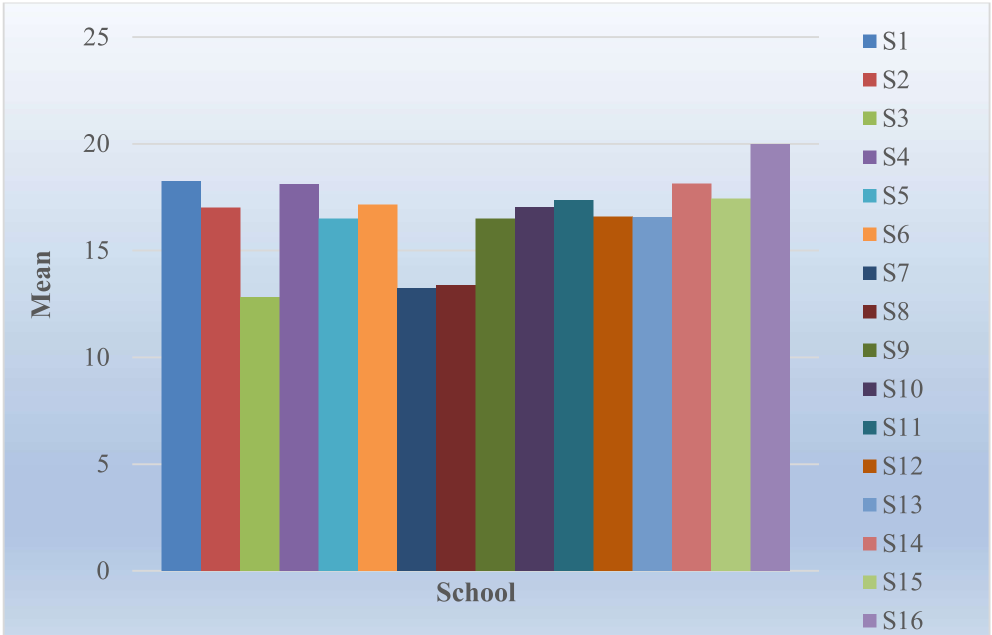

Figure 4: Means of Students' Science Achievement in Selected Schools

To analyze the significance level of students' achievement among schools, one-way ANOVA was used. Table 8 showed that there was a significant difference in students' achievement among selected schools, (F (15, 614) = 19.651, $p< .001$). This means that science achievement is differ across the schools in the selected region.

Table 8. ANOVA Result of Students' Science Achievement in Selected Schools

	Sum of Squares	***df***	**Mean Square**	**F**	**Sig.**
Between Groups	2219.592	15	147.973	19.651	.000***
Within Groups	4623.335	614	7.530		
Total	6842.927	629			

Note. ***$p< .001$

To compare the level of students' achievement, the means of students' achievement was separated into three parts: high, moderate and low. Table 9 demonstrated the degree of students' achievement gained in the selected schools with percentage and number of schools. It was found that the number of moderate level science students' achievement was mostly found in the selected region.

Table 9: Level of Students' Science Achievement in Selected Schools

Level of Students' Achievement	No. of Schools	Percentage (%)
High	1	6.25
Moderate	13	81.25
Low	2	12.5

To make the comparison of science teachers' pedagogical content knowledge and students' science achievement level, the three degree of high, moderate and low of two groups were listed as follows (see Table 10).

Table 10: Comparison of Science Teachers' Pedagogical Content Knowledge and Students' Science Achievement in Selected Schools

School	Science Teachers' Pedagogical Content Knowledge	Students' Science Achievement
S1	154.67 (H) > 154.439	13.353 < 18.25 (M) < 19.947
S2	138.461 < 148.75 (M) < 154.439	13.353 < 17.02 (M) < 19.947
S3	126.33 (L) < 138.461	12.83 (L) < 13.353
S4	138.461 < 151.75 (M) < 154.439	13.353 < 18.12 (M) < 19.947
S5	138.461 < 148.25 (M) < 154.439	13.353 < 16.50 (M) < 19.947
S6	138.461 < 149.70 (M) < 154.439	13.353 < 17.17 (M) < 19.947
S7	133.50 (L) < 138.461	13.23 (L) < 13.353
S8	135.50 (L) < 138.461	13.353 < 13.39 (M) < 19.947
S9	138.461 < 138.50 (M) < 154.439	13.353 < 16.51 (M) < 19.947
S10	138.461 < 148.86 (M) < 154.439	13.353 < 17.03 (M) < 19.947
S11	138.461 < 150.00 (M) < 154.439	13.353 < 17.38 (M) < 19.947
S12	138.461 < 141.25 (M) < 154.439	13.353 < 16.60 (M) < 19.947
S13	138.461 < 140.83 (M) < 154.439	13.353 < 16.57 (M) < 19.947
S14	138.461 < 152.33 (M) < 154.439	13.353 < 18.13 (M) < 19.947
S15	138.461 < 151.67 (M) < 154.439	13.353 < 17.45 (M) < 19.947
S16	155.50 (H) > 154.439	19.98 (H) > 19.947

Note .H = High Level
M = Moderate Level
L = Low Level

Relationship of Science Teachers' Pedagogical Content Knowledge and Students' Science Achievement

To analyze the relationship between science teachers' pedagogical content knowledge and students' achievement in science teaching, Pearson product-moment correlation (r) was used. The result showed that there was a positive relationship between science teachers' pedagogical content knowledge and students' science achievement, r (14) = .47, p = .019 (see Table 11).

Table 11: Correlation between Science Teachers' Pedagogical Content Knowledge and Students' Science Achievement

Correlation			
		Science Teachers' Pedagogical Content Knowledge	Students' Science Achievement
Science Teachers' Pedagogical Content Knowledge	Pearson Correlation	1	.470*
	Sig. (2-tailed)		.019
	N	16	16
*.Correlation is significant at the 0.05 level (2-tailed).			

It was found that the result of the correlation has positive correlation and the level was moderate. It was also pointed out that the high level of science teachers' pedagogical content knowledge will have the high level of students' achievement.

Discussions, Suggestions, Recommendations and Conclusion

Discussions and Suggestions

The results of the study indicate that (12.5%) of science teachers have high pedagogical content knowledge and (68.75%) of science teachers have moderate level and the other (18.75%) have low pedagogical content knowledge about science teaching. Two schools have high level of pedagogical content knowledge, eleven schools have moderate level and the other three have low level of pedagogical content knowledge. Students' science achievement was pointed that (6.25%) of middle school students have high science achievement, (81.25%) of students have moderate level and (12.5%) have low level achievement. One school has high level of students' achievement, thirteen schools have moderate level and two schools have low level achievement. It was found that the selected schools were at the moderate level of pedagogical content knowledge and students' science achievement. So, high level of pedagogical content knowledge is still needed to upgrade teachers' professional knowledge. It was found that No. (6) Basic Education

Middle School Hlaingtharyar was the highest pedagogical content knowledge and students' achievement among the selected schools. In this school, science teachers have longer science services and more understanding about how to students learn science and the nature of science subject. Moreover, the headmistress of this school is well-planned and managed the school to promote students' abilities in their learning. The lowest level pedagogical content knowledge and students' achievement school of No. (2) Basic Education Middle School Yankin is faced with the shortage of teachers, buildings and low parental involvement in students' learning. Moreover, science teacher of this school has shorter science teaching services and the former science teacher is retired recently. Shulman (1987) stated that pedagogical content knowledge is the amalgam of pedagogical knowledge and content knowledge. Although teachers are expertise in the subject matter, students' achievement will not be progressed when teachers cannot combine successfully with pedagogical knowledge.

According to the mean percentage level, knowledge of students' understanding of science has the greatest effect on teachers' pedagogical content knowledge and knowledge of instructional strategies has the lowest effect. It was shown that teachers need more knowledge of how students understand science concepts after teaching scientific concepts, what difficulties the students encounter, and which concepts are abstract. For some science topics, learning is difficult because the concepts are very abstract and they lack any connection to the students' common experiences (Magnusson et al., 1999). In the interview, teachers exactly show which concepts are difficult for their students, which parts are more familiar with their students, and which parts are abstract for their students. Moreover, teachers told that some practical experiments in which fire is used to react chemicals can be a danger for their students. In the pedagogical content knowledge questionnaire, knowledge of students' understanding of science has the greatest effect and knowledge of instructional strategies has the weakest effect on teachers' pedagogical content knowledge. This result pointed out that teachers cannot use instructional strategies effectively because of the difficulties of class size, frequent monthly assessments and the shortage of science teachers in schools.

Although most teachers have student-centered orientation, they cannot implement or apply instructional strategies completely as they enjoy. Most teachers said that student-centered is more suitable for teaching science although it consumes time and needs more time to complete the lessons. Monthly assessment is administered frequently. Thus, more time is needed to implement the instructional strategies effectively. Teachers agreed that present science curriculum is suitable for Grade Six students' learning abilities, and developmental level. But some contents related with the matter is difficult for their students because of the complex chemical names such as 'sodium chloride', 'calcium carbonate' and 'sodium hydroxide'. Almost all teachers exactly know the purposes of assessment and how to assess, evaluate science subject. They all accepted that the content about the concepts that can applied in real lives are vital in assessing and evaluating science achievement.

According to the ANOVA result, there is a significant difference between science teaching services and teachers' pedagogical content knowledge (see Table 4.5). Research findings indicated that teachers who possessed longer science teaching services have more pedagogical content knowledge. When teachers were accumulated more science teaching service, they can get more understanding about the subject matter, students' development level, how to support students' learning and how to access students' achievement. It was assumed that science teaching service was one of the factors of pedagogical content knowledge but it was not enough to decide students' achievement level.

The result of the study shows that there is a positive relationship between science teachers' pedagogical content knowledge and students' science achievement. It was consistent with the study of Lange, Kleckmann and Möller (2011) of teachers' pedagogical content knowledge was significantly related with students' achievement. With pedagogical content knowledge, students' can get more understanding about the concepts and subject matter representation. Moreover, it was also consistent with the study of Hill, Rowan and Ball (2005). The result of this study shown that teachers' knowledge is significantly related with the students' achievement. But it cannot be the only reason of the progress of students' achievement. Students' achievement does not rely only on teachers' knowledge. It was closely related with teachers' real practices, students' learning abilities and parental involvement. Although teachers have high level of knowledge but they cannot use it in classroom effectively, it does not show good result on students' achievement.

To upgrade the teachers' pedagogical content knowledge, refresher courses about teaching profession are in demand. Das (1985) stated that teachers are the media of the pupils and content and they are important pivot in instructional system. To develop better progress of students' achievement, teachers' professional development should be taken into account. At present, Ministry of Education mainly focused on the progress of students' achievement. Some refresher courses greatly focused on the progress of students' achievement, competency of subject matter and assessment techniques. Thus, refresher courses should emphasized on the professional development and knowledge about teaching practices. To upgrade the education system, teachers' knowledge and practices, some suggestions are expressed as follows:

- To construct sound subject matter knowledge in teachers.
- To find related resources that can be applied in instruction.
- To attend refresher courses about science teaching and laboratory works.
- To use pedagogical knowledge effectively in classroom that is consistent with students' learning abilities.
- To create science museum in classroom.
- To reduce the class size to be small.
- To arrange filed trips.

Further studies should focus on the relationship of teachers' pedagogical content knowledge, practices and students' achievement. Practices of teachers are also needed to implement good instruction. The studies about the relationship between students' achievement and teachers' pedagogical content knowledge with other grades and other subjects are also in demand. Moreover, further studies about pedagogical content knowledge with professional development can bring about effectiveness on students' achievement.

Recommendations

This study focused only on the impact of science teachers' pedagogical content knowledge on students' achievement in science teaching at the middle school level. Further studies are still needed with other grades to upgrade the knowledge of teachers and students' science achievement. Moreover, this study explored the impact of teachers' pedagogical content knowledge and students' science achievement and not to reveal ways and means to find the solution. The sample size of this study is small and not enough to interpret the whole country. Thus, more studies are still needed to validate the interpretations of the study.

Conclusion

Science is the study of the natural phenomena to make the society to progress living standards. In the twenty-first century, it becomes more and more popular and many people are interested in it to develop new inventions. Education is changing in accordance with the society. Science teaching is becoming more and more popular and many researchers find out the requirements of science education. In 1986, Shulman introduced the name of 'pedagogical content knowledge' in education. He proposed that pedagogical content knowledge is the special amalgam of subject matter knowledge and pedagogical content knowledge for the purpose of teaching. It was also the form of knowledge that made teachers differ from content specialists such as chemists, biologists and historians. Although content specialists established knowledge from the view of their respective subjects, teachers structured their knowledge for teaching from the perspective of teaching. Teachers are also considered about the subject matter to teach, the ways to represent the subject matter to their students and the strategies to be assessed. Thus, pedagogical content knowledge became as the teachers' specialized knowledge in teaching profession.

Many researchers started to find the relationship, effects and essence of pedagogical content knowledge related with their respective subjects.

Moreover, scholars assumed that teachers' knowledge is one of the factors of instructional system. The main purpose of this study was to investigate the impact of science teachers' pedagogical content knowledge on students' achievement in science teaching at the middle school level. Teachers' knowledge can create effective learning environment and support instruction. Teachers' pedagogical content knowledge can make the instruction to be more clear and feasible forms to convey subject matter knowledge to the students. With pedagogical content knowledge, teachers can combine subject matter knowledge (what to teach) and pedagogical knowledge (how to teach) to be a more feasible form. It is a unique knowledge because it can have only in teachers and teaching profession.

Abell (2007) stated that students' achievement will be relied on teachers' pedagogical content knowledge. According to this study, it was indicated that high pedagogical content knowledge of teachers will have high level of students' achievement. Thus, teachers' knowledge has several impart on students' achievement. To progress students' achievement, teachers need to upgrade their professional knowledge of teaching. The higher the teachers' knowledge, the better students' achievement. However, teachers' knowledge are not only one reason for progressing students' achievement. Some other factors can also influence students' achievement such as parental involvement, teachers' real practices in the classroom and other activities. But teachers' knowledge is still in an important role in instructional system. To deserve the term 'teacher', he/she must show the knowledge about the subject matter to teach and pedagogical knowledge to make it feasible in teaching. Thus, it is the crucial factor to upgrade teachers' knowledge associated with teaching profession and then should be fully applied in real classroom practices.

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Appendix A

Questionnaire for Teachers' Pedagogical Content Knowledge

tv,fwef;tqifh odyÜHq&mwpfOD;wGif
&Sd&rnfh todynmrsm;ESifh ywfoufonfh
pHkprf;ar;jref;vTm

tydkif; (u)

q&m? q&mrwdkY\udk,fa&;tcsuftvufrsm;

atmufygtaMumif;t&mrsm;udkjznfhpGufay;yg&ef/

usm;^r --------------------

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vuf&Sdwm0efxrf;aqmifaeaomausmif; -----

--------------------- jrdKUe,ftrnf -

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touf --------------------

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(u) -------------------------------

-----------------(c) ----------------

(*) --

vkkyfoufpkpkaygif; ---------------------------------------

odyÜHbmom&yf oifMum;aomvkyfouf ---------------------------wpfywfodyÜHbmom&yf

oifMum;csdef ------------------------------

vuf&SdoifMum;aeaomtwef;ESifhbmom&yfrsm; ---------------------

odyÜHbmom&yftay:wGifxm;&Sddaom

oabmxm;tjrif ---

tydkif; (c)

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1/

odyÜHoifMum;rIay:wGif&Sdaom q&m^q&mrrsm;\ cH,lcsufrsm;udk ppfaq; jcif;/

pOf	**ppfaq;rnfhtaMumif;t&m**	vHk;0oabmr	oabmrwlvq	rqHk;]zwfw	oabmwlonf	vHk;0oabmw
1/	odyÜHbmom&yfoifMum;&mwGif oifrnfhtaMumif;t&mrsm;udk q&muOD;aqmif&Sif;vif; oifjyoifhonf/					
2/	q&monf ausmif;om;rsm; vufawGUvkyfief;rsm; aqmif&Guf aecsdefwGif tultnDay;oltaejzifhom aqmif&Guf oifhonf/					
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6/	tcsdKUaom odyÜHbmom&yfqdkif&m taMumif;t&mrsm;udk ausmif;om;					

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9/	q&monf ausmif;om;rsm;\ oif,lavhvmjcif; vkyfief; xufatmifcsufjrifhrm;a&;udk OD;pm;ay;aqmif&Gufoifh onf/					
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2/ oif&dk;nTef;wrf;qdkif&mtodynmA[kokwrsm;udkppfaq;jcif;

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vHk;0oabmw

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1/	tv,fwef;tqifhodyÜHoif&dk;onf oif,lrIqdkif&mvkyfief; rsm;udk OD;pm;ay;a&;qGJxm;onf/					
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6/	tv,fwef;tqifh odyÜHoif&dk;onf ausmif;om;rsm; pOf;pm;awG;ac:rI &ifhoefvmap&ef?					

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8/	odyÜHoif&dk;nTef;wrf;qdkif&m aqG;aEG;yGJrsm;? bmoom&yf qdkif&mrGrf;rHoifwef;rsm; wufa&mufjcif;onf oifMum; oif,lrIqdkif&mvkyfief;rsm;udk taxmuftyHhrjzpfEdkifyg/					
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3/ tuJjzwfppfaq;rIqdkif&mtodynmA[kokwrsm;u dkppfaq;jcif;

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4/	bmom&yf oifMum;aepOfwGif ausmif;om;rsm;udk ppfaq;rI jyKvkyfjcif;onf tcsdefukefí xda&mufrI r&Sdyg/					
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8/	jyefvnfoifMum;rIjyK&aom taMumif;t&mrsm;udkxyfrH ppfaq;&ef rvdkyg/					
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10 /	oifcef;pm wpfckcsif;pDtvdkuf ta&;ygonfh taMumif; t&mrsm; (oif,lrIqdkif&mOD;wnfcsufrsm; aygufajrmuf apEdkifaomtaMumif;t&mrsm;)udkt"du					

pO f	**ppfaq;rnfhtaMumif;t&m**					
	xm;í ppfaq;rI jyKoifhonf/					

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pO f	**ar;cGef;rsm;**	**tajzjznfh &ef**
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	tajct aetcsdeftcg ESifhoifhavsmfonfh oifenf;udk (u) owfrSwfxm;jcif;r&Sdyg/ (c) owfrSwfxm;ygonf/ (*) tqifajyovdkoifMum;ygonf/ (C) owfrSwf&efrvdktyfyg/	
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3/	oifMum;aom taMumif;t&mrsm;udk ausmif;ol^om;rsm; em;rvnfygu (u) Oyrm? om"ursm;toHk;jyKí em;vnfatmifoifMum; ygrnf/ (c) qifwlaomjzpf&yfrsm;udk zefwD;toHk;jyKíoifMum; ygrnf/ (*) oifMum;jcif;udk acwÅ&yfem;jyD;rS	

	jyefvnfoifMum;yg rnf/ (C) erlemyHkrsm;jyí oifMum;ygrnf/	
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	(c) oifcef;pmESifh qufpyfaeonfh vkyfief;udk OD;pGmpl;prf; avhvmapjyD;rS odyÜHbmom&yfqdkif&m todonmrsm;udk jyefvnfaqG;aEG; oifMum;avh&Sdygonf/ (*) oifcef;pmyg taMumif;t&mrsm;udk ausmif;om;rsm;udk OD;pGmzwf apjyD;odvdkonfh tcsufrsm;udk ar;jref;apum odyÜHqdkif&m todonmrsm;udk oifMum;avh&Sdygonf/ (C) oifcef;pmwGifyg0ifaom taMumif;t&mrsm;udkausmif; om;rsm; em;vnfoabmaygufap&ef a[majym aqG;aEG;í oifMum;avh&Sdygonf/	

5/ ausmif;om;rsm;\ odyÜHbmom&yfem;vnfrI tay:wGif&Sdaom q&m\ todynm udkppfaqjcif;

atmufygwdkYudk vkyfaqmifrI&SdvQif "&Sd" wGiftrSefjcpf (Â) jznfhí vkyfaqmifrI r&SdvQif "r&Sd" wGiftrSefjcpf (Â) jznfhay;yg/

pOf	taMumif;t&m	&Sd	r&Sd
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	&Sdygovm;/		
5/	odyÜHbmom&yfyg oifcef;pmtaMumif;t&mrsm;wGif ausmif;om; rsm;em;vnf&ef cufcJonfhtydkif;rsm; yg&Sdygovm;/		
6/	oifcef;pmoifMum;&mwGif ausmif;om;rsm;rS oifcef;pmESifh qufpyfaeonfh ar;cGef;rsm;udk jyefvSefar;avh&Sdygovm;/		

Appendix B

Science Achievement Test

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(n)

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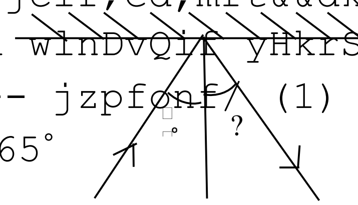

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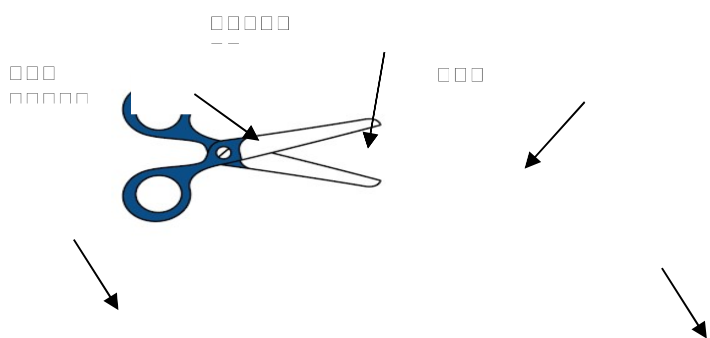

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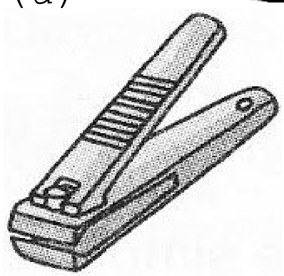

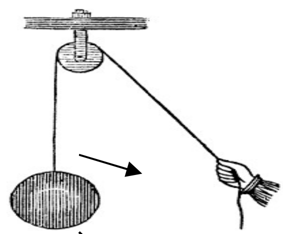

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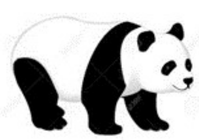
(2)  ------------------------
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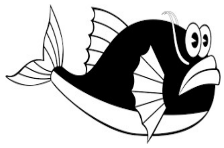
(4)  ------------------------------
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(p) (3) aMu;eD (1) rSwf
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(ps) (2) <uufom; (1) rSwf
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(c) t0wfavQmfqdk'g (5)
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(*) uefY (1) qmvzm (1)
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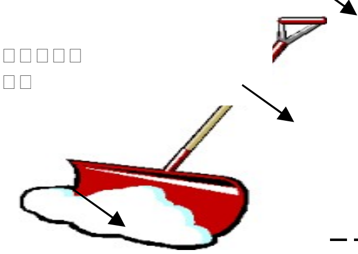

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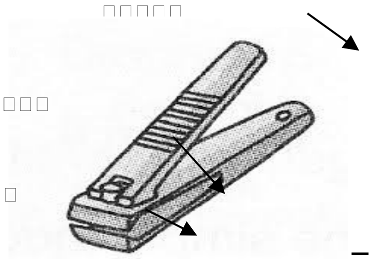

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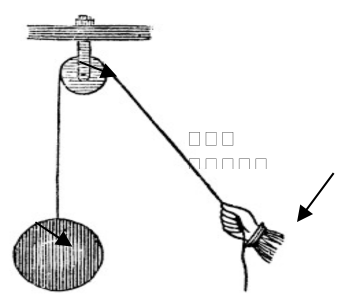

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pkpkaygif; -

(6) rSwf

1/ Multiple Choice (10)
rSwf

2/ Matching (5)
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3/ Label (4)
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4/ Short Questions (6)

rSwf

pkpkaygif; - (25)
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Appendix C

Interview Form

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aeY&uf -------------------

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----------odyÜHoifMum;onfhvkyfouf -------

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AN INVESTIGATION INTO THE PROBLEMS OF TEACHING AND LEARNING IN MATHEMATICS AT THE MIDDLE SCHOOL LEVEL

Lay Lay Hlaing[1], Htay Win[2]

Abstract

The main purpose of this study is to investigate into the problems of teaching and learning in mathematics at the middle school level. Specifically, this study aims at identifying the problems of teaching in mathematics and proffering solution to them for teachers and the problems of learning in mathematics for students. The design adopted for this study was a descriptive research design. Four townships were randomly selected from four districts in Yangon Region. One high school and two middle schools from each township were selected by using a stratified random sampling technique. The participants in this study were (600) Grade Seven students and (63) mathematics teachers. The data were collected by means of two questionnaires administered to teachers and students. To get the reliability, a pilot test was administered. The internal consistency of questionnaire for teachers was (.646) and the questionnaire for students was (.614). In the analysis of data, descriptive statistics (percentage) was used. Some of the findings that emerged are: (1) the foundation of most mathematics teachers in mathematics is poor. (2) The students have poor foundation in mathematics. (3) The teaching and learning environment is not conducive. Based on the findings, it was suggested that (a) The state government should, as a matter of urgency, send mathematics teachers to attend training and seminars for effective teaching and learning. (b) The government should endeavor to provide the necessary infrastructures and facilities that will motivate teaching and learning of mathematics.

Keywords: problem, teaching, learning, mathematics

Introduction

The teaching and learning of mathematics should be taken very seriously. Obodo (2000) averred that the problem of quality of mathematics instruction and learning are from diverse sources. The teacher has been accused to be responsible for the low quality of student performance in the current middle schools. Amazigbo (2000) has identified poor primary school

[1.] Tutor, Department of Physical Education, Bogalay Education College
[2.] Dr. Lecturer, Department of Methodology, Yangon University of Education

background in mathematics, lack of incentive for teachers, unqualified teachers in the system, lack of learner's interest, perception that mathematics is difficult, large classes and psychological fear of the subject as factors responsible for the dismal performance of students in the subject. Therefore, the researcher thought that it is essential to investigate the problems of teaching and learning in mathematics.

Statement of the Problem

The poor performance of students in mathematics has been a thing of concern to mathematics teacher and students themselves. At present most of mathematics teachers do not effort to identify the major problems associated with school mathematics. And then, the teachers rarely find the strategies that could solve the problems of teaching and learning mathematics. This is one of the real problems of the current mathematics classrooms.

Purposes of the Study

The main purpose of this study is to investigate the problems of teaching and learning in mathematics at the middle school level. The specific objectives are as follows.

1. To identify the problems of teachers in teaching mathematics.
2. To examine the strategies that could solve the problems of teaching and learning mathematics.
3. To identify the problems of students in learning mathematics.
4. To give suggestions for improving teaching and learning mathematics.

Research Questions

The research questions are as follows.

1. Which are the most serious problems of teaching in mathematics?
2. To what extent do the teachers respond to the strategies that could solve the problems of teaching mathematics at the middle school level?
3. Which are the most serious problems of learning in mathematics?

Scope of the Study

This research has its own particular limitations. The first limitation is related to the fact that the participants of the study came from only twelve selected schools from Yangon Region. Four Basic Education High Schools and Eight Basic Education Middle Schools were included in this study. Participants in this study were (600) Grade Seven students and (63) middle school mathematics teachers from the twelve selected schools in the academic year (2016-2017). The second limitation is that this study is only concerned with the teachers' questionnaire in which the problems such as students' background knowledge, maintaining and arousing students' interest, anxiety, teaching aids, characteristics of mathematics teacher, students' problem solving skill, motivation, teachers' qualification, class size and teacher's over workload were consisted. Besides, researcher seeks to identify the strategies that could be adapted to solve the problems of teaching mathematics in which the characteristics of the effective mathematics teachers and creating quality learning environments were consisted. The third limitation is the questionnaire for students in which the general problems of students' learning in mathematics were consisted.

Definition of Key Terms

Problem : A matter or situation regarded as unwelcome or harmful and needing to be dealt with and overcome (English Oxford Living Dictionary, 2016).

Teaching : Teaching is a form of interpersonal influence aimed at changing the behavior potential of another person (Gage, 1962).

Learning : Learning is a change in behavior (Pangborn, 2002).

Mathematics : The science of numbers and of shapes, including Algebra,

Geometry and Arithmetic (The Longman Company, 2009).

Significance of the Study

The teaching and learning of mathematics is a complex activity and many factors determine the success of this activity. The nature and quality of instructional material, the presentation of content, the pedagogic skills of the teacher, the learning environment, the motivation of the students are all important and must be kept in view in any effort to ensure quality in teaching-learning of mathematics.

Amazigbo (2000) identified poor primary school background in mathematics, lack of incentives for teachers, lack of learners' interest perception that mathematics is difficult as problems for the dismal performance of students in the subject. Osafehinti (1986) posits that if a student has a positive attitude towards mathematics, he will not only enjoy studying it but will also derive satisfaction from the knowledge of mathematical ideas he gains. Obodo (2002) explains further, if a student has a positive attitude towards mathematics, he will definitely interest in its teaching and learning.

Muhammad (2000) found that the students' anxiety about getting zero if they solved their problems in different way or through other method than those followed by teachers. Hossain (2000) found that the teachers used not at all teaching aids in the classroom except geometric tools sometimes in geometry class in similar way and their findings show that teachers make and execute that they cannot use teaching aids for the shortage of time to lesson plan.

Singh (as cited in Rathva, 2012) stated that mathematics is crucial not only for success in school, but in being an informed citizen, being productive in one's chosen carrier, and in personal fulfillment. Mathematical problem is used as not only to help students develop their thinking ability. Students can apply their knowledge and problem solving skill in daily life since the process of solving the mathematics problems are similar to the general problem solving in their lives.

Swan and Jones (as cited in Umameh, 2011) found that teachers should receive appropriate training in the subject matter area so that their classroom instruction could be above broad. For example, mathematics teachers who have completed Ph.D. course work in mathematics and an advanced certificated course in education are more effective than poor teacher without such advanced training in education.

Carron and Chau (as cited in Ministry of Education, 2007) found that certain teachers have an insufficient mastery of the subject matter they teach, and lack the pedagogical knowledge - how required for good presentation of the materials. Many teachers identified this as a problem for themselves. Willims (as cited in Ministry of Education, 2007) found that children who were in classes of more than (25) students were (1.5) times more likely to demonstrate lower test scores and higher grade repetition increased. The number of students is so large in the class that it become hard to focus and teacher fails to pay attention to all the students, as a result the weakness and problems of mathematics remain unsolved. According to American international journal of contemporary research shows that (27.8%) of mathematics teachers teach more than (30) lessons in a weeks. According to the Ministry of Education (2007), a teacher in a secondary school is supposed to teach at most (30) lessons on a week. This indicates that (27.8%) of mathematics teachers are over work load. This percentage is high and many contribute to poor performance in mathematics.

According to the facts mentioned above, it is needed to identify the problems of teaching and learning of mathematics in Myanmar and mathematics teachers need to consider how to overcome these problems successfully.

Theoretical Framework

Importance of the Background Knowledge in Mathematics

A person's background knowledge is a collection of abstracted residue that has been formed from all of life's experiences. All person, whether as a toddler or a centenarian, bring diverse bits of background knowledge consciously or subconsciously to every subsequent experience, and ones use them to connect or glue new information to old. Background knowledge is an essential component in learning because it helps them to link sense of new ideas and experiences with the old one. If the students do not have enough background knowledge in mathematics, it may be a problem for successful learning in mathematics.

Arousing and Maintaining Interest in Mathematics

To arouse and maintain the student's interest in mathematics is a major problem for the teacher. It is clear that loss of interest is one of the principle causes of student failure. A strong interest in mathematics would tend to produce a favorable attitude toward the subject, and such an attitude would in turn probably lead to or enhance the desire to study mathematics in a serious and productive way. Thus the development and stimulation of interest in mathematics becomes an important concern of the teacher. If the students do not have enough to arouse and maintain interest in mathematics, it may be a problem for successful learning in mathematics.

Mathematics Anxiety

Although mathematics' importance and applications in everyday life, it is often considered as a difficult subject. Research has demonstrated that many students have learning difficulties and show poor performance in mathematics. One of the attributed reasons is the anxiety that an individual may have towards mathematics. Mathematics anxiety is an important factor that affects students' achievement and attitude towards mathematics (Hembree, 1990). It may lead to poor performance and avoidance of mathematics. If the students have high anxious in mathematics, it may be a problem for successful learning in mathematics.

The Use of Teaching Aids (Instructional Materials) in Mathematics

The use of sensory aids in the teaching of mathematics is of recent origin. In fact, all teaching has always involved the communication of ideas through the sense either orally through the medium of a speech, or visually by the use of written or printed material, text-books, writing materials, geometrical instruments and the blackboard (all these are sensory aids) have long been regarded as indispensable equipment for mathematics classes. For many years resourceful teachers have used models, instruments, drawings, and other devices to stimulate interest and facilitate learning. But for a long time the potential values of these supplementary devices were fully realized only by exceptional teachers. Only lately has there been a concerted effort among leaders in mathematics teaching at making all the teachers alive to these possibilities. Mathematics is essentially a subject, where doing is more prominent than reading. That is why a certain amount of equipment is indispensable in order to make even a start in this subject. Moreover, it is felt by a vast majority of people that mathematics is a dry and difficult subject, full of abstract things. The result is that students take very little interest in it. To create the necessary interest is a constant problem for the teacher. This subject demands the use of aids at every step.

Characteristics of Effective Mathematics Teachers

The effectiveness of a specific individual as a teacher depends on a mix of such factors as (1) personal and professional qualifications; (2) the nature of the student population to be taught; and (3) the workplace condition that foster effectiveness or inhibit it. Although these characteristics vary in the literature, Ralph and Fennessey (as cited in Joseph & Leonard, 1998) stated that they generally involve the presence of a combination of (1) strong leadership by administrators; (2) a school climate that is safe and orderly; (3) an emphasis on basic academic skills; (4) a high level of teacher expectation for all learners; and (5) a system for monitoring and assessing student performance. The qualified and competent teacher realizes that principles and techniques of teaching that have been found to be effective in one classroom are not always equally effective in a different classroom. Thus, the teacher must use of judgment in deciding when and how to apply these principles and practices. According to Brophy (1982), the following observations are presented as guidelines for effective teaching.

1. Effective teachers take their jobs seriously.
2. Effective teachers provide children with an opportunity to learn.
3. Effective teachers manage their classrooms efficiently.
4. Effective teachers pace instruction to ensure that learners will be involved in meaningful tasks.
5. Effective teachers are active teachers.
6. Effective teachers have learners master desired outcomes.

7. Effective teachers recognize grade-level differences that require different teacher behavior.
8. Effective teachers provide a supportive learning environment.

Every teacher should possess above characteristics for promoting students learning in mathematics.

Students' Problem Solving Skill

Life is full of problems and the successful man in life is he, who is fully equipped with adequate knowledge and reasoning power to tackle these problems successfully. Problem solving becomes the central activity of the teaching mathematics. Resenbloom (1966) asserts that problem solving is a basic mathematical activity. Teaching for problem solving and learning problem solving skills, therefore, become the primary and important concerns of the teacher and the learners. National council of Teachers of Mathematics (as cited in Taplin, n.d.) advocated that all of the students, starting from the pre-school, should be made to acquire the behavior of building mathematical knowledge, being able to solve problem not only in mathematics but in every field as well, applying the proper problem solving strategies, and evaluating the problem solving. Because problem solving makes it possible to structure knowledge and to bring into connection with the other knowledge, it is included in the center of mathematics programs. Practicing on mathematics problems makes it possible to be developed aimed at the rational solutions of problems and enables these strategies to be adapted to all kinds of problem to encounter in life by leading to mathematical thinking. Development of mathematical ideas through problem solving is a difficult part of teaching mathematics. Teachers play an important role in the development of students' problem solving dispositions by creating and monitoring classroom environment in which students are encouraged to explore, take risks, share failures and successes, and questions with one another. In such supportive environment, students develop confidence in their abilities and a willingness to engage in and explore problems, and they will be more likely to pose problems and to persist with challenging problems. If students do not possess problem solving skill, they will not overcome their daily life problems successfully.

Incentive to Motivate Teachers

Motivation comes from many sources. Some teachers are motivated by their love of children and of teaching, some by more external factors such as a stable or the advantages of having more leave time. Most teachers are motivated by a complex combination of internal and external factors. Incentives used to motivate some teachers may antagonize others. Incentives are sometimes used by government and education leaders to encourage teachers to behave differently, presumably in ways that promote the ends desired by those giving the incentives. Indirect incentives include all the other financial resources offered to teachers. These might include: (a) professional support such as initial and ongoing training, teacher guides, resource books, instructional supervision; and (b) personal support such as free and subsidized housing, food and transportation. To the extent that incentives do work, research suggests that financial incentives appear to be more effective than other types of inputs. Vegas and Umansky (2005) suggest nine types of action that can operate as incentives in attracting teachers, retaining teachers, or in encouraging more effective teaching. These include intrinsic motivation, recognition and prestige, salary differentials, job stability, pension and benefits, professional growth, adequate infrastructure and teaching materials, subject master, and responding to stakeholders.

Teachers' Qualification

A poor teacher can only produce poor results. Sizer (as cited in Umameh, 2011) stated that a competent mathematics teacher will be a teacher with good academic and pedagogical backgrounds, who is not easily worn out by the system. As in the case of other teachers, many things are expected of the teacher of mathematics. His obligations not only are confined to the classroom but extend in many other directions also. It must not be forgotten, that his first and foremost obligation is to teach his subject effectively. Teaching mathematics is a task which, if sincerely undertaken, will challenge the best efforts of the best teacher. No teacher can do a thoroughly good job of teaching aspects of any true profession viz., significant knowledge and effective techniques. One cannot be efficiently professional if there is any serious weakness in either of the two. The beginning teacher will need to speed most of his time in improving his knowledge of his field and techniques of teaching, and becoming familiar with the traditions and administrative policies of the school. According to Sidhu (1995), the teachers of mathematics need to possess in general qualities and qualifications. Some of these are stated as follows.

1. Thorough knowledge of the subject
2. Interest in the subject
3. Knowledge of the child psychology
4. Enthusiasm for the subject
5. Capacity to inspire confidence in the students
6. Full knowledge of the objectives of the teaching of the subject
7. Up-to-date knowledge of the subject
8. Capacity of analysis and comprehensive description
9. Originality

Every teacher should possess above general qualities and qualifications for promoting students learning mathematics.

Class Size

According to Sidhu (1995), large class is general defect. No individual attention can be paid. It becomes difficult for the teacher to establish close contacts with the students. He cannot easily judge the capacities of the individuals. For education to be effective, teaching staff strength has to be adequate. A student-teacher ratio of (40:1) may be considered adequate but the situation is far from this in many schools. Card and Krueger (cited in Umameh, 2011) showed that both low pupil-teacher ratios and high quality school systems lead to higher future earnings for students. Finn (1998) concluded that no doubt that small classes have an advantage over larger classes in school performance and Krueger (1998), in a similar study confirms the original findings that students in small classes scored higher on standardized test than students in regular classes. Many studies indicate that reduced class size have a great impact in the progress of student achievement. The students are expected to do class works, home works and assignments frequently and the teacher is expected to correct these assignments and give feedback to the students, but when the number of students in a class is very big it makes this task impossible and it affects the progress of each child because of not getting the correct feedback timely. The large class size has also other impacts such as suffocated classrooms, hinder active participation of all students in class discussions, inconvenience in assessing each child, uncomfortable sitting and writing conditions etc. Therefore, large class is also a problem of teaching and learning mathematics.

Teachers' Over Work Load

Teachers are hugely committed professionals who work hard to put the needs of their pupils first. Their role is very rewarding but demanding and teachers want to spend their time on the things that will make the biggest difference to pupils' learning and progress. School leaders have a direct influence on the staff in their schools. No head-teacher wants to cause unnecessary and unproductive work for their teachers. As in the case of other teachers, many things are expected of the teacher of mathematics. So, the teacher is over work load on all sides and to follow the way of least resistance, he emphasizes cram work. He cannot adopt, and prepare for effective methods, as he has no spare time. His over work load does not allow him, time to remove individual difficulties (Sidhu, 1995).

Research Method

Research Design and Procedure

A quantitative research method was used in this study. The research design used in this study was a descriptive research design. First of all, the researcher explored the relevant literature concerning with the research. Secondly, in order to get the required data, the researcher constructed the instruments. Content validity was determined by expert judgment. After getting the validity of these instruments, a pilot testing was conducted. The modified instruments were distributed to all participants of the twelve sample schools and a test was administered with the help of the teachers of those schools in January 2017. After three weeks, all the instruments were returned, and then the data were entered into the computer data file and were analyzed using the Statistical Package for the Social Science (SPSS 22).

Instruments

(i) Questionnaire for Teacher

This questionnaire was used to investigate the problems of teaching mathematics. This consisted of two main parts: the problems of teaching mathematics and the strategies that could solve the problems of teaching mathematics. The second part was based on two areas: creating quality learning environment and the performance of effective mathematics teachers. Items (1, 2, 3 and 4) were concerned with creating quality learning environment and items (5, 6, 7, 8, 9 and 10) with the performance of effective mathematics teachers. The items were constructed based on a five point Likert-type scale from (1) to (5). For each item, the score closer to (1) indicated 'Strongly Disagree' and 'Strongly Agree' was indicated by the score closer to (5). The total scores of agree and strongly agree will define the level of the problems. It means that if the total scores of agree and strongly agree is high, the level of the problems will be high and the total scores of agree and strongly agree is low, the level of problems solving skill will be low. An expert review was conducted by (10) expert teachers. According to the pilot study, the internal consistency (Cronbach's Alpha) was (.646).

(ii) Questionnaire for Student

This questionnaire was used to investigate the problems of learning mathematics. There are ten items dealt with background knowledge of students, lack of interest, motivation, anxiety, students' problem solving skill, lack of instructional materials, inadequate mathematics teachers in terms of number and quality, support of parents, support of family and lack of mathematical instrument in this questionnaire. The items were constructed based on a five point Likert-type scale from (1) to (5). For each item, the score closer to (1) indicated 'Strongly Disagree' and 'Strongly Agree' was indicated by the score closer to (5). The total scores of agree and strongly agree will define the level of the problems. It means that if the total scores of agree and strongly agree is high, the level of the problems will be high and the total scores of agree and strongly agree is low, the level of problems will be low.

An expert review was conducted by (10) expert teachers. According to the pilot study, the internal consistency (Cronbach's Alpha) was (.614).

Population and Sample Size

The sample schools for the study were selected by using a stratified random sampling technique. One high school and two middle schools from each township were selected as the sample schools. Therefore, twelve schools (four high schools and eight middle schools) are included in this study. All mathematics teachers and Grade Seven students from the selected schools were selected as the sample of the study. The number of students and teachers were (600) and (63) respectively. Participants in this study were selected randomly. Table (1) shows the number of population and the sample size in the selected schools.

Table 1 Population and Sample Size

No.	Townships	School	No. of Teacher	Population	No. of Student		
					Male	Female	Total
1	Yankin	BEHS 2	6	267	29	21	50
2	Yankin	BEMS 2	5	84	22	28	50
3	Yankin	BEMS 4	4	76	26	24	50
4	Mayangone	BEHS 1	8	402	23	27	50
5	Mayangone	BEMS 3	4	113	26	24	50
6	Mayangone	BEMS 5	4	182	23	27	50
7	Dala	BEHS 1	7	340	25	25	50
8	Dala	BEMS 2	3	62	22	28	50
9	Dala	BEMS 3	4	97	23	27	50
10	Insein	BEHS 6	6	204	26	24	50
11	Insein	BEMS 3	6	153	21	29	50
12	Insein	BEMS 10	6	175	24	26	50
		Total	**63**	**2155**	**290**	**310**	**600**

Note: BEHS = Basic Education High School
BEMS= Basic Education Middle School

Data Collection

The modified instrument were distributed to all participants of the twelve sample schools with the help of the headmaster/headmistress of those schools.

Data Analysis

After three weeks, all the participants' answer sheets were gathered and their answer sheets were scored. In order to know the teachers' problems and students' problems questionnaires, descriptive statistics (percentage) was used.

Research Findings

Findings of the Problems of Teaching Mathematics

In order to find out the problems of teaching in mathematics, a questionnaire for teachers was used. According to the results, the teachers strongly agree to the facts that the poor foundation of students, teachers' qualification, over work load of teachers and incentives to motivate teachers are the most serious problems of teaching mathematics. This result shows that the first three serious problems are the background knowledge of the students, the characteristics of effective teachers, and students have problems even when similar examples are given (students' problem solving skill) (see Table 2).

Table 2: Percentage of Teachers Response to each Problem

No	Problem	Percentage of Teachers' Response				
		SDA	**DA**	**N**	**A**	**SA**
1	Background knowledge of students	0	5	2	46	47
2	Lack of interest	6	36	18	37	3
3	Anxiety	5	25	9	48	13
4	Use of instructional materials	2	20	2	65	11
5	Characteristics of effective teachers	0	3	5	71	21
6	Students' problem solving skill	0	16	2	66	16
7	Incentive to motivate teachers	2	17	10	46	25
8	Teachers' qualification	6	16	5	46	27
9	Class size	6	21	10	49	14
10	Over work load of teachers	3	16	2	53	26

Note: SDA = Strongly Disagree, N = Neutral, SA = Strongly Agree
DA = Disagree A = Agree

Findings of Strategies that could Solve the Problems of Teaching in Mathematics

In order to find out the strategies that could solve the problems of teaching in mathematics, a questionnaire for teachers was used. About (49%) of the teachers strongly agree to the fact that the teachers should use appropriate method to be able to work their homework lessons smoothly. According to the results, the teachers strongly agree to the facts that using relevant teaching methods, motivation, managing class size and giving feedback are the best strategies that could solve the problems of teaching mathematics. This result shows that the highest percentage of strategies that could solve the problems of teaching in mathematics are the using relevant teaching methods, motivation for students, giving feedback, caring for individual differences, relating real life situation, creating positive learning environment (see Table 3).

Table 3: Percentage of Teachers Response to each Strategy

No	Strategy	Percentage of Teachers' Response				
		SDA	DA	N	A	SA
1	Using relevant teaching aids	0	2	0	81	17
2	Making available for school facilities	0	3	0	70	27
3	Creating positive learning environment	0	0	0	64	36
4	Managing class size	0	0	2	57	41
5	Motivation	0	0	0	52	48
6	Relating real life situation	0	0	0	63	37
7	Using relevant teaching methods	0	0	0	51	49
8	Caring for individual differences	0	0	0	62	38
9	Using practical work	0	3	3	65	29
10	Giving feedback	0	0	0	60	40

Note: SDA = Strongly Disagree, N = Neutral, SA = Strongly Agree
DA = Disagree A = Agree

Findings of Problems for Students

In order to find out the problems of students' learning mathematics in general, a questionnaire for students was used. According to the results, the students strongly agree the fact that background knowledge of the students, lack of mathematical instruments, lack of instructional aids and inadequate mathematics teachers are the most serious problems of learning mathematics. This result shows that the first three serious problems of learning mathematics are the poor foundation of the students (background knowledge), lack of instructional aids, and lack of mathematical instruments (see Table 4).

Table 4: Percentage of Students Response to each Problem

No	Problem	Percentage of Students' Response				
		SDA	**DA**	**N**	**A**	**SA**
1	Lack of Background knowledge of students	2	2	3	27	66
2	Lack of interest (motivation)	19	22	13	34	12
3	Lack of hard work	27	37	16	16	4
4	Anxiety	14	21	15	35	15
5	Problem solving skill	25	34	14	19	8
6	Lack of instructional aids	8	10	7	37	38
7	Inadequate mathematic teachers	13	20	20	25	22
8	Parental involvement	29	28	8	24	11
9	Support by family	14	28	13	30	15
10	Mathematical instruments	12	11	5	30	42

Note: SDA = Strongly Disagree, N = Neutral, SA = Strongly Agree
DA = Disagree A = Agree

Discussion, Suggestions, and Conclusion

Discussion

The place of mathematics in the life of any nation is linked with the place of development in that nation. In this changing world, those who understand and can do mathematics well will have significantly enhanced opportunities and options for shaping their future. The knowledge of mathematics is an essential tool in one's society. One cannot lead his daily life activities very well without basic knowledge of mathematics. Therefore, it is necessary for everyone to have a good foundation of mathematics to lead his daily life activities properly. So, to develop the country, the teaching and learning of mathematics should be taken very seriously. The quality of mathematics that will pave way for the much needed pursuit in science and technology at the higher level is a matter of concern. Quality has to do with the attainment of standards and standards ensure accountability.

The teachers pointed out the problems of teaching in mathematics. Teachers' problems from highest to lowest are as follows.

1. Background knowledge of the students
2. Characteristics of effective teachers
3. Students' problem solving skill
4. Over work load of teachers
5. Use of instructional materials
6. Teachers' qualification
7. Incentives to motivate of teachers
8. Class size
9. Anxiety
10. Lack of interest

This result shows the most serious problems of teaching in mathematics. So, this finding reveals the answer of research question (1): Which are the most serious problems of teaching in mathematics?

The teachers pointed out the strategies that could solve the problems of teaching in mathematics. Teachers' strategies from highest to lowest are as follows.

1. Using relevant teaching methods
2. Motivation
3. Giving feedback
4. Providing for individual differences
5. Relating real life situation
6. Creating positive learning environment
7. Managing class size
8. Using relevant teaching aids
9. Making available for school facilities
10. Using practical work

This result shows the first highest percentage of strategies that could solve the problems of teaching in mathematics. So, this finding reveals the answer of research question (2): To what extent do the teachers respond to the strategies that could solve the problems of teaching in mathematics at the middle school level?

The students pointed out the problems of learning in mathematics. Students' problems from highest to lowest are as follows.

1. Background knowledge of the students
2. Lack of instructional aids
3. Lack of mathematical instruments
4. Anxiety
5. Inadequate mathematics teachers
6. Lack of interest
7. Support by family
8. Parental involvement
9. Problem solving skill
10. Lack of hard work

This result shows the most serious problems of learning in mathematics. So, this finding reveals the answer of research question (3): Which are the most serious problems of learning in mathematics?

Suggestions

On the basis of research findings and related literature, some suggestions are given under three headings: suggestions for teachers, suggestions for others and suggestions for further studies.

Suggestions for Teachers: A person's background knowledge is a collection abstracted residue that has been formed from all of life's experiences. So, it is an essential component in learning because it helps him make sense of new ideas and experience. To overcome the problem of lack of background knowledge of the students, the teachers should confront every new topic with four basic instructional problems; (1) teaching for understanding, (2) teaching for assimilation, (3) teaching for permanence, and (4) teaching for transfer. To arouse and maintain the students' interest in mathematics is a major problem for the teacher.

Genuine interest in mathematics probably depends basically upon the problem solving aspect of the subject. If mathematics is properly taught, the teacher should present the student with an abundance of problems, and also provide him with certain general modes of thought and a supply of techniques which enable him to attack these problems successfully. With each successful solution he receives a dividend of satisfaction he feels good when he gets the answer.

Posamentier and Stepelman (1986) expressed (13) ways to overcome mathematics anxiety. They are relax and enjoy, curb excessive competitiveness, no speed tests, praise a pupil's effort, never humiliate, develop a sense of humor, be a positive role model, do not use mathematics as a punishment, treat girls and boys equally, develop spatial relations, have pupils make up problems and humanize mathematics. Therefore, these ways should be used to overcome mathematics anxiety among the students.

One of the important components of the problem solving process is the problem solving procedures. The use of suitable problem solving procedures is significant in term of being successful in solving problems. Teacher should teach students how to solve problems by using appropriate problem solving procedures.

Suggestions for Others: There are inadequate number and quality of mathematics teachers. To overcome this problem, mathematics teachers' pre-service and in-service training must be encouraged and funded. Some innovative teaching methods and instructional strategies combined with new technologies in mathematics to enhance effective and efficient teaching and learning.

There are no incentives to motivate the teachers to be put in the best. To overcome this problem, the education and government decision makers should exhibit intense interest in identifying specific actions and benefits they might use as incentives to encourage valued teacher behaviors. They also should come up with packages that will motivate mathematics teachers and reward hardworking teachers and students.

Teachers' qualification is a common defect in educational set-up that most of the subject teachers are not adequately qualified in the subjects concerned. Without proper qualifications and proper training, they fail to do justice to the subject. A teacher may be able to show good examination results in spite of his low qualifications, but even that is not a sufficient criterion to allow him to continue with the teaching of his subject. An adequate, high qualification of the teacher develops self-confidence in him and serves as a source of inspiration to his students. The teacher must be master in his subject. Professional training should equip him to attain desirable standards in teaching. He must possess real knowledge of and insight into, the processes of mathematics and their effective teaching.

A large class size is a general problem. No individual attention can be paid in a large class. It becomes difficult for the teacher to establish close contact with the students. He cannot easily judge the capacities of the individuals. This problem, can be removed by limiting the number of students in each class up to a maximum of forty-five.

The teacher is over work loaded on all sides and, to follow the way of least resistance, he emphasizes cram work. He cannot adopt, and prepare for, effective methods, as he has no spare time. His work load does not allow him time to remove individual difficulties. It should be lightened to enable him to show his originality and initiative.

There is a serious lack of mathematical apparatus (such as compass, dividers, protractor, set square, etc.) in the schools. There should be an adequate provision of concrete materials in the classroom. Without them, the subject becomes abstract. The establishment of a mathematical laboratory will remove this problem. Though it is mainly the job of the management and higher authorities, the teachers' enthusiasm towards its establishment is also necessary. Thus, the government through the Ministry of Education should, as a matter of urgency, endeavor to provide necessary infrastructures and facilities that will motivate teaching and learning mathematics, and buy educational materials such as text books and other equipment as per requirements in the curriculum.

Suggestions for Further Studies: This study was dealt with the problems of teaching and learning in mathematics such as background knowledge of the students, maintaining and arousing students' interest, anxiety, teaching aids, characteristics of mathematics teacher, students' problem solving skill, incentive to motivate, teachers' qualification, class size and teacher over work load. Therefore, further studies should be conducted for other problems. This research is concerned with the problems of teaching and learning in mathematics of Grade Seven students. Further studies should be conducted to find out the problems of teaching and learning in mathematics at other Grade levels.

Conclusion

Today's world largely depends on science, and science in turn depends on mathematics.

Although there is no fixed rule for good practices, examining existing problems of teaching and learning can be put forth towards creating better practices. As prerequisites for an effective mathematics lesson, teachers must be competent in the subject content knowledge, possess good pedagogical skills especially questioning, and have a good relationship with their students. Furthermore, as change in the real world is inevitable, it is therefore vital for mathematics teachers to constantly learn and update their instructional practices and find and solve the problems of teaching and learning mathematics so as to promote and equip students with the required mathematical understanding to meet the challenges of the 21st century.

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A STUDY OF THE EFFECTIVENESS OF COOPERATIVE LEARNING STRATEGIES ON STUDENTS' ACHIEVEMENT IN MIDDLE SCHOOL SCIENCE

Su Mon Aung[1] and Khin Mar Khaing[2]

Abstract

The main purpose of the present study is to investigate the effectiveness of cooperative learning strategies on students' achievement in middle school science. It is an experimental research. Treatment is based on instructional design concerning cooperative learning strategies. According to the format of that design, (7) sample lesson plans of learning materials were constructed. The target population is Grade Six students. Two high schools that situated in Mayangone and Insein Townships in Yangon Region were selected by random sampling method. A total of (120) students and (4) science teachers participated in it. To study the effectiveness of cooperative learning strategies on students' achievement in middle school science, one of the true experimental designs, pretest- posttest only control group design was used. Treatments were conducted separately to two groups. The experimental groups were taught according to the cooperative learning strategies. The control groups were taught as formal. Learning materials were selected from Chapter (5), Earth and Space, from Grade Six General Science Textbook. The posttest scores or data were analyzed with independent samples *t* test to test the hypotheses of this study. The instrument used in this study was a posttest. The result of this study showed that, there was a significant difference in the achievements of science learning between the students who were taught by using cooperative learning strategies and those who were not. It can be suggested that the cooperative learning strategies should be used in the classroom in teaching middle school science. Therefore, it was concluded that cooperative learning strategies brings positive contributions to the middle school science.

Keywords: cooperative learning strategies, effectiveness, science

[1] Senior Assistant Teacher, Basic Education High School, Ywar Thit, Ayeyarwady Region
[2] Dr, Lecturer, Department of Methodology, Yangon University of Education

Introduction

Education is the process of helping the child to adjust to the changing world. The best type of education guides the immature child to live his life richly and abundantly, at the same time to contribute social betterment. One of the main tasks of education in a modern society is to keep pace with the advance in knowledge. In such a society, knowledge cannot be received passively. It is something that is to be actively discovered. Thus, the main account in education should be on the awakening of curiosity, the stimulation of creativity, the development of proper interests, attitudes and values and the building of essential skills such as independent study and capacity to think and judge for oneself.

The science teacher sees education as a process of interaction between the child and his environment. They also realize the constant influence of communication media outside the classroom upon the students. Children learn by doing and learn how to learn in groups and also individually. According to Johnson and Johnson (2000), cooperative learning is more than just asking students to sit and work together. It is also an instructional methodology which splits class members into small groups in order for them to learn assigned material and make sure that all members of the group master the assignment (Johnson & Johnson, 1994). Group learning has been defined as the physical placement of students into groups and the usage of specific instructional strategies for the purpose of learning. Cooperative learning differs from traditional whole-class instructions in which students are taught as a single large group by a teacher. By creating a cooperative learning environment, students can share their knowledge about the scientific concepts and discuss their own perspective views on scientific discoveries.

The ultimate aim of education is to grow not just physically but in greater insight into and control over oneself and over one's environment (Khin Zaw, 2001). Thus, all schools and schooling systems accept that part of their role is to prepare students for the world of work, sometimes implicitly more and more, explicitly. To achieve this aim, school systems and their stakeholders see that affective and motivational aspects of science learning are important not only in the classroom but also in the wider societies. Teachers and students enjoy working with science ideas, especially when they have the opportunity to investigate their own ideas and compare them with the ideas of standard science. But students reject a school science that is disconnected from their own lives, a depersonalized science, where there is no space for themselves and their ideas. To complement this, the students and teachers need to create a cooperative learning environment. Because cooperative learning actually raises student achievement while developing collaborative skills in a mutually supporting environment (Slavin, 1995, Johnson & Johnson, 1994).

Purposes of the Study

The main purposes for this study are:

(1) To study the effectiveness of cooperative learning strategies on students' achievement in middle school science

(2) To describe how to apply cooperative learning strategies in learning science

(3) To evaluate the effectiveness of cooperative learning strategies

Research Hypotheses

(1) There is a significant difference in the achievement between Grade Six General Science students who receive instruction with cooperative learning strategies and those who do not.

(2) There is a significant difference between the science achievement of experimental group and control group in answering knowledge level questions.

(3) There is a significant difference between the science achievement of experimental group and control group in answering comprehension level questions.

(4) There is a significant difference between the science achievement of experimental group and control group in answering application level questions.

Scope of the Study

The following points indicate the scope of the study.

(1) The study is geographically restricted to Yangon Region.

(2) The participants in the study are Grade Six students from the selected schools during the period within the academic year 2016- 2017.

(3) The study is limited to the content areas of "Earth and Space" from Grade Six Science textbook prescribed by the Department of Educational Planning and Training, Myanmar, 2015.

Definitions of the Key Terms

(1) Cooperative Learning Strategies: The structured, systematic instructional techniques in which small group work together to achieve a common goal. (Slavin, 1995)

(2) Effectiveness: Effectiveness (effect) means having power to produce, or producing, a desired result (Cruickshank & Bainer, 1999).

(3) Science: Science is defined as organized knowledge gained through science as activity, frequency used with a qualifying adjective to indicate a special branch of study (Good, 1959).

Review of Related Literature

Education is very broadly to describe all experiences in which people learn. All instruction is part of education because all instruction consists of experiences leading to learning. But not all education is instruction because many experiences that lead to learning are not specifically developed and implemented to ensure effective, efficient and appealing experiences leading toward particular learning goals. Actually, effective learning occurs as a result of effective teaching strategies. In order to develop effective lesson plans to bring about the attainment of desired objectives, teachers must possess a variety of skills and have a solid understanding of different concepts, ideas, and theories.

Behavioral Learning Theory

Behavioral theory emphasized the influence of the environment on learning. According to behavioral theories, teachers can play a significant role in effecting learning by determining what to teach with objectives based on desired behavior. Another important element in behaviorism is the transfer of learning. The transfer of learning shows the ability to correct theoretical orientation and practical application and to apply what one had achieved in the learning process to real-life situations (Orlich, Harder, Callahan, Trevisan &Brown, 2004).

Cognitive Learning Theory

Cognitive learning theory places much more emphasis on factors within the learner and less emphasis on factors within the environment than behavioral theories. Clearly, cognitive learning theory focuses on explaining the development of cognitive structures, processes and representations that mediate between instruction and learning. In attending to these structures and processes, the role of the learner as an active participant in the learning process takes on great importance. The learner is viewed as constructing meaning residing alone within instruction. Cognitive learning emphasizes social interactions, a purposeful relationship among individuals and their perceived environment. One of the important factors in cognitive teaching is to foster student motivation to become active learners through interactions with the environment Piaget (1952, cited in Reynolds & Muijs, 2011) stated that one of the main influences on children's cognitive development is what he termed maturation, the unfolding of biological changes that are generally programmed into us at birth. A second factor is activity. Increasing maturation leads to an increase in children's ability to act on their environment, and to learn from their actions. This learning in turn leads to an alteration of children's thought processes. A third factor in development is social transmission, which is learning from others. As children act on their environment, they also interact with others and can therefore learn from them to a differing degree, depending on their developmental stage. According to Piaget (1952, cited in Reynolds & Muijs, 2011), learning occurs in four stages of sensori- motor, pre- operational, concrete operational, and formal operational.

Table 1: A Summary of Piaget's Stages

Approximate age range	Stage	Major characteristics
Birth- 2 years	Sensorimotor	Development of object permanence, development of motor skills, little or no capacity for symbolic representation.
2- 7 years	Preoperational	Development of language and symbolic thinking, egocentric thinking.
7- 12 years	Concrete operational	Development of conservation, mastery of concept of reversibility.
12- adulthood	Formal operational	Development of logical and abstract thinking.

Source: Feldman ,1993

Constructivist Learning Theory

The essence of constructivist theory is the idea that learners must individually discover and transform complex information if they are to make it their own (Anderson, 2000, cited in Slavin, 2003). Thus, in a student-centered classroom, the teacher becomes the “guide on the side” instead of the “sage on the stage,” helping students to discover their own meaning instead of lecturing and controlling all classroom activities (Windschitl, 1999, cited in Slavin, 2003).

Social Constructivism

The main theory that underpins cooperative learning refers to social constructivism advanced by Lev Semyonovich Vygotsky (1896-1934). In Vygotsky’s social constructivism, social interaction is an important way in which children learn knowledge available in their culture without needing to reinvent it by them. Teachers and adults give direction and instructions, comments, and feedback to students. Children also use conversations in working with their peers in handling exercises, projects, and problems. In this way, they exchange ideas and receive information, thereby generating understanding and developing knowledge. (Wood, Bruner, & Ross, 1976, cited in Eggen & Kauchak, 1999).

Cooperative Learning Strategies

Cooperative learning is a student- centered, instructor- facilitated instructional strategy in which a small group of students is responsible for its own learning and the learning of all group members. Students interact with each other in the same group to acquire and practice the elements of a subject matter in order to solve a problem, complete a task or achieve a goal. Various cooperative learning methods and models have been developed over the years by different scholars and put into actual practice in the classroom. According to Eggen and Kauchak (2012), the most suitable cooperative learning strategies for today's classrooms are Student Teams-Achievement Division (STAD), Jigsaw II and Group Investigation. They are briefly explained as follows.

1. Student Teams-Achievement Division (STAD): STAD is appropriate to use in a wide variety of subjects including mathematics, language arts and social studies. It is most appropriate for teaching well-defined objectives, such as mathematical computations and applications, language usage and mechanics, geography and map skills, and science facts and concepts.

2. ***Jigsaw II:*** Jigsaw was originally designed by Elliot Aronson and his colleagues in1978. Slavin (1995) developed a modification of Jigsaw by adapting Elliot Aronson’s technique. It is appropriate to use in subjects like language, literature and social studies in which the learning materials are in the written narrative mode. Jigsaw II has 5 steps. They are (1) Reading, (2) Expert group discussion, (3) Home group reporting, (4) Testing, and (5) Group recognition.

3. Group Investigation: Group investigation is a general classroom organization plan in which students work in small groups using cooperative inquiry, group discussion and cooperative planning and projects. Moreover, it is said to be one of the most student-centered methods as students have much freedom to choose their topics of interest for investigation, plan and carry it out, present and evaluate the results. As group investigation is most suited for investigating problems which can have different solutions, it helps develop students' higher order thinking skills.

Purposes and Characteristics of Cooperative Learning

Instructional procedures bearing the title or resembling cooperative learning have something in common with all instructional alternatives – they encourage students to learn. In contrast to others, cooperative learning encourages learners to work together for both the common and individual good. Its main purpose is all for one and one for all. Besides, cooperative learning systems are generally characterized by (1) the way the groups or teams are made up, (2) the kinds of tasks they do, (3) the groups' rules of behavior, and (4) their motivation and reward systems. According to Slavin (1985), cooperative learning seems to be an extraordinary success. It has an excellent research base, many viable, successful forms, and hundreds of enthusiastic adherents.

Establishing a Cooperative Task Structure in the Classroom

Establishing a task structure for a cooperative learning activity involves five specific steps. They are (1)specify the goal of the activity, (2) structure the task, (3) teach and evaluate the collaborative process, (4) monitor group performance, and (5) debrief.

1. Specifying the Goal: The goal of a cooperative learning activity specifies the prodct and behaviors that are expected at the end of the activity. To ensure the desired outcome, the teacher's job is to identify the outcome, check for understanding, and set a cooperative tone.

2. Structuring the Task: The structure of the task is what separates just any group activity from a cooperative learning activity. Four characteristics of an effective task structure involve the followings. They are positive interdependence, individual accountability, equal participation and simultaneous interaction.

Diversity contributes to the collaborative process by creating a natural flow of information from those who have it to those who need it. It also promotes the transmission of alternative perspectives and viewpoints that often sends the flow of information in unexpected and desirable directions (Buehl, 2008 & Putnam, 2006, cited in Borich, 2014).

Students' role in Cooperative Learning: Some of the more popular cooperative learning role functions that teachers can assign within or across groups are summarizer, checker, researcher, runner, recorder, supporter and observer (Johnson & Johnson, 1998, cited in Borich, 2014). In addition to these specific role functions, all group members have other responsibilities to perform.

Teacher's Role in Cooperative Learning: The teacher plays a crucial role in orchestrating and overseeing that group activities occur as planned. There are also some key duties that the teacher must be responsible for. They are (1) Specify academic objectives (2) Specify collaborative skills (3) Decide on group size (4) Assign students to groups (5) Arrange the room (6) Plan materials (7) Assign roles (8)Explain the task (9) Test and question individual students (10) Promote inter group cooperation (11) Monitor students' behavior (12) Praise good use of group skills (13) Provide assistance on understanding a task (14) Provide assistance on how the group can work together more effectively and(15) Ask students to reflect on how well they are working together as a group (Johnson &Johnson, 1994). In addition to deciding on group composition, size and the individual responsibilities of group members, establish a system of reinforcement and reward to keep the students on task and working toward the goal. The reinforcement strategies that have been used effectively with the cooperative learning activities are (1) Grades (individual and group), (2) Bonus points, (3) Social responsibilities, (4) Tokens or privileges and (5) Group contingencies.

3. Teaching and Evaluating the Collaborative Process: Johnson and Johnson (2008) suggest some important cooperative learning skills and some of the ways the teachers can teach them:

(1) Teach how to communicate one's own ideas and feelings.

(2) Make messages complete and specific.

(3) Make verbal and nonverbal messages congruent.

(4) Convey an atmosphere of respect and support.

(5) Demonstrate how to assess whether the message was properly received.

(6) Teach how to paraphrase another's point of view.

(7) Demonstrate how to negotiate meanings and understandings.

(8) Teach participation and leadership.

4. Monitoring Group Performance: To establish a cooperative learning structure, teachers must observe and intervene as needed to assist students in acquiring their group's goal. Typically, the teacher will move from group to group at least once at the beginning of a cooperative activity, repeating the task and the goal to be certain each group understand it. Key to teachers' monitoring is their ability to recognize when a group is at a difficult juncture. Teachers' encouragement and support can instill the confidence some students will need to complete a task they may be unsure of and that may not be of their own choosing.

5. Debriefing: Providing feedback to the groups on how well they are collaborating is important to their progress in acquiring collaborative skills (Brookhart, 2008 & Weissglass, 1996, cited in Borich, 2014). The teacher can accomplish debriefing and evaluation at the end of the collaborative activity in the following ways:

(1) Openly talk about how the groups functioned. Ask students for their opinions.

(2) Solicit suggestions for improving the process and avoiding problems so higher levels of collaboration can be reached.

(3) Get viewpoints of predesignated observers. Teachers might assign one or two individuals to record instances of particularly effective and ineffective group collaboration and to report to the full class at the time of the debriefing.

Limitations of Cooperative Learning

Not all lessons are conducive to cooperative learning. Ideally, topics are used that require the searching out of answers and exploring of alternative solutions. The teacher also has to make organizational decisions that may only be possible in certain circumstances. There can also be difficulties in assigning students to groups. The intent is to form truly heterogeneous groups, but personality conflicts still occur (Chan, 2004, cited in Marsh, 2008). Students may need considerable help in developing problem- solving skills (Barry, 1998, cited in Marsh, 2008).

Outcomes of Cooperative Learning

By bringing students together in adult- like settings to provide appropriately models of social behavior, cooperative Learning is an instructional strategy that instills in learners important behaviors that prepare them to reason and perform in an adult world (Behl, 2008, Gillies, 2010, Johnson & Johnson, 2008 & Jolliffe, 2007, cited in Borich, 2014). According to Borich (2014), the following behaviors resulted from cooperative learning strategies as the outcomes of cooperation.

Attitudes: Adult learners form their attitudes and values from social interaction. Students exchange their information and knowledge with that of others, who have acquired different information and knowledge in different ways. This exchange shapes their views and perspectives.

Prosocial Behavior: During close and meaningful encounters among family members, models of prosocial behavior are communicated. Students learn right from wrong implicitly through their actions and the actions of others that come to the attention of adult family members. Cooperative learning brings students together in adult- like settings that, when carefully planned and executed, can provide appropriate modes of social behavior (Stevens & Slavin, 1995, cited in Borich, 2014).

Alternative Perspectives and Viewpoints: Students formed their attitudes and values by confronting viewpoints contrary to their own. Confronted with these alternatives, they are forced into the objectivity necessary for thinking critically, reasoning, and problem solving. Cooperative learning provides the context or meeting ground where many different viewpoints can be orchestrated, from which the students form more articulate attitudes and values of their own.

Integrated Identity: One of the most noticeable outcomes of social interaction is its effect on how students develop their personalities and learn who they are. Students' personality becomes more coherent and integrated and is perceived by others as a more forceful and confident projection of their thoughts and feelings. Cooperative learning can be the start of stripping away the irrelevant, overly dramatic and superficial appendages that mask the students' deepest thoughts and feelings.

Higher Thought Processes: If all of the preceding benefits of cooperative learning were not enough, cooperative learning has also been linked to increases in the academic achievement of learners at all ability levels (Steven & Slavin, 1995). It actively engages students in the learning process and seeks to improve their critical- thinking, reasoning, and problem- solving skills (Greeno, 2006, Jacobs, Power & Loh 2002, cited in Borich, 2014). Together with these outcomes, cooperative learning can provide the ingredients for higher thought processes and set them to work on realistic and adult- like tasks. These higher thought processes are believed to be stimulated more by interaction with others. These behaviors require interaction with others, as well as reflection on self, to unleash the motivation required for thinking and performing in complex ways. With these outcomes, therefore cooperative learning can be seen that it is not just an activity that engages students in working together but an instructional strategy for acquiring thinking skills and values that represent lifelong learning goals.

Within cooperative learning situations, students benefit from helping each other learn, in competitive learning situations, students suffer from obstruction and frustrating each other's learning, and in individualistic learning situations, neither encouragement nor opposition takes place. Therefore, there is more considerably more helping, encouraging, tutoring and assisting among students in cooperative than in competitive or individualistic learning situations (Johnson & Johnson, 1987).

Description of Cooperative Learning Strategies Based Instruction

This study developed a conceptual framework from the literature review of various theoretical models which include Glaser's Basic Teaching Model (1965), Interaction Analysis Model (Flanders), Cooperative learning methods (Johnson & Johnson, 2002), Cooperative learning (Slavin, 1995) and Cooperative learning strategies (Eggen & Kauchak, 2012). According to this framework, cooperative learning is a general term that describes a set of instructional strategies, all of which have specific structures and are designed to teach content and develop interpersonal skills. In this study, the three types of cooperative learning strategies are used. The steps in these strategies are:-

1. ***Steps in Planning and Implementing STAD Activities***

(a) Planning

(1) Identify content or skill to be mastered.
(2) Plan large- group presentation and seatwork materials similar to planning for any topic.
(3) Plan for assigning students to groups.
(4) Plan for improvement points.
(5) Plan for group rewards.

(b) Implementation

(1) Introduce and explain procedures.
(2) Provide initial instruction on target skill or content.
(3) Divide students into groups and distribute worksheet materials.
(4) Assign students to pairs and use team study to ensure mastery of content.
(5) Monitor groups for active involvement of all members.

(c) Assessment

(1) Administer quiz or teat as the teachers normally do.
(2) Score and assign improvement points.
(3) Recognize team achievement and provide feedback about different group's performance.

2. ***Steps in Planning and Implementing Jigsaw II***

(a) Planning

(1) Identify an area of study requiring students to understand interconnected or organized bodies of information that can be broken down into subtopics.

(2) Divide the content area into three or four roughly equal subtopics that will allow different students to specialize in their study.
(3) Locate resources that students can use to study the topic.
(4) Develop expert worksheets or charts that structure student's study effort and ensure that students will learn essential information.
(5) Divide students into heterogeneous groups.

(b) Implementation

(1) Introduce and explain procedures and divide students into groups.
(2) Hand out worksheets or charts and explain how they are to be used to guide individual study and group teaching.
(3) Monitor study in different groups.
(4) Convene expert groups (use groups of six or smaller) to discuss and compare information.
(5) Monitor students as they teach their topic to other members of the group.

(c) Assessment

(1) Administer quiz or tests as the teachers normally would. Make sure quiz covers all topics and encourages students to interrelate information across topic.
(2) Score, using improvement points.
(3) Recognize team achievements and provide feedback about group performance.

3. ***Steps in Planning and Implementing Group Investigations***

(a) Planning

(1) Indentify a common topic that will serve as a focal point for the class as a whole.
(2) Catalog or gather resources that students can use as they investigate the topic.

(b) Implementation

(1) Introduce the general topic to the class and have students identify specific subtopics that individual groups will investigate.
(2) Divide students into study groups on the basis of student interest and heterogeneity.
(3) Assist students in cooperative learning regarding goals, procedures, and products.
(4) Monitor student progress, assisting students to work effectively in groups.

(c) Assessment

(1) Use group presentations to share information gained.
(2) Provide individual and group feedback about projects, presentation, and group effectiveness.

Method

Procedure

In order to ensure the effects of cooperative learning strategies, seven lesson plans through cooperative learning strategies and seven lesson plans through lecture methods were prepared. The sample lesson plans were validated with (8) experts in this field. After completing the required instruments, a pilot study was started with the total of (60) students. This current study included (120) Grade Six Students. This research used the true experimental design of pretest- posttest control group design. Because true experimental designs control for nearly all sources of internal and external invalidity (Airasian & Gay, 2003). In this study, some experts in the field were asked to validate the pretest items, the posttest items and marking schemes for both tests and rate each on its representativeness, relevance and clarity. After that, these two test items are modified again according to their suggestions. To establish the reliability of the instruments, a pilot study was conducted with (60) Grade Six students at No. (1) B.E.H.S, Insein in Insein Township. To show the internal consistency of the test, the reliability coefficient, Cronbach's alpha, was computed. The values of internal consistency for the instruments are 0.715, 0.723 and 0.807 respectively.

A pretest was administered before the treatment was provided. In experimental group, the treatment was received with cooperative learning strategies based sample lessons. In contrast, the control groups were taught by the formal method. Each class was taught five periods per week. A period lasts forty- five minutes. This research study lasts (2) weeks from end of November to mid of December. After the treatment period, the posttest was administered to both groups. Besides, the attitude questionnaires were received by the experimental groups. The results of each test were analyzed by using the Statistical Package for the Social Science (SPSS 22.0).

Subjects

The required sample schools were selected by using random sampling method. One of the Basic Education High Schools was selected from Mayangone township in western district of Yangon Region. Another Basic Education High School was selected from Insein township in northern district of Yangon Region. After that, simple random sampling method was used to select those sample students. The target population was Grade Six students.

Table 2: Population and Sample Size

Name of School	No. of Population	No. of Sample
BEHS (Mayangone)	611	60
BEHS (Insein)	465	60
Total (2 BEHS)	1076	120

Instrumentation

To conduct this experimental research, the instruments were constructed in accordance with the selected research design. The pretest consists of True- false items, completion items, multiple- choice items, matching items, and short answer items. At the end of the treatment, both groups were administered by a posttest. True- false items, completion items, multiple- choice items, short answer items and essay items were mainly involved. These items were constructed on the basis of the first three levels of Bloom's Taxonomy i.e. knowledge, comprehension, and application. Both pretest and posttest items were constructed to fifty marks. Test items were constructed based on Grade Six General Science textbook. The allocated time for pretest and posttest were forty- five minutes. Finally, questionnaire for observing students' attitudes towards cooperative learning strategies was used. In this questionnaire, (8) items were included.

Data Analysis

In order to determine the significance differences between the students' performance in each treatment, descriptive statistics and independent sample *t*-test were used with the Statistical Package for the Social Science (SPSS 22.0). The achievement of students in each group on both tests was analyzed by independent samples *t*-test.

Findings

This section is concerned with the findings of the selected students' achievement in the test for prior knowledge, the findings of these students' achievement on the posttest questions and the summary of the findings for this study. In order to find out the prerequisite knowledge of selected sample students in experimental and control group, pretest was administered for both groups in two schools. The data obtained from the pretest were analyzed by using independent samples *t*-test to compare the difference between experimental groups and control groups. Following tables show the results of *t*-test, the mean scores, standard deviations and mean differences of both groups.

Table 3: *t*-values for Pretest Mean Scores in Science

School	Group	N	$\overline{X}$	SD	MD	*t*	*df*	Sig. (2 ailed)
BEHS (Mayangone)	Experimental	30	23.6	3.125	-0.967	-1.200	58	.235(ns)
	Control	30	22.63	3.113				
BEHS (Insein)	Experimental	30	20.13	3.577	-0.767	-0.837	58	.406(ns)
	Control	30	19.37	3.521				

Note: n.s = not significant

Table 3 shows the pretest mean scores of experimental groups and control groups. It also shows the *t*-values for the scores on science achievement in pretest. Based on the data, it can be interpreted that both the control and experimental groups were essentially the same on the dependent variable at the start of the study. Data obtained from the posttest were analyzed by independent sample *t*- test to compare the differences between the control group and experimental group.

Table 4: *t*-values for Posttest Scores on Knowledge Level Questions

School	Group	N	$\overline{X}$	SD	MD	*t*	*df*	Sig. (2 tailed)
BEHS (Mayangone)	Experimental	30	3.10	0.923	0.267	1.372	58	0.175
	Control	30	2.83	0.531				
BEHS (Insein)	Experimental	30	3.17	1.206	0.967	3.652	58	0.001
	Control	30	2.20	0.805				

Note: ***$p < .001$

Table 4 shows the *t*-values for knowledge level scores. Results of knowledge level scores showed that the mean scores of the experimental groups were significantly higher than that of the control groups. It showed that there was a significant difference between the experimental groups and the control groups for scores on knowledge level questions.

Table 5: *t*-values for Posttest Scores on Comprehension Level Scores

School	Group	N	$\overline{X}$	SD	MD	*t*	*df*	Sig. (2 tailed)
BEHS (Mayangone)	Experimental	30	10.03	1.732	3.367	7.028	58	.000***
	Control	30	6.67	1.971				
BEHS (Insein)	Experimental	30	9.00	2.665	2.333	3.855	58	.000***
	Control	30	6.67	1.971				

Note: ***$p < .001$

Table 5 shows the *t*-values for comprehension level scores. As regards with the comprehension level scores, the mean scores of the experimental groups were significantly higher than that of the control groups. It showed that there was a significant difference between the experimental groups and the control groups for scores on comprehension level questions.

Table 6: *t*-values for Posttest Scores on Application Level Questions

School	Group	N	$\overline{X}$	SD	MD	*t*	*df*	Sig. (2 tailed)
BEHS (Mayangone)	Experimental	30	6.03	1.956	3.367	1.733	58	.001**
	Control	30	4.30	1.557				
BEHS (Insein)	Experimental	30	5.90	0.023	2.333	1.600	58	.000***
	Control	30	4.30	1.557				

Note: $^{**}p < .01$, $^{***}p < .001$

Table 6 shows the *t*-values for application level scores. As shown in table, the mean scores of the experimental groups were significantly higher than that of the control groups. It showed that there was a significant difference between the experimental groups and the control groups for scores on application level questions.

Table 7: Students' Attitudes towards Cooperative Learning Strategies

No.	Statements	Percentage of the Students	
		Agree	Disagree
1.	Enhancing working relationships among students friendly.	88%	22%
2.	Improving teamwork skills.	100%	0%
3.	Getting better memorizing in lessons by working cooperatively.	95%	5%
4.	Willingly participated in cooperative learning activities than the traditional classroom activities.	78%	22%
5.	Getting the habit of accountability in their group work.	83%	71%
6.	Improving the attitudes towards science.	93%	7%
7.	Getting more interest in lessons with cooperative learning strategies.	75%	25%
8.	Preferring cooperative learning strategies to formal method.	85%	15%

From the students' responses in the observation and questionnaire, most of them showed a very positive response and expressed that they like the cooperative learning strategies and enjoyed learning and hoped that the teacher would continue implementing the strategy. The following figure shows the students' attitudes towards cooperative learning strategies according to the data from the questionnaire.

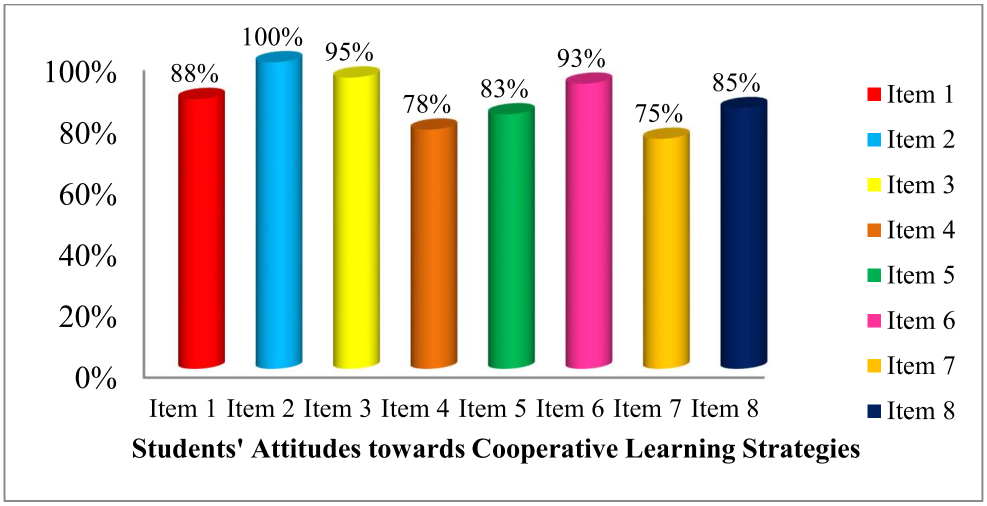

Figure 1: Graphic Illustration of Students' Attitudes towards Cooperative Learning Strategies

Summary of the Findings

From the experimental findings, the following results were found.

- There was a significant difference between the science achievement of experimental groups and control groups.
- There was a significant difference between the science achievement of experimental groups and control groups in answering knowledge level questions. It can be interpreted that cooperative learning strategies have positively contributed to the knowledge level of the science teaching at the middle school level.
- There was a significant difference between the science achievement of experimental groups and control groups in answering comprehension level questions. It can be interpreted that cooperative learning

strategies have positively contributed to the comprehension level of the science teaching at the middle school level.

- There was a significant difference between the science achievement of experimental groups and control groups in answering application level questions. It can be interpreted that cooperative learning strategies have positively contributed to the application level of the science teaching at the middle school level.

According to the results from the questionnaires, the following results were found.

- 88%of the students got working relationships among students friendly.
- 100% of the students got teamwork skills.
- 95% of the students memorized the lessons from working cooperatively.
- 78% of the students willingly participated in cooperative learning activities than the traditional classroom activities.
- 83% of the students got the habit of accountability in their group work.
- 93% of the students improved their attitudes towards science.
- 75% of the students got more interest in lessons with cooperative learning strategies.
- 85% of the students preferred cooperative learning strategies to formal method.

Discussion

Since the primary purpose of this study was to find out the effectiveness of cooperative learning strategies on students' achievement in middle school science, the research results verified it. Results from the study showed that the students who received new treatment had higher achievement in science learning than the control students who received formal or traditional treatment. There were no groups without making errors in answering the test items. Controlled students had more errors in those items than experimental students.

The experimental groups perform better than the control groups. The experimental groups were actively involved in various learning situations such as the whole class, small group learning, and watching a video. The students build their understanding of new concepts rather than merely absorbing information. They also learn from each other, they share their ideas and knowledge. Then they discuss their ideas or opinions until to get the common consensus. From the results of the posttest scores on knowledge level questions, the mean score of the experimental group was not significantly higher than that of the control group in both schools. Therefore, traditional teaching methods are not very much different from cooperative learning strategies at knowledge level. With respect to the mean scores on comprehension level questions and application level questions, the mean score of the experimental groups were significantly higher than that of the control groups in each school. Hence, cooperative learning strategies affects not only the students' actual understanding of science concepts but also their performance on the problems based on these concepts. It also supported to the research hypothesis. So, this finding pointed out that cooperative learning strategies have positively contributed to the achievement of the students in science learning.

In this research study, students in the control groups were taught learning materials under the whole class instruction. During the cooperative learning strategies based instruction, the teachers observed the students' activities and the responses to the new treatment. By conducting this research, teachers can understand what the cooperative learning strategies mean: Cooperative learning strategies are successful teaching strategies in which small groups, each with students of various levels of ability, use a multiple of learning activities to improve their understanding of a subject; each member of a team is answerable not only for knowledge what is taught but also for helping other team members to learn, thus developing an environment of success (Slavin, 1995). After implementing the cooperative learning strategies, students in experimental groups were asked to express their attitudes concerned with the new treatment. According to the results from the attitude questionnaires, most of the students wanted to use cooperative learning strategies in their teaching- learning situation. Therefore, integrating the traditional group work with cooperative learning strategies in teaching middle school science is a fruitful choice for students’ achievement.

This study is not perfect in an effort, because there were some limitations in this study such as time duration, and content area. In this study, only one content area was studied. Therefore, the results were not representative for the whole content area of Grade Six General Science. With respect to the research findings, the researcher wants to suggest the following facts. While using cooperative learning strategies, the teachers should plan activities that are challenging and yet doable if the group members work together. Tasks should be required the concentrated efforts of all team members doing their jobs and working with the allotted time. The teachers who use cooperative learning strategies should have a firm knowledge base about the purposes and uses of cooperative learning strategies, as well as considerations for their use such as content validity, engagement, flexibility, inquiry based, ease of use, reciprocal benefits and impact before he/ she select a particular cooperative learning strategy. During the cooperative learning activity, it is the responsibility of the teacher to monitor the students. Regularly, according to the cooperative learning strategies, the teachers had to give immediate feedback and reinforcement for learning. Besides, in science teaching, the teachers have to re-teach certain concepts if necessary. The teachers need to keep a close watch on the personal interactions going on within groups. Happy well-functioning groups matched with appropriate tasks and given adequate time constraints run smoothly. The teachers have to make sure that the cooperative learning activity is organized and has a smooth closure is to allow time after clean up and whole group information sharing to ask the groups to evaluate how they interacted with one another. Moreover, the teachers have to informally assess student learning and collaboration. This study is specially contributed to science teaching at the middle school level. Although this research was concerned with science teaching, it can be applied into other subject matter contexts and the various school levels including primary school level and middle school level. This study was based on only one content area in science because of time limitation. Further research should be carried out by using wide content area of science. In this study, sample schools were randomly selected from Yangon Region. The research should be carried out in every BEHS. So, the result will be more reliable.

Conclusion

To meet the needs of 21st century, schools should move away from teacher-directed whole-group instruction to learner-centred workplaces for a collective culture of students at work. Giving students a chance to share a wide variety of kinds of intelligence adds to their confidence and beliefs in themselves as intelligent and competent learners, that no matter what the tasks they will be able to learn to do it (Bellanca & Brandt, 2010). Out of many teaching strategies, cooperative learning is the key to 21st century learning.

Over (500) research studies back the conclusion that cooperative learning produces gain across all content areas, all grade levels, and among all types of students including special needs, high achieving, gifted, urban, rural, and all ethnic and racial groups. In terms of consistency of positive outcomes cooperative learning remains the strongest researched educational innovation ever with regard to producing achievement gains (Kogan, 1999). Cooperative learning is cognitive in nature. The teachers must realize that for students to be successful in the twenty first century they need to be lifelong learners. Helping them to develop the skills necessary to become lifelong learners requires a different approach to teaching and learning. At that point, the teachers must make every step of the way by providing the environment, the content, the experiment and the place for students to put it all together to share with other students, parents, and the world. In conclusion, cooperative learning strategies take advantage of heterogeneity in classes by encouraging learners to learn from one another and from more and less knowledgeable peers (Adams, 2013). Bonds thus develop among learners which can lead to increased understanding and acceptance of all members of society, a benefit of cooperative learning that expand beyond the walls of the school itself.

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AN INVESTIGATION INTO THE EFFECTIVENESS OF ACTIVE LEARNING INSTRUCTIONAL STRATEGIES ON THE ACADEMIC ACHIEVEMENT OF SCIENCE STUDENTS AT THE MIDDLE SCHOOL LEVEL

Win Thinzar Kyaw[1] and Khin Mar Khaing[2]

Abstract

The purpose of this study was to investigate the effectiveness of active learning instructional strategies on the academic achievement and basic science process skills of science students at the middle school level. Science process skills are central to the acquisition of scientific knowledge and enable students experience hands-on engagement with science materials when solving problems using practical approaches. These skills can be developed by using active learning instructional strategies in the science classroom because the aim of these strategies is skills development rather than just conveying information: students engage in activities to promote higher order thinking. Therefore, to investigate the effectiveness, nonequivalent control group research design was used. Two townships, one high school from each, were randomly selected from four districts in Yangon Region. Two classrooms from Grade Six were randomly selected and assigned to control and experimental groups in each selected school. A pretest, a posttest and an attitude questionnaire were used. A "*t*" test for independent samples and an analysis of covariance were used to find the difference in the science achievement and basic science process skills between the students who received active learning instructional strategies and those who did not. According to the results, there were significant differences between the two groups in basic science process skills in one of the selected schools. In another school, although there were significant differences between the two groups in communicating, classifying and inferring skills, there was no significant difference in observing, measuring and predicting skills. Moreover, there were significant differences in science achievement between the two groups in both schools. Therefore, it was found that using active learning instructional strategies in teaching science had significant improvement in the academic achievement and basic science process skills of the students, and it developed positive attitudes towards learning science.

Keywords: active learning, active learning instructional strategies, academic achievement

1. Tutor, Department of Educational Theory, Thingangyun Education College
2. Dr., Lecturer, Department of Methodology, Yangon University of Education

Introduction

Education, therefore, is a process of the development of talent inborn in the individual and not conveying to an individual a body of information and knowledge (Dhiman, 2007). However the purpose of education is no longer personal cultivation but the acquisition of the skills of science to make value judgments regarding science-based issues occurring daily. Therefore, science plays a vital role in students' everyday lives.

According to Collette and Chiappetta (1989), science should be viewed as a way of thinking in the pursuit of understanding nature, a way of investigating and a body of established knowledge. Therefore, children must learn by doing and then reflecting, how to investigate and discover scientific concepts, theories and processes.

In most secular education settings, students are accustomed to passive learning where the teacher plays a dominant role in passing on information to students who are considered repository of knowledge. In reality, learning is not a spectator sport. Students do not learn much just by sitting assignments and spitting out answers. Contrast to this is using the active learning instructional strategies which encourage the students to interact cognitively, socially, behaviorally with content and processes to construct knowledge within the classroom (Chickering and Gamson, 1985, cited in Bonwell and Eison, 1991).

Purposes

The main purpose of this study is to investigate the effectiveness of active learning instructional strategies in middle school science teaching. The specific objectives are as follows:

(a) To compare the academic achievement between the science students who receive active learning instructional strategies and those who do not.

(b) To highlight the effectiveness of active learning instructional strategies in teaching science.

(c) To give suggestions on active learning instructional strategies in teaching science to teachers.

Research Hypotheses

1. There is a significant difference in the academic achievement between Grade Six science students who receive active learning instructional strategies and those who do not.
2. There is a significant difference in Basic Science Process Skills between Grade Six science students who receive active learning instructional strategies and those who do not.

Scope of the Study

The following points indicate the scope of the study.

1. This study is geographically restricted to Yangon Region.
2. Participants in this study are Grade Six students from selected schools in the academic year (2016-2017). Two classes from each school are selected in this study.
3. This study is limited to the content area of Chapter 5, "The Earth and Space", from Grade Six science textbook prescribed by Basic Education Curriculum, Syllabus and Text book Committee (2014).
4. The duration taken for the treatment is about two weeks for each school.

Definition of Key Terms

Active Learning is a technique that can be thought of as cogitatively engaging students' minds through externally stimulating thinking and physical actions in order to increase retention of presented material (Bonwell and Eison, 1991).

Active learning instructional strategies are defined as instructional activities involving students in doing things and thinking about what they are doing (Bonwell and Eison, 1991).

Academic achievement represents performance outcomes that indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in school, college and university (Oxford Bibliographies, 2015).

Review of Related Literature

The Science Process Skills

Science is simultaneously a body of knowledge and a way of gaining and using that knowledge. Science is thus a combination of both "processes" and "products" related to and dependent upon each other. A process is a series of activities or operations performed to attain certain goals or products. Science processes are the inter-linked activities performed by any qualified person during the exploration of the universe. The American Association for the Advancement of Science – AAAS (1968), in their programme, Science – A Process Approach (SAPA) has classified the science process skills into two types - basic and integrated (more complex) skills (Sheeba, 2013).

Basic science process skills apply specifically to foundational cognitive functioning especially in the elementary grades. In addition, these skills also form the backbone of the more advanced problem-solving skills and capacities. **Integrated science process skills** are immediate skills that are used in problem-solving. Basic Science Process Skills comprise the following six sub-skills; observing Skill, classifying skill, measuring skill, communicating skill, predicting skill and inferring skill.

Harlen (1999), cited in Sheeba (2013) also emphasizes the need to include science process skills in the assessment of learning in science and that without the inclusion of science process skills in science assessment, there will be a mismatch between what students need from science, and what is taught and assessed.

Active Learning

According to Farrell (2013), cited in Listyani (2014), "conceptually, active learning implies deep learning on the part of the students as they construct knowledge and create meaning from their surrounding". In educational setting, the application of active learning ranges from focusing activities on cooperative structures to active involvement of thinking process in the learning and application of knowledge. In the active learning classroom, the teacher's role is to talk less and facilitate more by setting up situations and experiences that allow students to be immersed in the material with their peers. In the meantime, students are socially constructing greater understanding of the curriculum.

Therefore, active learning strategies shift from teachers to students and their active engagement with the material. Through active learning strategies and used by teachers, students shed the traditional role as passive receptors and learn and practice how to apprehend knowledge and skills and use them meaningfully. Moreover, active learning strategies involve providing opportunities for students to meaningfully talk and listen, write, read and reflect on the content, ideas, issues and concerns of an academic subject (Meyers and Jones, 1993, cited in Momani et al., 2016).

Constructivist's View of Learning

Constructivist learning is an inductive learning which involves an active process in which learners construct meaning by linking new ideas with their existing knowledge". Constructivists dictate that the concepts follow the action rather than precede it. The activity leads to the concepts; the concepts do not lead to the activity. Essentially, in constructivist learning, the standard classroom procedure is turned upside down – no lectures, no demonstrations, and no presentations. From the beginning, students engage in activities through which they develop skills and acquire concepts. According to Good and Brophy (1994), cited in Bhattacharjee (2015), constructivist learning includes:

1. Learners construct their own meaning
2. New learning builds on prior learning
3. Learning is enhanced by social interaction
4. Meaningful learning develops through "authentic" tasks

Two Major Trends of Constructivist Perspective on Active Learning

According to Bonwell and Eison (1991), active learning is a technique that can be thought of as cogitatively engaging students' mind through externally stimulated thinking physical actions in order to increase retention of presented material. Therefore, before trying to understand active learning, the instructor must have a sound knowledge about how the individual construct knowledge and how learning is enhanced by social interaction.

Cognitive constructivism (Cobb, 1994; Moshman, 1982, cited in Applefied et al., 2000) focuses on internal, individual constructions of knowledge. This perspective, which is derived from Piagetian theory emphasizes individual knowledge construction stimulated by internal cognitive conflict as learners strive to resolve mental disequilibrium. Essentially, children as well as older learners must negotiate the meaning of experiences and phenomena that are discrepant from their existing schema. Students may be said to author their own knowledge, advance their cognitive structures by revising and creating new understandings out of existing ones. This is accomplished through individual or socially mediated discovery-oriented learning activities.

Social constructivism (Brown et al., 1989; Rogoff, 1990, cited in Applefied et al., 2000) views the origin of knowledge construction as being the social interaction of people, interactions that involve sharing, comparing and debating among learners and mentors. Through a highly interactive process, the social milieu of learning is accorded center stage and learners both refine their own meanings and help others find meaning. In this way knowledge is mutually built. This view is a direct reflection of Vygotsky's sociocultural theory of learning, which accentuates the supportive guidance of mentors as they enable the apprentice learner to achieve successively more complex skill, understanding, and ultimately independent competence.

Factors of Active Learning Instruction

Meyer and Jones (1993), cited in Karamustafaoglu (2009) have maintained that active learning consists of three factors which are interrelated. These are: basic elements, learning strategies and teaching resources.

Basic Elements

The basic elements of active learning are talking, listening, reading, writing and reflecting. These five elements involve cognitive activities that allow students to clarify the question, consolidate and appropriate the new knowledge.

Learning Strategies

The second factor of active learning is the learning strategies that incorporate the above five elements. These are small groups, cooperative work, case studies, simulation, discussion, problem solving and journal writing, etc. Active learning tasks are much appreciated for making the learning experiences of the material to learn in a see, hear, do or touch fashion.

Teaching Resources

Bolick et al. (2003), cited in Gist (2003) define teaching resources as teaching aids used to enhance teaching and learning. Teaching resources are integral component of teaching and learning situation, it is not just to supplement learning but to complement its process.

Typical Active Learning Instructional Strategies
Problem Solving Strategies

Sharma (2009) describes that problem solving strategy fits well to the very nature of the science and it gives the students sufficient opportunity, practice and experience to discover and learn the facts of science with their own independent efforts. There are three models in problem solving strategy; exploration is used to gather information; inquiry to generate knowledge that is new to the problem solver; and decision making is employed to help the individual choose among alternative courses of action (Schuncke and Hoffman, 1980, cited in Schuncke, 1988).

Inquiry is one of the primary methods of problem solving to develop the ideas of discipline; concepts and generalizations are the results of the utilization of this scientific method. It utilizes three specific activities that are concerned with the hypothesis (Schuncke, 1988).

1. Determining the problem
2. Hypothesizing
3. Preparing to gather data
4. Gathering data
5. Examining, Analyzing, and Evaluating the Data
6. Accepting or Rejecting Hypothesis
7. Generalizing

Cooperative Learning

Teaching practices that provide opportunities to students to learn together in small groups are known as Cooperative Learning. Cooperative learning allows more students to be actively engaged in learning (World Education, Inc., 2009). Active participation in small groups helps students learn important social skills while simultaneously developing academic skill and democratic attitudes (Arends, 2007). Many of the key features of the Group Investigation (GI) approach were designed by Herbert Thelen. Sharan (1984) and his colleagues, cited in Arends (2007) describe the following six steps of the GI approach:

1. Topic selection
2. Cooperative planning
3. Implementation
4. Analysis and synthesis
5. Presentation of final product
6. Evaluation

Discussion

Discussion may be whole class or small group in nature, groups may vary in size and composition. According to Callahan and Clark (1988), as students gain more experience with group procedure and acquire sophisticated skills, they can begin to handle more substantive aspects of course content through working together in genuine inquiry that provide many opportunities for students to participate actively in the learning process. There are many small group techniques that may be used in almost any course with very little effort or risk. Some of them are Buzz sessions, Brainstorming, The Fishbowl Technique and Jury Trial Technique and so on (Callahan and Clark, 1988). Guidelines for conducting buzz groups include the following:

1. Form buzz groups arbitrarily.
2. Appoint a leader and recorder for each group.
3. Brief the group on what they are to do. Be sure they understand.
4. Let them discuss for five to ten minutes.
5. Follow up with a whole class exercise

Advantages of Active Learning Instructional Strategies

Hall (n.d.) pronounces that several research studies demonstrate the positive impact that active learning can have upon students' learning outcomes:

- Increased content knowledge, critical thinking and problem-solving abilities, and positive attitudes towards learning in comparison to traditional lecture-based delivery
- Increased enthusiasm for learning in both students and instructors
- Development of graduate capabilities such as critical and creative thinking, problem-solving, adaptability, communication and interpersonal skills
- Improving students' perceptions and attitudes towards information literacy

Impediments to Using Active Learning Instructional Strategies in Science Teaching

Martin (2010) describes that there are specific obstacles associated with the use of active learning instructional strategies including limited class time; a possible increase in preparation time; the potential difficulty of using active learning in large classes; a lack of needed materials, equipment, or resources, and potentially reticence on the part of the students to participate. Perhaps the single greatest barrier of all, however, is the fact that teachers' efforts to employ active learning involve risk – the risks that students will not participate.

Research Method

Population and Sample Size

Participants in this study were 151 Grade Six students. Two of four districts from Yangon Region were randomly selected. One township from each selected district was also chosen in random. Then, two of Grade Six classes in the academic year of 2016-2017 were selected by random sampling method in the selected schools.

Experimental Design

The design adopted in this study was one of the Quasi-Experimental Designs: The Nonequivalent Control Group Design (see Table 1).

Table 1. Experimental Design

Group	Group Assignment	No. of Students		Pretest	Treatment	Posttest
		No.(1)	No.(5)			
Control	Random	35	37	PSK	Teacher Directed Learning	SA
Experimental	Random	40	39	PSK	Active learning Instructional Strategies	SA

***Note*:** PSK = Previous Science Knowledge   No. (1) = No. (1) BEHS, Yankin
SA = Science Achievement   N0. (5) = No. (5) BEHS, Kamayut

Instruments

The instruments used for this study were a pretest, a posttest (Achievement Test), questionnaire and learning materials.

Procedure

Items of the test for students' previous knowledge (pretest) in science were constructed based on the content areas of Chapters (1) to (4) from Grade Six Science Text Book in accordance with Bloom's Basic cognitive Domain

(Jacobsen, 2006). However, items of science achievement test (posttest) were constructed in line with Basic Science Process Skills (Sheeba, 2013) based on the content area of Chapter (5) from Grade Six Science Text Book.

In order to get validation, the instruments such as pretest, posttest, questionnaire and lesson plans were distributed to seven experienced science teachers. According to their suggestions, test items were modified again. To establish the reliability of the instruments, a pilot study was conducted with (31) Grade Six students at No. (1) BEHS, Kamayut in December 2016. After that, the instruments were modified again according to the results of the pilot study.

According to Nonequivalent Control Group Design, the entire classrooms were assigned to treatment in Nonequivalent Control Group Design. It involved random assignment of intact groups to treatment, not random assignment of individuals. Firstly, the pretest was administered on 9^{th} January, 2017 in both schools. In each school, the control group was given treatment by using teacher-directed learning and the experimental group was provided treatment by using active learning instructional strategies. The experiment was conducted in January 2017. At the end of the treatment period, all classes had to sit for the posttest but questionnaire for students' attitude towards learning science was administered to the experimental groups.

Research Findings

Data Analysis

To investigate the effectiveness of using active learning instructional strategies in teaching science at the middle school level, the data were analyzed by using descriptive statistics; *t* test for the independent samples and analysis of covariance (ANCOVA).

Analysis on the Scores of Pretest Questions and Findings

To be able to determine whether there is a significant difference between the experimental group who are taught by active learning instructional strategies and the control group who are taught by teacher directed learning, the data obtained from the pretest were recorded systematically and analyzed by using the *t* test for independent samples. The results are shown in table 2.

Table 2: *t* Values for Scores on Pretest Questions

School	Group	N	M	MD	*t*	*df*	Sig.
No. (1) BEHS, Yankin	Experimental	40	14.33	1.67	2.779	73	.007**
	Control	35	12.66				
No. (5) BEHS, Kamayut	Experimental	39	9.67	-2.92	-5.410	74	.000***
	Control	37	12.59				

Note. $^{**}p < .01$, $^{***}p < .001$

According to the results, the mean of experimental group was higher than that of control group in BEHS (1), Yankin. However, the mean of the control group was higher than that of the experimental group in BEHS (5), Kamayut. It showed that there were significant differences between the two groups on the pretest questions ($p < .01$, $p < .001$) in both selected schools. Therefore, their scores of posttest questions will be analyzed by using analysis of covariance (ANCOVA).

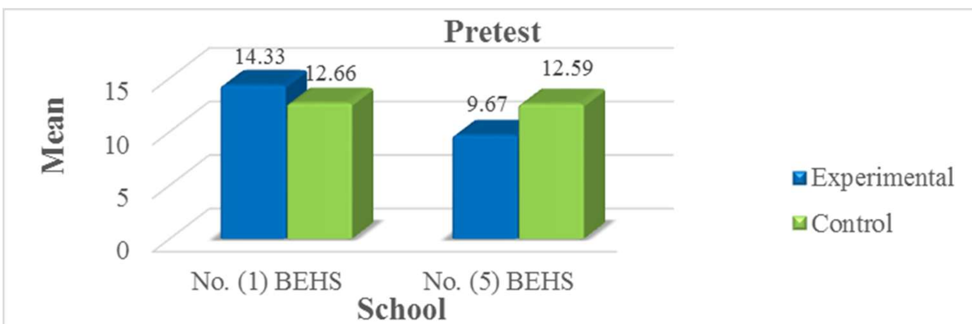

Figure 1: The Comparison of Means for Pretest Questions

The comparison of means for pretest questions showed that the previous science knowledge of the experimental group is slightly higher than that of the control group in BEHS (1), Yankin. On the other hand, the participants of the control group are more knowledgeable about science than that of the experimental group in BEHS (5), Kamayut.

Analysis on the Scores of Posttest Questions and Findings

The data obtained from the posttest of both schools were recorded systematically. And then these data were analyzed by using the Analysis of Covariance (ANCOVA) to compare the differences between the experimental groups who received active learning instructional strategies and the control groups who received teacher directed learning.

Table 3: The ANCOVA Source Table for Posttest in BEHS (1), Yankin
Dependent Variable: posttest

Source	**Type III Sum of Squares**	***df***	**Mean Square**	**F**	**Sig.**
Corrected Model	2107.097[a]	2	1053.548	66.459	.000
Intercept	149.348	1	149.348	9.421	.003
pretest	201.563	1	201.563	12.715	.001
Group	1377.828	1	1377.828	86.915	.000
Error	1141.383	72	15.853		
Total	23816.000	75			
Corrected Total	3248.480	74			

Note. $^{***}p < .001$

Table 4: The ANCOVA Source Table for Posttest in BEHS (5), Kamayut
Dependent Variable: Posttest

Source	**Type III Sum of Squares**	***df***	**Mean Square**	**F**	**Sig.**
Corrected Model	122.022[a]	2	61.011	3.079	.052
Intercept	346.722	1	346.722	17.499	.000
pretest	90.882	1	90.882	4.587	.036
Group	96.018	1	96.018	4.846	.031
Error	1446.399	73	19.814		
Total	20264.000	76			
Corrected Total	1568.421	75			

Note. $^{*}p < .05$

Table 5: Means and Standard Deviation for Science Achievement on Posttest

School	Group	N	M	SD	MD
No. (1) BEHS, Yankin	Experimental	40	21.28	3.850	10.11
	Control	35	11.17	4.743	
No. (5) BEHS, Kamayut	Experimental	39	16.31	4.959	1.28
	Control	37	15.03	4.093	

Results of scores for science achievement showed that the means of the experimental groups were significantly higher than that of the control groups in the selected schools (see Table 5). The differences in their means were found statistically significant ($F(1, 72) = 86.915$, $p < .001$) in BEHS (1), Yankin and ($F(1, 73) = 4.846$, $p < .05$) in BEHS (5), Kamayut (see Table 3 and 4). It showed that there were significant differences between the experimental and control groups on the science achievement in the selected schools.

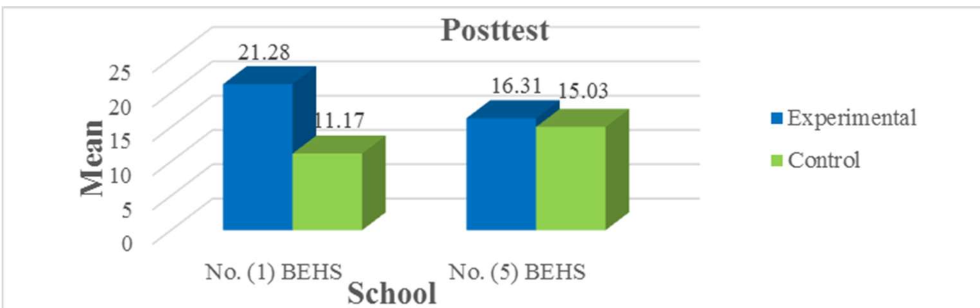

Figure 2: The Comparison of Means for Posttest Questions

The comparison of means for posttest questions revealed that the experimental groups who received active learning instructional strategies did better both in their learning and in science achievement test than the control groups who did not.

Analysis on the Basic Science Process Skills of Students and Findings

The performance on each basic science process skill of the experimental groups who are taught by active learning instructional strategies and the control groups who are not was calculated by using the Analysis of Covariance (ANCOVA) as there were significant differences between the control and experimental groups in the selected schools before they were treated.

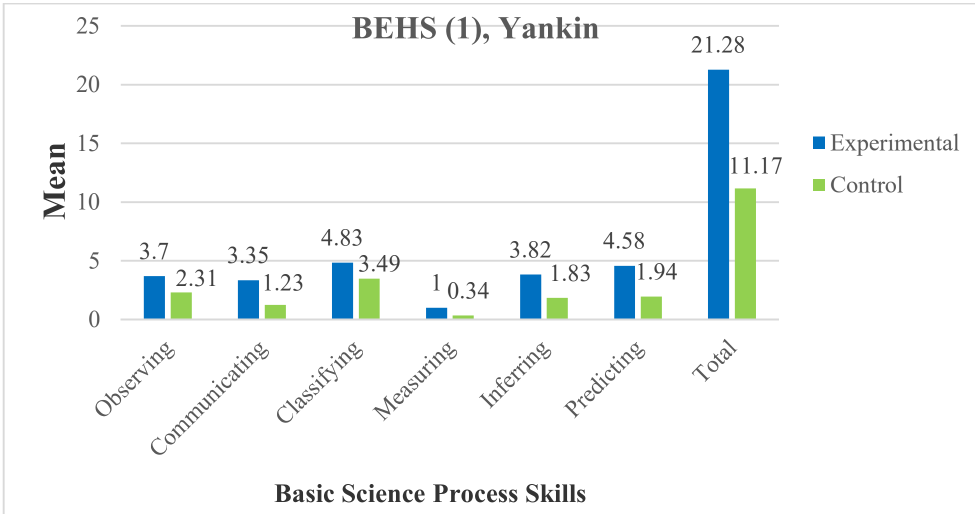

Figure 3: The Comparison of Means on Posttest for BEHS (1), Yankin

From figure (3), it can be found that the basic science process skills of the experimental group who were taught by active learning instructional strategies were significantly higher than that of the control group who were not taught by them in BEHS (1), Yankin. Interestingly, the measuring skill of both groups were lower than the others. To add this, the difference between the communicating, inferring and predicting skills of the experimental and control groups was greater than the difference between observing and classifying skills.

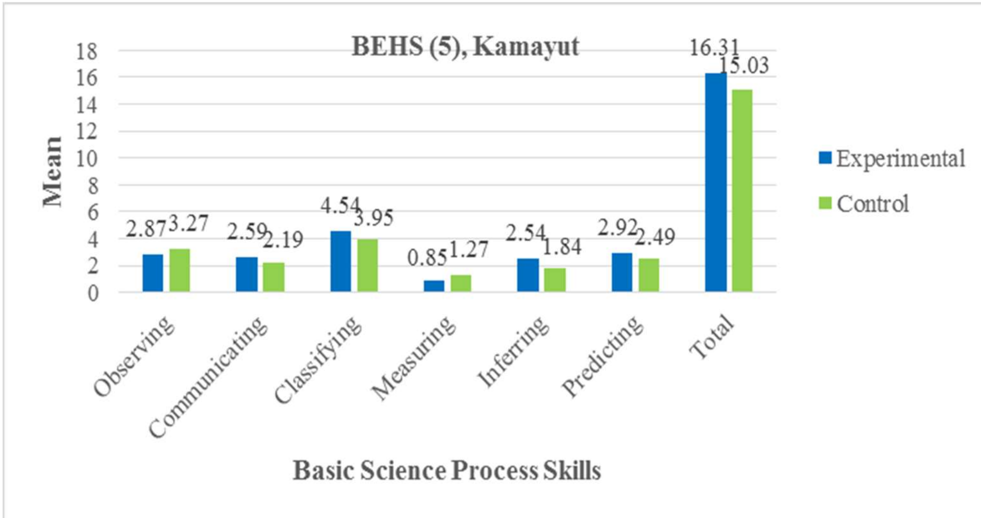

Figure 4: The Comparison of Means on Posttest for BEHS (5), Kamayut

In BEHS (5), Kamayut, the experimental group who received active learning instructional strategies outperformed the control group who did not receive it in communicating, classifying and inferring skills. In this way, by analyzing statistically, the control group performed better than the experimental group in observing, measuring and predicting skills.

Findings for Students' Attitudes towards Learning Science by Active Learning Instructional Strategies

In order to find out the attitudes of students towards active learning instructional strategies, a questionnaire of students' attitudes was administered to experimental students after giving the treatment. The data are expressed in percentage based on the students' answers (see Table 5).

Table 5: Students' Attitudes towards Learning Science by Active Learning Instructional Strategies (ALIS)

No	Item	School	Percentage (%)				
			1	2	3	4	5
Factor (1) Students' attitudes towards active learning instructional strategies							
1	Learning by doing is more enjoyable than learning from teacher's demonstration.	No (1)	-	-	12.5	40	47.6
		No (5)	5.12	7.5	10.2	20.5	56.4
		Total	**2.53**	**3.79**	**11.39**	**30.37**	**51.89**
2	Learning by ALIS is pleasurable.	No (1)	-	-	5	40	55
		No (5)	5.12	2.56	7.5	41.02	43.58
		Total	2.53	1.26	6.32	40.5	49.36
3	The process of learning is satisfied during learning by ALIS.	No (1)	2.5	5	40	30	22.5
		No (5)	2.56	-	20.5	46.15	30.76
		Total	**2.53**	**2.53**	**30.37**	**37.97**	**26.58**
4	Learning in groups supports to build good relationship with classmates.	No (1)	-	-	27.5	20	52.55
		No (5)	2.56	7.5	2.56	17.94	69.23
		Total	1.26	3.79	15.18	18.98	60.75
5	Learning by doing actively improves confidence in exam.	No (1)	-	2.5	32.5	22.5	42.5
		No (5)	2.56	2.56	2.56	15.38	76.92
		Total	**1.26**	**2.53**	**17.72**	**18.98**	**59.49**
Factor (2) Advantages from learning with active learning instructional strategies							
6	Learning by ALIS can help to grasp the concepts of science.	No (1)	2.5	5	5	32.5	55
		No (5)	-	5.12	2.56	46.15	46.15
		Total	**1.26**	**5.06**	**3.79**	**39.24**	**50.63**
7	Knowledge can be applied in solving daily life problems.	No (1)	2.5	5	30	40	22.5
		No (5)	7.5	2.56	15.38	20.5	53.84
		Total	5.06	3.79	22.78	30.37	40.5
8	The facts and concepts can be retained longer.	No (1)	2.5	10	12.5	50	25
		No (5)	2.56	5.12	7.5	25.64	58.97
		Total	**2.53**	**7.59**	**10.12**	**37.97**	**41.77**
9	ALIS can stimulate the desire to actively participate in learning.	No (1)	-	5	25	40	30
		No (5)	-	2.56	25.64	23.07	48.71
		Total	**-**	**3.79**	**25.31**	**31.64**	**39.24**
		No (5)	2.56	2.56	10.2	28.20	56.41
10	Learning by doing can give an assistance to learn the lesson easily.	No (1)	-	5	22.5	27.5	45
		No (5)	2.56	2.56	10.2	28.20	56.41
		Total	**1.26**	**3.79**	**16.45**	**27.84**	**50.63**
Factor (3) Students' values towards science							

No	Item	School	Percentage (%)				
			1	2	3	4	5
11	ALIS can increase interest in learning science.	No (1)	2.5	-	22.5	37.5	37.5
		No (5)	2.56	2.56	12.82	33.33	48.71
		Total	**2.53**	**1.26**	**17.72**	**35.44**	**43.03**
12	ALIS can stimulate curiosity about science.	No (1)	-	7.5	25	40	27.5
		No (5)	7.5	5.12	12.82	23.07	51.28
		Total	**3.79**	**6.32**	**18.96**	**31.64**	**39.24**
13	The lessons of science are related with daily lives.	No (1)	2.5	5	27.5	35	30
		No (5)	2.56	5.12	5.12	33.33	52.5
		Total	**2.53**	**5.06**	**16.45**	**34.17**	**41.77**
14	Learning by ALIS can improve reasoning skill.	No (1)	2.5	12.5	12.5	40	32.5
		No (5)	2.56	-	20.5	25.64	51.28
		Total	**2.53**	**6.32**	**16.45**	**32.91**	**41.77**
15	The knowledge of science can be constructed by ourselves.	No (1)	-	-	35	20	45
		No (5)	-	10.2	10.2	25.64	53.84
		Total	**-**	**5.06**	**22.78**	**22.78**	**49.36**

Note. No (1) = BEHS (1), Yankin,
No (5) = BEHS (5), Kamayut

Summary of Results

The results of research study from the two selected schools were as follows:

1. There were significant differences between the experimental groups who were taught by active learning instructional strategies and the control groups who were taught by teacher directed learning on the scores of science achievement in two selected schools.
2. There were significant differences between the experimental group who were taught by active learning instructional strategies and the control group who were not taught by them on the scores of questions measuring students' basic science process skills in BEHS (1), Yankin.
3. There were significant differences between the experimental group who received active learning instructional strategies and the control group who did not receive them on the scores of the questions concerning with students' communicating, classifying and inferring skills in BEHS (5), Kamayut. However, there was no significant

difference in observing, measuring and predicting skills between the two groups.

4. Experimental students' attitudes towards active learning instructional strategies are as follows:

    - 89% of the students feel happy and can grasp the concepts of science.
    - 82% of the students prefer learning by doing to learning from teacher demonstration.
    - 79% of the students retain the facts and concepts of science longer than before.
    - 78% of the students feel more familiar with their classmates, can learn easily and improves confidence to sit for exam.
    - 75% of the students can relate the lesson of science with daily life activities.
    - 74% of the students improve their reasoning skills.
    - 72% of the students construct the knowledge of science by observing and investigating by themselves.
    - 70% of the students apply knowledge of science in solving daily life problems, improve their motivation to actively participating in learning and their curiosities about science.
    - 64% of the students are satisfied their learning process.

Interpretation of Research Findings

Findings of this research study was summarized as follows:

1. It was found that active learning instructional strategies had positive effect on science teaching at the middle school level.
2. It was observed that learning science by active learning instructional strategies had been more effective than learning science by teacher directed learning.

3. It was found that active learning instructional strategies had been more effective than teacher directed learning in terms of academic achievement.
4. It was revealed that the science achievement of the experimental groups who received active learning instructional strategies had been more effective than that of the control groups who did not.
5. It was found that active learning instructional strategies had been effective in fostering students' acquisition of basic science process skills.
6. It was observed that students who received active learning instructional strategies outperformed those who did not receive them in basic science process skills.
7. It was revealed that active learning instructional strategies improved students' positive attitudes towards learning science.

Conclusion

Discussion and Suggestion

According to the results of the study, it was found that teaching science by using active learning instructional strategies was significantly effective on the science achievement of the students. It may be because of the fact that active learning instructional strategies provided students enough opportunities to participate in learning and construct science knowledge by themselves. Moreover, it could stimulate the students' interest to actively participate in activities, problem solving and discussion.

This result is consistent with the finding of Farajallah and Alarjani (2012) who found that there were significant differences between the control groups who learned by traditional teaching methods and the experimental groups who learned by active learning method. This research pointed that using active learning had impacts on rising the achievement level of the low achievement students and increased the learner's motivation towards education.

Moreover, the result showed that active learning instructional strategies could bring about an effective improvement of students' basic science process skills in BEHS (1), Yankin. It may be because of the fact that students actively participated in doing experiments, observations and creation of new knowledge by themselves. Another reason may be that they actively presented their findings of experiments, observations and discussion to others.

However, according to the result of study, teaching science by using active learning instructional strategies were effective in the improvement of students' communicating, classifying and inferring skills in BEHS (5), Kamayut but were not effective in observing, measuring and predicting skills of the students. The cause may be that the basic mathematics knowledge of the participants in the experimental group were very low and they had less past experiences to forecast the forthcoming events based on previous knowledge than the control group.

This result is consistent with the finding of Ghumdia and Adams (2016) who found that inquiry-based method, one of the active learning instructional strategies, was more effective in fostering students' acquisition of science process skills than the lecture method. This research pointed that allowing students to engage in various learning activities enabled them to find out and develop their knowledge of the abstract concepts individually or in groups.

Furthermore, the findings of students' attitudes towards active learning instructional strategies showed that through learning by using these strategies, students learned the concepts and information that was in the area of their interest and remembered the information and connected it with their own experiences and applied it in their daily life to make what they have learned a part of their own self and their being. This result is consistent with the findings of Momani et al. (2016) also studied the attitudes of teachers towards active learning instructional strategies. The finding of his study indicated that over ninety percent of the teachers agreed that active learning strategies improved students' communication, enhanced their motivation and created desirable attitudes towards interaction in class.

Some suggestions concerning with using active learning instructional strategies in teaching science are expressed as follows: the teacher

- must provide the students an opportunity to engage in learning materials
- must create an active, dynamic, interactive and conducive learning environment
- should present the problems or activities that resembles with the ones that they are encountering in their daily lives
- should provide authentic tasks to develop basic science process skills of students
- must serve as facilitator, organizer and partner in active learning
- should nurture the students to become active learners, presenters and critical thinkers

Recommendations

This research study only focused on the development of teaching of science at the middle school level and the development of students' science achievement. In this study, as the size of sample is small and the duration of experiment is short, this result may not be generalized to a larger population. Thus, further research studies should be carried out nationally representative samples and in a longer duration to validate the results of present research. Moreover, basic science process skills of students at the primary or high school level and in other subject areas should be studied by using the remaining active learning instructional strategies to get a reliable and valid result.

Conclusion

Science as a practical subject provides the students an opportunity to solve their daily life's problems and contribute to national development by integrating and applying their knowledge, skills and attitudes. Therefore, the science teacher must provide the activities which students carry out in scientific investigations to enable the acquisition of scientific knowledge and skills. To obtain these, science process skills are central because they are procedural skills, experimental and investigating science habits of mind or scientific inquiry abilities.

Moreover, the learning process is also student's responsibility which helps him exert more effort and the optimal investment of his abilities and take advantage of the supporting educational environment of active learning which links the student with the subject he is learning. It is known that active learning instructional strategies also depend on self-activity and positive participation of the learner, in which he searches scientific facts and concepts using a range of activities and scientific processes under the supervision and guidance of the teacher. Furthermore, the result of this study showed that active learning helped students enjoy learning and gave them the ability to acquire knowledge and science process skills. Moreover, it was found that it had been effective in the science achievement of the students.

Even though there are pros and cons in using active learning instructional strategies, many researchers showed that using these strategies in teaching science can meet the goals of both science teaching and education. It is known that one of the goals of education is to nurture students to be active, independent and lifelong learners. Active learning can meet this goal because actively participating in learning, problem solving, observation, investigation and communicating knowledge and experiences fulfills sound knowledge, enriches valuable experiences and then develops skills and abilities for further learning that leads to independent and lifelong learners. It also meets the right of human being as everyone has a basic right to the full development of their minds and of their capacities for learning. Thus, active learning instructional strategies should be applied at all levels of science teaching in basic education in Myanmar.

To sum up, according to the result of this study, using active learning instructional strategies in teaching science is effective in the academic achievement of science students. Moreover, these strategies can give an assistance to develop students' basic science process skills and improve positive attitudes towards learning science. Therefore, science teachers should integrate active learning instructional strategies to be effective in teaching science. According to the nature of topics, science teachers can choose the suitable strategies among active learning instructional strategies to reach their students' learning goals.

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Appendix A

Pretest (Test for Students' Previous Knowledge in Science)

q|rwef;ausmif;om;? ausmif;olrsm;
odyÜHbmom&yfwGif&Sdaom odrIe,fy,ftm;
tMudKppfaq;vTm

ar;cGef;tm;vHk;ajzqdkyg/
cGifhjyKcsdef / / (45) rdepf

1/ atmufygwdkUudk rSefvSsif(rSef)? rSm;vSsif(rSm;)[k tajzae&mwGif a&;yg/

(1) tjrpfr&Sdaom &dk;&Sif;aom yifpnfESifh ao;i,faom t&Gufi,frsm;&Sdaom tyifrsm;onf zef;tkyfpkwGifyg0ifonf/

(2) ykZGefonf ausm&dk;&Sdowå0gtkyfpkwGif yg0ifonf/

(3) qm;aysmf&nfrS qm;udk jyefvnf&&Sd&ef taiGUysHjcif;enf;udk oHk;onf/

(4) oHvdkufacsmif;rsm;\ rsdK;wl0if&dk;pGef;rsm;onf qGJiifMujyD; rsdK;rwlaom0if&dk;pGef;rsm;onf wGef;uefMuonf/

tajzjznfh&
(1)-------
(2)-------
(3)-------
(4)-------
(5)-------

(5) acgif;ay:&SdqHyifESifh
aywHudkyGwfwdkufjcif;jzifh
aywHwGif oHvdkuf"mwf
&&SdEdkifonf/

tajzjznfh&ef

2/ atmufygazmfjycsufwdkU\
tajzrSeftu©&mudk tajzjznfh&efae&mwGif
a&;yg/

(1) wå0grsm;udk trsdK;tpm;cGJ&mwGif ydkrdkípepfusap&ef ¤if;wdkY\((u) aexdkif&ma'o (c) zGJUpnf;yHkvu©Pmrsm; (*) pm;aomufyHk)t& cGJjcm;xm;onf/

(2) yvufwDerfonf ((u) owåK (c) owåKr[kwfaomj'yfpif (*) j'yfaESm) jzpfonf/

(3) aomufa&oefUxkwfvkyfonfh enf;onf ((u) t&nf ppfjcif;enf; (c) taiGUysHjcif;enf; (*)aygif;cHjcif;enf;) jzpfonf/

(4) tvkyfvkyf&ef pdkufxkwf&aomtm;udk ((u) pdkuftm; (c) yGwftm; (*) &dk;&dk;puf) [k ac:onf/

(5) tvif;wef;rsm;onf MunfhrSef\ rsufESmjyifudk awGUxdí tvif;jyefaomtcg ¤if;udk ((u) tvif;auGUjcif; (c) yHkrSeftvif;jyefjcif; (*)

o

(1)-------

(2)-------

(3)-------

(4)-------

(5)-------

ysHUa&mtvif;jyefjcif;) [k ac:onf/

3/ atmufazmfjyygwdkU\ tajzrSefudk tajzjznfh&ef ae&mwGif a&;yg/

(1) xif&Sm;qHk;aom ouf&SdtrsdK;tpm;rsm;rSm owå0grsm;? tyifrsm;ESifh ------ wdkUjzpfonf/

(2) yfjymjrIyftvG,fwulxGufaoma&udk ------[kac:onf/

(3) efUpifaom rdk;a&onf ------ jzpfonf/

(4) yifnDaMu;rHkay:aom yHk&dyfonf ------ jzpfonf/

(5) Hvdkufwpfck\ oHwdkoHprsm;udk qGJiifEdkifaom ¤if;\ ywf0ef;usifrS tuGmta0;udk ------ [kac:onf/

tajzjznfh&t

(1)-------

(2)-------

(3)-------

(4)-------

q

(5)-------

o

j

o

4/ atmufygar;cGef;rsm;udk ajzqdk&efay;xm;aomae&mwGif vdk&if;omajzqdkyg/

(1) owåKj'yfpif (2) rsdK;udk azmfjyyg/

----

(2) oJrIefUESifh vTpmrIefUa&mxm;aom aysmf&nfrSa&udk cGJxkwfvdkvSsif rnfonfhenf;jzifh cGJxkwf&rnfenf;/

----

(3) ausm&dk;rJUowå0gtkyfpkrsm;\ trnfrsm;udk azmfjyyg/

----

(4) tDem;&Sm;qdkonfrSmtb,fenf;/

----

(5) vSsyfjyufjcif;ESifh rdk;csKef;oHonf wjydKifeufwnf; jzpfay:aomfvnf; vSsyfjyufjcif;udk tvsifjrif&ovm; (odkUr[kwf)

rdk;csKef;oHudk tvsifMum;&ovm;/
tb,faMumifhenf;/

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5/ atmufygar;cGef;rsm;udk ajzqdkyg/

(1) oMum;aysmf&nfrS oBum;udk
jyefvnf&&Sd&ef rnfonfhenf;udk
toHk;jyK&rnfenf;/
jyKvkyfyHktqifhqifhudk azmfjyyg/

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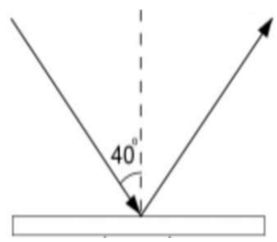
(2) tvif;jyefed,mrudk azmfjyyg/
¤if;ed,mrt& þy
jyefaxmifhu


40°

Appendix B

Posttest (Science Achievement Test)

q|rwef;ausmif;om;? ausmif;olrsm;

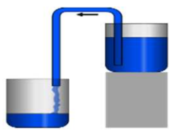
odyÜHbmom&yfwGif&Sdaom

Basic Science Process Skills **ppfaq;vTm**

cGifhjyKcsdef/ / (1) em&D

1/ atmufazmfjyygwdkU\tajzrSefudk tajzjznfh&efay;xm;aomae&mwGifa&;yg/

(1) yHkwGifyg0ifaom ypönf;ud&d,mrsm;rSm a&wdkifuD? a&yHk;i,fESifh ------- wdkUjzpfMuygonf/



ar;cGef; (1) tajzjznfh&ef

(2) avzdtm;udk usEkfyfwdkUrjrif&aomfvnf; ------ jzifh prf;oyfod&SdEdkifygonf/

ar;cGef; (2) tajzjznfh&ef

(3) þonfrSm -------a'owGif MuHKAawGUae&aom vu©Pm&yfjzpfonf/

ar;cGef; (3) tajzjznfh&ef

(4) urÇmUajrjyifteD;wGif tvsm;? teH? tjrifh (3)rDwm&Sdaom ajcmufaoGUaom

ar;cGef; (4) tajzjznfh&ef

(5) {&d,m 150 pwk&ef;pifwDrDwm&Sdaom pm;yGJcHkay:wGif oufa&mufaeaom av\ tav;csdefyrmPrSm ------- jzpfonf/

ar;cGef; (5) tajzjznfh&ef

(6) ysdK;yifav;rsm; a&epfaoqHk;ae&onfh taMumif;&if;rSm -------

a

pfonf/

ar;cGef; (6) tajzjznfh&ef

(7) ajymif;zl;yifrsm;rS t&Gufrsm;onf nId;EGrf;í tndka&mifoef;vmonfrSm ----- -- aMumifh jzpfEdkifygonf/

ar;cGef; (7) tajzjznfh&ef

(8) opfyifrsm;aygrsm;pGm aygufa&mufaeaoma'owGif a&aiGUyg0ifrIyrmP ------- ygonf/

ar;cGef; (8) tajzjznfh&ef

(9) rsufESmjyif{&d,m ------- ay:odkU zdaeaom av\zdtm;udk avzdtm;[k

ar;cGef; (9) tajzjznfh&ef

(10) tu,fí pdkufcif;twGuf

rdk;a&vHkavmufrIr&Sdygu a&udk ------

ar;cGef; (10) tajzjznfh&ef

ay;ydkUEdkifygonf/

2/ atmufygar;cGef;rsm;udk

vdk&if;omajzqdkyg/

(1) rdk;onf;xefpGm

&GmoGef;aeaoma'oESihf

rdk;acgifaoma'owdkUudk cGJjcm;jyyg/

(u) **(c)** **(*)**

(C) **(i)** **(p)**

rdk;onf;xefpG	rdk;acgif

ar;cGef;(1)t

m&Gmaoma'o	aoma'o

(2) a&aiGUyg0ifrIrsm;aomjrdKUESifh a&aiGUyg0ifrIenf;aomjrdKUrsm;udk cGJjcm;jyyg/

(u) &efukef (c) rEÅav; (*) oHwGJ (C) xm;0,f (i) jyifOD;vGif

ar;cGef;(2)

a&aiGUyg0if Irsm;aom	a&aiGUyg0ifrIenf;aom jrdKU

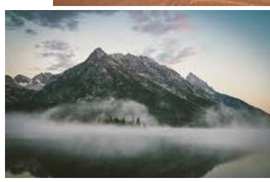
(p) acsmif;om

(3) a&aiGUyg0ifrIrsm;aoma'oESifh a&aiGUyg0ifrIenf;aoma'orsm;udkcGJjcm;jyyg/

(u) (c) (*)



(C) (i)

a&aiGUyg0ifrIrsm;aom ar;cGef;(3)t	a&aiGUyg0ifrIenf;aom a'o

(p)

(4) tylvGefuJrIaMumifh ysufpD;aeaom oD;ESHyifrsm;udk cGJxkwfazmfjyyg/



(u) (c) (*)



(C) (i) (p)

ar;cGef;(4)t

tylvGefuJrIaMumifh ysufpD;aeaomoD;ESHyif rsm;	tjcm;taMumif;&if;a ifh ysufpD;aeaomoD;ESI rsm;

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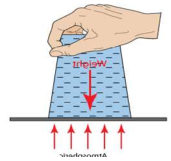


(u) (c) (*)

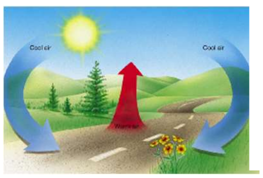
(C) (i) (p)

ar;cGef;(5)t

avzdtm;&SdaMumif; prf;oyf... w¦K	avzdtm;&SdaMumif; prf;oyfír&aomt&m0w¦K

(6) ajcmufaoGUoefU&Sif;aom
zefcGufwpfckxJodkU a&cJwHk;av;rsm;
xnfhxm; ygutcsdeftwefMumvSsif
tjyifbufzefom;wGif rnfodkUawGU&oenf;/

(7) þyHkrSoifavhvmawGU&Sd&aom tcsufudk
jyefvnf&Sif;jyyg/



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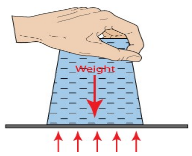
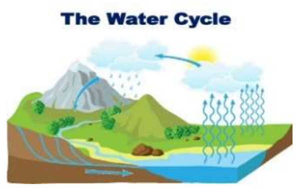
ypönf;ud&
rnfodkUaw



(9) avrIwfxm;aomylaygif;ESifh
avavsmhxm;aomylaygif;wGif
rnfonfuydkav;oenf;/ tb,faMumifhenf;/

(10) þyHkrS oifavhvmawGU&Sd&aom taMumif;&if;rsm;udk azmfjyyg/



4/ atmufygar;cGef;rsm;udk ajzqdkyg/

(1) a'owpfckwGifvaygif;rsm;pGmrdk;&GmaevSsif ¤if;\aemufqufwGJtjzpf pdkufysdK;a&;wGif rnfonfhqdk;usdK;rsm; jzpfyGm;Edkifoenf;/

----

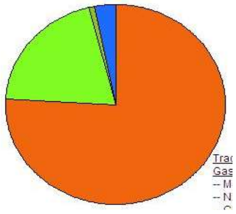
(2) rdk;av0oESihf ZvaA'nTefMum;rIOD;pD;XmerS tcsdeftcg r[kwf rdk;&GmoGef; rnf[k aMunmxm;vSsif oif\oD;ESHyifrsm;twGuf rnfonfhMudKwif jyifqifrIrsm; jyKvkyfxm;&rnfenf;/

----

(3) rdrdtdrf&Sda&wdkifuDrSa&udk tjcm;a&yHk;i,frsm;odkU ajymif;a&TUvdkvSsif rnfonfh ypönf;ud&d,mudk toHk;jyK&rnfenf;/ jyKvkyfyHktqifhqifhudk a&;yg/

----

(4) þpuf0dkif;onf avxkwpfckvHk;udkudk,fpm;jyKí ¤if;wGif EdkufMxdK*sif 76%? atmufqD*sif 19%? tm*GefESifh tjcm;"mwfaiGU 1% yg0ifvSsif a&aiGUyg0ifrI yrmPonf rnfrSsjzpfrnfenf;/



(5) þa'owGifMuHKawGUae&aom ab;tEÅ&m,fonf rnfonfh taMumif; &if;rsm; aMumifh jzpfEdkifoenf;/ xdktajctaersm;aMumifh pdkufysdK;a&;wGif rnfonfh qkd;usdK;rsm; jzpfyGm;Edkifygoenf;/

Appendix C

Lesson Plans

Lesson Plan (1) for Experimental Groups

pmoifcsdef (1)

1/ twef; - q|rwef;

2/ bmom - taxGaxGodyÜÜH

3/ oifcef;pmacgif;pOf - tcef; (5)

urÇmajrMuD;ESifh tmumo

(i) tmumoESifh

rdk;av0o

(1) a&cdk;a&aiGU

obm0

4/ tcsdef - (45) rdepf

5/ a,bk,s OD;wnfcsuf - a&cdk;a&aiGU\ obm0jzpfwnfrIESifh ywfoufaom todynmrsm; &&Sdap&ef/

6/ tao;pdwfOD;wnfcsuf - avxkxJwGif a&aiGU&SdaMumif;vufaw GU prf;oyfvkyfaqmifwwfap &ef/

- a&cdk;a&aiGUrSt&nftjz pfodkUajymif;vJ&onfh taMumif;&if;udk aqG;aEG;wifjywwfap&ef /

- aiGU&nfzGJUjcif;tm; t"dyÜg,f zGifhqdkwwf ap&ef/

7/ oifMum;? oif,lrI - a&cJwkH;? zefcGuf? ta&mifwiftqD? taxmuftuljyKypönf;rsm; yvyfpwpf tdwf? vkyfief;rSwfwrf;pm&Guf

8/ Teaching Method - Problem Solving Strategies (Inquiry)

9/ oifMum;? oif,lrI vkyfief;pOf

oifenf; tqifh	oifMum;rIvkyfief;pOf	oif,lrIvkyfief;pOf	oifaxmufulypönf;	tcsdef
Introduction	- ausmif;om;OD;a& (5) a,mufwpftkyfpk jzifh tkyfpkzGJUy	- tkyfpkzGJUygrnf/ -	- zefcGuf?	(5) rdepf

1. Determining the Problem	grnf/ - yxrOD;pGm zefcGufxJ wGifa&cJESi fh a& tenf; i,fxnfhjyD; tcsdef twefMumvsSi f tjyifbufzef om;wGif jzpfay:vmao majymif;vJr Iudk tkyfpkvdkuf aqmif&Guf avhvmap ygrnf/	tkyfpkvdk uf aqmif &Guf avhvmyg rnf/ - awGU&Sdcs ufrsm;udk rSwfom;yg rnf/	a&cJ? a&? vkyfie f;rSwf wrf;pm &Guf - vk yfief; rSwf wrf;pm &Guf	(5) rdep f
2. Hypothesizing		- awGU&Sdcs ufrsm;ESi fh ywfoufí quf vufpl;prf ;avh vm tajz&Sm & rnfh jyóemrsm; udkowfrSw fygrnf		
3. Planning to gather data	- xdkjyóemrsm ;rS oif cef;pmESif h qufpyf aom	Oyrm - zefcGuftj	- vkyfie f;rSwf wrf;pm	(15) rdep

4. Gathering data	jyóemrsm;u dk qufvuf pl;prf; tajz &Smapygrnf / - ypönf;ud&d, mrsm; udk tkyfpkvdkuf cGJa0jyD; vufawGUaqmi f&Guf apygrnf/ - vkyfief;pOf rsm;udk q&muMudKwif nTefMum;ay; ygrnf/	yifbuf wGifawGU& aoma&rsm; onf a&cGuf twGif;&Sd a&rsm; ,dkzdwfjc if;aMumif h vm;/ - rnfonfhae &mrS a&muf&Sdv moenf; - tb,faMumi fh a&muf&Sdv moenf; - jzpfEdkif acs&Sdaom taMumif;& if;rsm;ud k tkyfpkwGi f aqG;aEG;j yD;	&Guf vkyfief ;pOf(1) a&cJwHk ;? a&? ta&mifw ifqD vkyfief ;pOf(2) a&cGuf(2)cGuf? a&cJwHk ;?a&? yvyfpwp f cGuf? vkyfief ; rSwf	f (5) rdep f

5. Examining, Analyzing and Evaluating data 6. Accepting or Rejecting Hypotheses	- awGU&Sdcsuf rsm;? ajymif;vJrI rsm;udk vkyfief;rSw fwrf; pm&GuffwGif rSwfom; apygrnf/ - tkyfpkvdkuf aqmif&Guf csufrsm;udk	vkyfief;r Swfwrf; pm&GufwGi f rSwfom; ygrnf/ - vufawGUpr f;oyf aqmif&Guf ygrnf/ Oyrm - vkyfief;pO f (1) - zefcGufxJ odkU a&cJ ESifha& tenf;i,f xnfhjyD; vsSif ta&mifwif qD xnfhí oratmif arTygrnf/ - tcsdeften f;i,f apmifhMun fhygrnf/	wrf; pm&Guf - vkyfief ;rSwf wrf;pm& Guf	(5) rdepf

7. Generalizing	**q&mu avhvm apmifhMunfh jyD; vdktyfonfh tul tnDrsm; ay;ygrnf/**	**vkyfief;pOf (2) - a&cGuf (2) cGufwGif a&cJESifh a&tenf;i,f xnfhygrnf/ - 'kwd,a&cGuftm; avvHkaomy vyfpwpf tdwftwGif; odkU xnhfygrnf/ - tcsdeftenf;i,f apmifhMunfhygrnf/ - ajymif;vJrIudkapmifh Munfhavhvmygrnf/**		**(10) rdepf**

	- tkyfpkrsm;\ aqG;aEG; csufrsm;rSt "dutcsuf rsm;udkoify kef;ay:wGif pm&if;jyKpk ygrnf/ “þuJUodkUa&c dk;a&aiGU rsm;t&nftjz pfajymif;vJ oGm;jcif;rS maiGU&nf	- awGU&Sdcs ufrsm;udk vkyfief;r Swfwrf; pm&Guf wGiff rSwfom;yg rnf/ Oyrm - zefcGuftj yif buf&Sd a&onf zefcGuftw Gif;&Sd a&ESifh ta&mif rwlyg/ - yvyfpwpft dwf twGif;&Sd zefcGuf \ tjyifbufw Gif a&rsm;raw GU&yg/ -		

	zGJUjcif;jz pfonf” [kjcHKiHkoH k;oyfay;í &v'frsm;? vkyfief; aqmif&GufrI rsm;tay: a0zefoHk;oy fjcif;? tMuHnPfay;j cif;rsm; jyKvkyfygrn f/	yvyfpwpft dwf rygaom zefcGuf \ tjyifbufw Gif a&rsm;awG U&onf/ - &&Sdxm;ao m awGU &Sd csufrsm;o nf jyóem\taj z jzpfEdkif \? rjzpf Edkif\udk tkyfpkwGi f; aqG;aEG;y grnf/ - aqG;aEG;j cif;&v'f ESifh csrSwfxm; aom jzpfEdkif		

		acs taMumif;&if; rsm; udkufnDrI&Sd? r&Sdudk ppfaq;jyD; ¤if;wdkY udk vufcHrI (odkUr[kwf) jiif; y,frIjyKvkyfygrnf - jyóem\ tajz rsm;udk aemufqHk; jcHKiHkoHk;oyfaumuf csufcsygrnf/ - tkyfpkwGif;oHk;oyf csufrsm;udk tjcm; tkyfpk		

		rsm;tm; rsSa0ygrn f/ Oyrm **- zefcGuftj yifbuf wGifawGU& onfha&onf zefcGufwG if; &Sda&r[kw fyg/ - avxJ&Sd a&cdk; a&aiGUrsm ;rStoGif ajymif;jz pfay:vm jcif;jzpf onf/ - tb,faMumi fh qdkaomf ¤if;a&cdk ; a&aiGU rsm;onf at;aom zefom;**		

		ESifhxdaw GU oGm; aomaMumif h t&nftjzpf ajymif;vJ oGm;jcif; jzpfygonf / - xdkUaMumif havxk xJwGifa&ai GU&Sd aMumif;odE dkifonf/		

Appendix D

Students' Attitudes towards Learning Science by Active Learning Instructional Strategies Questionnaire

atmufazmfjyygtaMumif;t&mrsm;udk zwfí oif\ oabmxm;tjrifESifh udkufnDaom tajzae&mwGif (√) jcpfyg/

1 = vHk;0oabmrwlyg/ 2 = oabmrwlyg/ 3 = rqHkk;jzwfwwfyg/

4 = oabmwlygonf/ 5 = vHk;0oabmwlygonf/

pOf	**taMumif;t&m**	**1**	**2**	**3**	**4**	**5**
taMumif;t&m (1) wufMuGpGmyg0ifaqmif&Gufoif,lenf;jzifh oif,l&jcif;tay: ausmif;ol? ausmif;om;rsm;\ oabmxm;						
1/	uREkfyfonf q&m?q&mrrsm;\ o&kyfjyoifMum;jcif;rS avhvm oif,l&onfxuf udk,fwdkifyg0ifaqmif&Guf avhvm&onfudk ydkíESpfoufygonf/					
2/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; jzifh oif,l&jcif;udk aysmf&Tifrdygonf/					
3/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; jzifh oif,laepOfwGif rdrd\ oif,lrIjzpfpOfESifh oif,lrIvkyfief;rsm;tay:wGif auseyfESpfoufrI&Sdygonf/					
4/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; wGif tkyfpkzGJU avhvm oif,l&jcif;jzifh uREkfyfwdkUoli,fcsif; tcsif;csif; ydkrdk&if;ESD; vmonf[k cHpm;rdygonf/					
5/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; jzifh oif,l&mü uREkfyf onf oif,lrIvkyfief;rsm;wGif udk,fwdkifyg0if aqmif&Guf &jcif;aMumifh pmar;yGJwGif aumif;pGmajzEdkifrnf[k ,HkMunf					

pOf	taMumif;t&m	1	2	3	4	5
	onf/					
taMumif;t&m(2)wufMuGpGmyg0ifaqmif&Gufoif,lenf;rS ausmif;ol? ausmif;om;rsm; &&SdEdkifonfh tusdK;aus;Zl;rsm;						
6/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; jzifh oif,l&jcif;rS taxGaxGodyÜHbmom&yf\tajccHoabmw&m;rsm;udk em;vnf vmonf/					
7/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; jzifh oif,l&jcif;rS &&Sd aomtodynmrsm;tm;aeUpOfb0vdktifrsm;? jyóemrsm;udk ajz&Sif;&mwGif toHk;csEdkifonf/					
8/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; jzifh oif,l&jcif;rS oifcef;pmyg taMumif;t&mrsm;udk ydkrdkMum&SnfpGm rSwfrd Edkifonf/					
9/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; jzifh oif,laepOfwGif oif,lrIvkyfief;rsm;ü uREkfyf\ wufMuGpGmyg0ifaqmif&Guf vdkrIudk EId;qGay;ygonf/					
10/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; jzifh oif,laepOfwGif uREkfyfonf oif,lrIvkyfief;rsm;ü udk,fwdkifyg0ifaqmif&Guf &jcif;aMumifh taxGaxGodyÜHoifcef;pmrsm;udk					

pOf	**taMumif;t&m**	**1**	**2**	**3**	**4**	**5**
	tvG,fwul oif,lwwfajrmufonf/					
taMumif;t&m(3)odyÜHbmom&yftay: ausmif;ol ausmif;om;rsm;\ wefzdk;xm;rI						
11/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; jzifh oif,ljcif;jzifh taxGaxGodyÜHbmom&yfwGif pdwf0ifpm;rIwdk;vmygonf/					
12/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; jzifh oif,ljcif;jzifh uREkfyf\taxGaxGodyÜHbmom&yfESifh ywfoufí qufvuf odvdkrIudk Edl;qGay;ygonf/					
13/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; jzifh oif,laepOfwGif taxGaxGodyÜHbmom&yfrS oifcef;pmrsm;onf uREkfyfwdkU\ aeUpOfb0ESifh qufpyfrI&Sdonf[k ydkrdkxifjrifrdonf/					
14/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; jzifh oif,ljcif;& aMumifh vufawGUb0wGif aMumif;usdK;qufpyfí aqmif&Guf Edkifonf/					
15/	wufMuGpGmyg0ifaqmif&Gufoif,lenf; jzifh oif,ljcif;jzifh taxGaxGodyÜHbmom&yfESifh ywfoufaom todynmrsm;udk udk,fwdkif&SmazGvmEdkifonf/					

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THE IMPACT OF STUDENTS' MOTIVATION ON THEIR ACADEMIC ACHIEVEMENT IN SCIENCE AT THE MIDDLE SCHOOL LEVEL

Phyo Su Khin[1] and Kyi Swe[2]

Abstract

The purpose of this study was to investigate the impact of students' motivation on their academic achievement in science at the middle school level. The design adopted in this study was a descriptive research. The participants were (1043) Grade-seven students from four middle schools and four high schools. The instruments used for this study were a questionnaire for students' motivation to learn science and science achievement test. The questionnaire was based on Tuan, Chin and Shich, (2005) which contains six dimensions. The questionnaire included (35) items of five-point Likert-scale by five responses: strongly disagree, disagree, cannot understand, agree and strongly agree. Science achievement test was based on the content area from Chapter (1) to (4) in Grade Seven General Science Textbook. It included objective items, short questions and long questions items. A descriptive statistics was used to study the impact of students' motivation to learn science and their academic achievement in science. Moreover, Pearson-product moment correlation was used to study the impact of students' motivation to learn science and their academic achievement in science. It was found that students' motivation to learn science is moderately correlated to their academic achievement in science. It means that highly motivated students perform better than lowly motivated students on science achievement test.

Keywords: science, motivation, science achievement

Introduction

Education is the process of receiving or giving systematic instruction, especially at a school or university. Teachers are trying to improve the achievement of their students. However, the academic achievement of students is not always the same. This may be due to their difference in motivation to learn. Motivation is an inner force that activates and provides direction to our thought, feelings and actions. Science teachers should try to help students to become highly motivated students so that they become high achievers.

1. Senior Assistant Teacher, No(2), Basic Education High School (Branch) Nyaung Hnit Pin, Hmawbi, Yangon Region

2. Dr. Lecturer, Department of Methodology, Yangon University of Education

Purposes of the Study

The main purpose of this study is to investigate the impact of students' motivation on their academic achievement in science at the middle school level.

The specific objectives are as follows:

(a) To investigate Grade-seven students' motivation to learn science.

(b) To explore the relationship between Grade-seven students' motivation and their academic achievement in science at the middle school level.

Research Hypothesis

(a) There is a relationship between students' motivation of self-efficacy and their achievement in science.

(b) There is a relationship between students' motivation of active learning strategies and their achievement in science.

(c) There is a relationship between students' motivation of science learning value and their academic achievement in science.

(d) There is a relationship between students' motivation of performance goal and their academic achievement in science.

(e) There is a relationship between students' motivation of achievement goal and their achievement in science.

(f) There is a relationship between students' motivation of learning environment stimulation and their academic achievement in science.

Definitions of the Key Terms

Science: Science is an ordered knowledge of natural phenomena or processes and the interrelations between them. (Dampier, cited in Hodes, 1974)

Motivation: Motivation is usually defined as an internal state that arouses, directs, and maintains behavior. (Woolfolk, 1998).

Science achievement: Achievement test score represents science achievement of the students.

Review of Related Literature

Teaching and Learning science

Science education must meet the challenge of improving the scientific literacy of the future citizens and of society as a whole. Without a broad-based understanding of science, it is likely that science teachers will place heavy emphasis on science as a body of knowledge, teaching and testing for factual information. Students must learn factual information, but, more important, they must discover ideas for themselves through laboratory activities, field studies, and library work (Collette &Chiappetta, 1989).The word ‘Science’ is originated from a Latin word 'Scientia' which means to know. Therefore, an originated effort to know about the things and happening in the nature is science (Singh, 2010).

Motivation

Motivation is an internal power which arouses, directs and controls the human interest and behavior (Woolfolk, 1990 cited in Sang, 2003). Its existence is due to the human physiological or psychological need. It is not inherited and does not exist naturally. It is an incentive to achieve a certain pre-determined goal. The level of motivation is directly proportional to the rate of desire. The stronger the desire to achieve a certain goal, the higher the level of motivation will be (Sang, 2003).

Types of Motivation

Psychologists classify motivation into intrinsic motivation and extrinsic motivation. Bruner (1996 cited in Sang, 2003) considered intrinsic motivation as natural instinct of desire to know and drive to achieve efficiency processed by pupils who just begin their primary education in school. In contrast, extrinsic motivation comes from external stimulus with the aim of encouraging people to carry out a certain activity which is beneficial to them (Woolfolk,1998).

Strategies to Enhance Students' Motivation

(a) Building Confidence and Positive Expectations

1. Begin work at the students' level and move in small steps.
2. Make sure learning goals are clear, specific and possible to reach in the near future.
3. Stress self-comparison, not comparison with others.
4. Communicate to students that academic ability is improvable and specific to the task at hand.
5. Model good problem solving, especially when the teacher have to try several approaches to get a solution.

(b) Seeing the Value of Learning

1. Tie class activities to student interests in sports, music, current events, pets, common problems.
2. Arouse curiosity.
3. Make the learning task fun.
4. Make use of novelty and familiarity.

(c) Staying Focused on the Task

1. Give students frequent opportunities to respond through questions and answers, short assignments or demonstrations of skills.
2. Have students create a finished product.
3. Avoid heavy emphasis on grade and competition.
4. Reduce task risk without oversimplifying the task.
5. Model motivation to learn for the students (Woolfolk, 1998).

Research Method

The purpose of this study was to investigate the impact of students' motivation on their academic achievement in science at the middle school level.

Research Design and Procedure

The research design of this study was a descriptive research design in which the researcher seeks to determine the correlation between students' motivation on their academic achievement in science at the middle school level. Students were selected by using a simple random sampling technique from four high schools and four middle schools in Yangon Region. First of all, the researcher explored the relevant literature with the research. Secondly, the researcher constructed the instruments under the guidance of the supervisor. Expert validity of the questionnaire and achievement test items were obtained from a retired associate professor and two lecturers. After getting the validity of these instruments, a pilot test was conducted. Based on the pilot test, some items were modified to adapt to the students' understanding. After the pilot test, the major survey was conducted on 15th, November, 2016. The modified questionnaires were distributed to all the participants of the eight sample schools and administered with the help of the teachers of those schools.

Instruments

(1) Questionnaire for Students' Motivation to Learn Science

The questionnaire for students' motivation to learn science was consisted of 35 items with a five point Likert-Scale. According to experts' suggestions, the questionnaire for students' motivation to learn science was modified again. The Cronbach alpha for the entire questionnaire was 0.89.

(2) Science Achievement Test for Students

The achievement test was based on the content area from chapter one to four in Grade Seven General Science Textbook prescribed by the Department of Educational Planning and Training, Republic of the Union of Myanmar (2012). The table of specifications was prepared including number of items according to the content areas.

The achievement test consisted of true/false items, completion items, matching items, short question items and long question items. According to experts' suggestions, the achievement test items were modified again. The allocated time for this achievement test was (1:30) hours. The marking scheme for the achievement test was presented. After the pilot test had been administered, discrimination indices and difficultly indices were computed by using U-L index method by John Stocklein (1957 cited in Sevilla, 1992). The difficulty indices and discrimination indices are within the acceptable ranges of 0.20 to 0.80 and 0.30 to 0.80.

$$Df = \frac{Pu+}{2}$$

$$D_s = Pu\text{-}Pl$$

Where D_f = Difficulty index

D_s = Discrimination index

P_u = Proportion of the upper 27 percent group who got the item right

P_l = Proportion of the lower 27 percent group who got the item right

Population and Sample Size

The sample for the descriptive design was selected from eight schools in Yangon Region.

No.	**Strata**	**Township**	**School**	**Population**	**Sample Size**		
					Male	**Female**	**Total**
1	Inner-City	Dagon	BEHS 2	244	91	53	144
2	Inner-City	Dagon	BEMS 1	274	57	43	100
3	Inner-Suburb	Hlaing	BEHS 2	288	69	81	150
4	Inner-Suburb	Hlaing	BEMS 6	178	55	60	115
5	Outer-Suburb	Mayangone	BEHS 2	635	71	75	146
6	Outer-Suburb	Mayangone	BEMS 5	182	62	56	118
7	Satellite	North Dagon Myothit	BEHS 3	578	71	79	150
8	Satellite	North Dagon Myothit	BEMS 3	211	54	66	120
Total				2379	530	513	1043

Note: BEHS=Basic Education High School
BEMS=Basic Education Middle School

Data Analysis

The data were analyzed by using the Statistical Package for the Social Science (SPSS 23). The Pearson product-moment correlation was used to indicate the degree of strength and direction of relationship between students' motivation and achievement in science.

Findings and Interpretations

In this study, the total number of Grade-seven students is (1043).Students who had motivation score between (137 - 175) can be regarded as highly motivated students and those who had (64 - 136) as lowly motivated. The motivation score and mean of lowly motivated students were 119.71 and 32.17 and that of highly motivated students were 147.64 and 40.49 respectively.

The means of different factors influencing motivation to learn science are (76.60%) in self-efficacy, (77.08%) in active learning strategies, (79.48%) in science learning value, (68.60%) in performance goal, (83.80%) in achievement goal and (71.27%) in learning environment stimulation respectively.

Students' motivation to learn science and their academic achievement in science were moderately related at 0.01 level (see Table 4.1 and 4.2).

Table 4.1: Correlation of Students' Motivation to Learn Science and their Academic

Achievement in Science at the Middle School Level

Students' Position	***R***	***p***
Lowly Motivated Students	.511**	.000
Highly Motivated Students	.523**	.000

**Correlation is significant at the 0.01 level (2-tailed).

Table 4.2: Correlation of Factors Influencing Students' Motivation to Learn Science and their Academic Achievement in Science at the Middle School Level

Different Factors	*r*	*p*
Self-efficacy	.563	.000
Active Learning Strategies	.626	.000
Science Learning Value	.554	.000
Performance Goal	.461	.000
Achievement Goal	.455	.000
Learning Environment Stimulation	.514	.000

**Correlation is significant at the 0.01 level (2-tailed).

To sum up,

- Students were less motivated by performance goal and learning environment stimulation. They had moderate self-efficacy and they liked active learning strategies in learning science. The students were more motivated by achievement goal and science learning value.
- There is a significant difference between lowly motivated and highly motivated students' motivation to learn science in terms of the means of students' motivation to learn science.
- For students' achievement in science, there is a significant difference between lowly motivated and highly motivated students' achievement in science in accordance with the means of students' achievement in science.
- The achievement of highly motivated students is significantly higher than that of lowly motivated students.
- The students' motivation to learn science has moderately correlated with their academic achievement in science.

  According to the results mentioned above, students' motivation to learn science has an impact on their academic achievement in science.

Discussion and Conclusion

Discussion

According to the results of this study, it was found that students differ significantly in their academic achievement in science based on the extent to which they are motivated in classroom setting. In a classroom, students differ in their family background, parents' income, parents' education, interest, intelligence, motivation and many others. Among these factors, the impact of motivation to learn science on their academic achievement in science was investigated. In the study, (49.57%) of the students were more motivated to learn science than (50.43%) of the students. Students who got motivation scores of (64 - 136) are regarded as highly motivated students and those who got (137 - 175) as lowly motivated students. The means of motivation and standard deviations of lowly and highly motivated students were (119.71), (16.53), (147.64) and (7.75) respectively. It was found that there was a significant difference in students' motivation to learn science.

This result is consistent with the findings of (Tella, 2007) that highly motivated students perform better academically than lowly motivated students. In school, most teachers and students are likely to think that intelligent or bright students can be top students and only these students can be high achievers. Empirical findings are available that highlighted the significance of motivation for students' achievement in different subjects. According to the earlier studies, the relationship between students' motivation to learn science and their academic achievement in science is an important consideration in learning science.

Another finding was that the means of students in different factors influencing motivation to learn science were (26.81) in self-efficacy, (30.83) in active learning strategies, (19.87) in science learning value, (13.72) in performance goal, (20.95) in achievement goal and (21.38) in learning environment stimulation respectively. Thus it was found that students were less motivated by performance goal and learning environment stimulation. They had moderate self-efficacy and they liked active learning strategies in learning science. The students were more motivated by achievement goal and science learning value. In schools, students learn scientific facts, concepts, scientific laws and theories by heart. This may be one of the weak points of students in learning science. They cannot know how to approach and learn science and how to motivate themselves to learn science. They can use some motivational techniques such as setting goals, drawing timetable and studying lessons according to the timetable, providing rewards and incentives to themselves, seeing the value of learning and competing with themselves than with the others.

Another finding was that the results of Pearson product-moment correlation described the degree of strength and direction of relationship between students' motivation to learn science and their academic achievement in science. Highly motivated students got more high scores in science achievement test than lowly motivated students. In this study, students' motivation to learn science and their academic achievement in science were moderately related at 0.01 level. This result is consistent with the findings of Abdurrahman &Garba (2014). They summarized that highly motivated students perform academically better than the lowly motivated students. The study of Amrai, Motlagh, Zalani & Parhon (2011) indicated a significant relationship between academic motivation and academic achievement. Early studies investigated that there was a relationship between students' motivation and their academic achievement.

Conclusion

Motivation, according to Schunk (1990 cited in Driscoll, 2005) refers to the process whereby goal-directed behavior is instigated and sustained. Human behavior is hardly possible without motivation which is a most important factor in learning. Motivation in education means inculcating and stimulating interest in studies and other such activities in pupils. It involves the understanding and use of natural urges of the child and also assisting him in acquiring new desirable motives (Kuppuswamy, 2002).

Motivation involves the forces that energize and direct behavior. The study of motivation is the study of all the forces that create and sustain students' effortful, goal-directed action. One's motivation to learn determines one's achievement (Donnell, Dobozy, Bartlett, Bryer, Reeve & Smith, 2012).

Motivation is an important factor in determining a student's achievement at school. It may be the main reason of getting high or low achievement of students. Although students can have the same level of intelligence, their achievement can be different. This may be due to their difference in level of motivation to learn. A student's motivation can be measured by dimensions such as interest, attitude, self-efficacy, use of active learning strategies, learning value, performance goal, achievement goal and learning environment stimulation.

Motivated students develop self-regulatory skills to set their own goals and manage their own learning and performance (Driscoll, 2005). Achievement goals set by learners influence their task persistence and problem-solving efforts (Elliot &Dweck, 1988; Meece, 1994 cited in Driscoll, 2005) as well as their study behaviors and what they remember (Nolen & Haladyna,1990 cited in Driscoll, 2005).

A strong source of motivation comes from learners' beliefs about themselves in relation to task difficulty and task outcome. Bandura (1997 cited in Driscoll, 2005) proposed self-efficacy as a belief system that is causally related to behavior and outcomes. It can be said that motivated students possess high self-efficacy level and they know what they need to do, to which extend they can achieve and how to manage themselves. Needs are based on some deficit within the person. Drive, though certainly based on needs, have the added feature of an observable change in behavior (Sprinthall, Sprinthall & Oja, 1994).

In order to consider the concept of motivation, reinforcement should not be missed. Reinforcement can motivate behavior. Early researchers called this extrinsic motivation. Children's early experiences at home may affect their motivation. Regardless of the family's socioeconomic level, cognitively stimulating home environments encourages academic intrinsic motivation through early adolescence. Conversely, parental reliance on extrinsic motivational practices to promote achievement may lower academic intrinsic motivation (Fleming, & Gottfried, 1998 cited in Bohlin, Durwin & Weber, 2012). Extrinsic rewards may not be necessary in early childhood because children at this developmental level generally are curious, inquisitive and motivated to learn new things (Harter, 1978 cited in Bohlin, Durwin & Weber, 2012). Students tend to become less intrinsically motivated as they move from upper elementary grades through middle and high school (Lepper et al., 2005; Spinath & Spinath, 2005 cited in Bohlin, Durwin& Weber, 2012). So stimulation from teachers and parents is necessary for adolescence.

In order to become successful learners, they need to become active learners, in turn highly motivated learners. To become effective teachers, it is necessary not only to be good at teaching but also to be proficient at motivating students to learn. Motivation leads learners to reach where they intent to achieve and encourage them to participate in learning process actively. Therefore, motivation is an essential and fundamental component of learning.

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AN INVESTIGATION INTO THE MATHEMATICS PROCESS SKILLS OF THE MIDDLE SCHOOL STUDENTS

Hnin Aye Nyein[1] , NaingNaingThein[2]

Abstract

The development of mathematics process skills in students is essential in learning and application of mathematics. The purpose of this study is to investigate the mathematics process skills of the students at the middle school level. The design adopted in this study was a descriptive research design. Twelve schools were randomly selected from four townships of four districts from Yangon Region. In order to obtain the require data, (600) students were requested to participate in this study. A mathematics process skills test was used as an instrument. It consists of five main parts: problem solving, reasoning, communication, connection, and representation. Each part consists of (10) multiple choice items. Students' answer sheets were scored manually, each correct answer was scored one mark while a wrong answer was scored zero. Mean, standard deviation, and Pearson product-moment correlation were calculated to analyze the data. The research findings indicated that most of the students possessed moderate level of mathematics process skills. Communication skill was the highest among the students and connection skill was the lowest among the students. Furthermore, there were significant positive relationships among five mathematics process skills.

Keywords: mathematics, mathematics process skills, problem solving, reasoning, communication, connection, representation

Introduction

Today society requires individuals who are able to think critically about complex issues, analyze and adapt to new situations, solve problem of various kinds and communicate effectively. The study of mathematics can equip individuals with knowledge, skills and habits of mind that are essential for successful and rewarding participation in such a society. Mathematical problem solving, reasoning, communication, connection and representation are more important than the ability to answer familiar textbook questions because it comes to developing mathematical skills in everyday life.

1. Senior Assistant Teacher, BEBHS – 10 mile, Kawthaung
2. Dr. Lecturer, Department of Methodology, Yangon University of Education

Mathematics today requires the ability to think mathematically, to solve new problems and to learn new mathematics ideas that are beyond the textbook. The aim of mathematics education is to encourage students to apply mathematical knowledge and skills in everyday life situations(MOE, 2009). Learners must have mathematical process skills such as problem solving, reasoning, communication, connection, and representation in order to apply, combine and adapt their mathematical knowledge to new situations in their life and work. Therefore, this study is intended to investigate the mathematics process skills of students at the middle school level in Myanmar.

Statement of the Problem

The current mathematics teaching in schools has traditionally emphasized on repetition, drill, and convergent right answer thinking. Most of the times, teachers do not emphasize on the mathematical understanding and the development of mathematics process skills of the students. Students are rarely asked to construct their own understanding. There is a little work or activity to apply mathematics in students' real life situation. Thus, students' learning is facing with difficulties and poor mathematics performance usually occurs in schools. This is one of the real problems of the mathematics classrooms today.

Purposes of the Study

The main purpose of this study is to investigate the mathematics process skills of students at the middle school level. The specific purposes of the study are:

- to investigate the students' mathematics process skills(problem solving, reasoning, communication, connection, and representation) in mathematics,
- to examine the highest and the lowest process skills among the students, and
- to explore the relationships among mathematics process skills of the students.

Research Questions

The research questions are as follows.

Q_1: To what extent do the students possess mathematics process skills(problem solving, reasoning, communication, connection, and representation)in mathematics?

Q_2: Which process skills are the highest and the lowest among the students?

Q_3: Is there any significant relationship among mathematics process skills of the students?

Scope of the Study

This research has its own particular limitations. The first limitation is related to the participants of the study who came from only Yangon Region. Participants in this study were Grade Eight students from the twelve selected schools in the academic year (2016- 2017). The second limitation is that this study is only concerned with the National Council of Teachers of Mathematics' mathematics process skills (problem solving, reasoning, communication, connection and representation) of the students. The third limitation is the content area of the subject. The content area is limited to eleven chapters from mathematics textbook volume I and three chapters from mathematics textbook volume II to measure students' mathematics process skills.

Definition of Key Terms

Mathematics

Mathematics is a way to settle in the mind of children a habit of reasoning (Lockee, n.d, cited in Mishra, 2009).

Mathematics Process Skills

Mathematics process skills are defined as the skills that can be acquired through the processes of problem solving, reasoning and proof, connection, communication and representation (National Council of Teachers of Mathematics, 2000).

Significance of the Study

Mathematics is a powerful tool for learning other subjects and solving daily life problems. Mathematics equips students with concise and powerful means of communication. Mathematical structures, operations, process and language provide students with a framework and tools for reasoning, justifying conclusion and expressing ideas clearly. Students must have mathematics process skills, if they want to understand mathematics deeply.

Carpenter et al. (1981, cited in Bergeson, 2000) expressed that mathematical problem solving skill was central to mathematics learning. Students need to acquire ways of thinking, habits of persistence and curiosity and confidence to solve unfamiliar problems, problems requiring multi-steps, or problems with extraneous information. Thus, teaching for problem solving and learning problem solving skill become the primary and important concerns of the teacher and the learners.

Lockee (n.d, cited in Mishra, 2009) expressed that mathematics was a way to settle in the mind of learners a habit of reasoning. Complete mathematical understanding includes the engaging process of thinking and reasoning. There is a need for the teachers to help students become more aware of and take more control their own thinking in order to produce more skillful mathematician.

Communication both orally and in writing in mathematics classroom helps students understand mathematical concepts deeply. Hulukati (2005, cited in Alhaddad et al., 2015) stated that if students are not able to communicate properly and interpret mathematical problems and concepts, they cannot solve the problem well. Thus, creating opportunities to develop students' mathematical communication skill is needed in today mathematics classroom.

Anthony and Walshaw (2009) pointed out that to make sense of a new concept or skill, students needed to be able to connect it to their existing mathematical understandings, in a variety of ways. Some students see mathematics as an isolated subject and encounter difficulties in making sense of new mathematical concepts and ideas due to the lack of connection skill.

So, there is a need for students to have mathematical connection skill in order to connect and apply mathematics in everyday contexts.

Today, students are facing with difficulties in solving word problems. They cannot represent the problem statement with mathematical language or symbols because of the lack of mathematical representation skill. Lesser and Tchoshanov (2005) stated that students' representation skill effected on the understanding of mathematical concept. Therefore, mathematics teachers need to consider and use the most effective teaching methods to develop students' representation skill.

The lack of mathematics process skills might cause the most difficulties among students while solving unfamiliar problems. Myanmar students are also facing this kind of problems. Thus, teaching of mathematics should be based on process oriented approach. Creating of a classroom atmosphere where students are encouraged to use a variety of tools to reason, make connections, solve problems and communicate ideas should be the goal of every mathematics teachers.

According to the facts mentioned above, it is necessary to study mathematics process skills of the students and to give suggestions for the teachers to foster effective mathematics instruction and to improve mathematics performance of the students.

Theoretical Framework

Mathematics Education

Mathematics education is a critical component of the 21st century literacy because it is used extensively in science and technology. It can be described as a filter in the educational pipe-line, blocking the advancement of many individuals who have an interest in science and engineering but who lack the requisite mathematical skills. Grouws and Cebulla (2000) stated that if students were to compete effectively in a global, technologically oriented society, they must be taught the mathematical skills needed to do so. The prosperity of man and his advancement have depended considerably upon the advancement of mathematics. According to the above perspectives, mathematics education can be regarded as the important aspect in the person life.

Mathematics Reform Movement

Before the twentieth century, mathematics education was mainly textbook-based and dominated by rote recitation of factual information. In drawing of a technological advanced society, there was a call for changes in mathematics education. Basic to the reform movement was a standards-based approach to mathematics teaching. Standards-based instruction in mathematics is an instruction with a clear identification of what students should learn at each level. The driving force behind the standards-based approach to mathematics instruction has been the standards developed by the National Council of Teachers of Mathematics in 2000.Standards provide more than a curriculum framework as they describe the skills, concepts and knowledge that are to be mastered (Education Alliance, 2006).

Mathematics Process Skills/Standards

Mathematics process skills/standards are the basis of the functional skills standards for mathematics and apply at all levels. The National Council of Teachers of Mathematics, (NCTM) (1980, cited in Krawee, 2010) pointed out that in the existing mathematics curriculum, mathematics competence was erroneously tried to foundational computation skills and it called for a shift in focus to problem analysis and interpretation. Members of NCTM recognized the need to link mathematics instruction to the increasing requirements of the society. In 2000, NCTM proposed five process standards that should be incorporated into the mathematics curriculum at every grade level. They are:

- problem solving,
- reasoning and proof,
- communication,
- connections, and
- representation.

The process standards refer to the mathematical process through which students should acquire and use mathematical knowledge. To teach in a way that reflects these process standards is one of the best definitions of what it means to teach according to the standards.

(i) Problem Solving

Problem solving is an integral part of all mathematics learning. Polya (1966, cited in Mishra, 2009) asserted that the central activity of all teaching of mathematics is the development of problem solving skill in students. Effective problem solvers constantly monitor and adjust what they are doing. They make sure to understand the problem and plan frequently, periodically taking stock of their progress to see whether they seem to be on the right track.

(ii) Reasoning

Mathematics is the science of logical reasoning. Reasoning skillis crucial to one's success in the modern world, where making rational decisions is increasingly becoming a part of everyday life. According to Mishra (2009), reasoning mathematically is a habit of mind, and is developed through consistent use in many contexts. Systematic reasoning is a defining feature of mathematics. It is found in all content areas of mathematics with different degrees of rigor at all grade levels.

(iii) Communication

Communication is the process of expressing mathematical ideas and understandings orally, visually, and in writing, using numbers, symbols, pictures, graphs, diagrams, and words. Lomibao et al. (2016) defined the communicating skills as the ability of the students to express their ideas, describe, and discuss mathematical concepts coherently and clearly. Communication process also helps students to develop a language for expressing mathematical ideas and an appreciation for the need for precision in that language.

(v) Connection

Mathematical ideas are interconnected and built on one another to produce a coherent whole. Viewing mathematics as a whole highlights the need for studying and thinking about the connections within the discipline. Singapore Ministry of Education (2012) defined connection as the ability to see and linkages among mathematical ideas, between mathematics and other subject, and between mathematics and everyday life. This helps students make sense of what they learn in mathematics. Students should learn mathematics with understanding, actively building new knowledge from experience.

(vi) Representation

The term representation refers to the use of symbols, charts, graphs, models, manipulative, and diagrams as powerful methods of expressing mathematical ideas and relationships. Representing applies to externally observable processes and products as well as to those that occur internally in the minds of students as they are doing mathematics. When students have access to mathematical representations and the ideas they represent, they have a set of tools that significantly expand their capacity to think mathematically (Van de Walleet al.,2010).

Research Method

Research Design

A quantitative research method was used in this study. The research design used in this study was a descriptive research design.

Instrument

A mathematics process skills test was constructed for this study. This test consists of five main parts: problem solving skill, reasoning skill, communication skill, connection skill, and representation skill. Each part consists of (10) multiple choice items. It was based on the content areas of Grade Eight mathematics textbook prescribed by the Department of Educational Planning and Training. This test included (14) chapters: (11) chapters from mathematics textbook volume I and (3) chapters from mathematics textbook volume II. The test items were prepared according to NCTM's process standards (National Council of Teachers of Mathematics, 2000) and mainly based on New Jersey Assessment of Skills and Knowledge (New Jersey Department of Education, 2006).

After preparing the instrument, in order to get validation, an expert review was conducted by five experts in the field of teaching of mathematics from the Department of Methodology, Yangon University of Education. Since, ambiguities were found in the responses, necessary changes were made in the original test after consulting with the experts.

Pilot Testing

A pilot testing was done with a sample of sixty Grade Eight students in No. (1), Basic Education High School in Thingangyun. To measure the reliability of this test, the Cronbach's Alpha was calculated. According to the pilot study, the internal consistency (Cronbach's Alpha) for the students' mathematics process skilltest was (.721).

Population and Sample Size

This study was conducted in Yangon Region. The sample schools for this study were selected by using a stratified random sampling method from Yangon Region. Two high schools and one middle school were selected from each district. Therefore, eight high schools and four middle schools were included in this study. Fifty Grade Eight students from each selected school were selected as the samples. There were (600) participants in this study. Table (1) shows the number of population and sample size of the selected schools.

Table 1: Population and Sample Size

No.	District	Township	School	No. of Student	
				Population	Subject
1	East	South Dagon	BEHS 2	320	50
2			BEHS 6	423	50
3			BEMS 3	157	50
4	West	Hlaing	BEHS 1	163	50
5			BEHS 4	145	50
6			BEMS 8	96	50
7	South	Thanlyin	BEHS 1	435	50
8			BEHS 2	326	50
9			BEMS Bogyoke	75	50
10	North	Mingaladon	BEHS 3	426	50
11			BEHS (Branch) Htaukkyant	125	50
12			BEMS 7	168	50
Total				**2999**	**600**

Note: BEHS= Basic Education High School
BEMS= Basic Education Middle School

Data Collection

The modified instrument was distributed to all participants of the twelve sample schools with the help of the headmaster/headmistress of those schools in January, 2017.

Data Analysis

After four weeks, all the participants' answer sheets were gathered and their answer sheets were scored according to the marking scheme. Each correct answer was scored one mark while a wrong answer was scored zero. The data were analyzed by using descriptive statistics. In order to know the level of students' mathematics process skills, mean, standard deviation, and percentage were calculated. To examine the relationships among mathematics process skills, Pearson product-moment correlation was calculated.

Research Findings

Students' Level of Five Mathematics Process Skills

Based on the mathematics process skill test scores, students' mathematics process skills levels were divided into three groups: low, moderate, and high. Students with scores above the (+1) standard deviation from the sample mean were identified as high group and students with scores below the (-1) standard deviation from the sample mean were considered as low group. Then, the students with the scores between (+1) and (-1) standard deviation from the sample mean were identified as average group. In order to assess the students' levels of five mathematics process skills, the percentage of these three levels were described in Table (2).

Table 2: Students' Level of Five Mathematics Process Skills

Level	Percent (%)					
	Problem Solving Skill	Reasoning Skill	Communication Skill	Connection Skill	Representation skill	Mathematics Process Skills
Low	22.8	11.3	10.0	15.2	11.0	16.7
Moderate	56.9	71.0	77.1	69.0	68.5	64.9
High	20.3	17.7	12.9	15.8	20.5	18.4

According to the above table, it can be interpreted that most students have moderate level of abilities to solve mathematical problems, to reason mathematically, to communicate mathematical thinking, to connect mathematical concepts and ideas, and to represent mathematical ideas with mathematical symbols, graphs, charts or figures.

Comparison of Five Mathematics Process Skills of the Students

Table (3) shows the comparison of the means for the students' problem solving skill, reasoning skill, connection skill, communication skill and representation skill. The mean of communication skill (6.13) was the highest among five process skills. The mean of connection skill (4.57) was the lowest among five process skills. It can be said that communication skill is the highest and connection skill is the lowest among the students.

Table 3: Comparison of the Means of Five Mathematics Process Skills

Type of Mathematics Process Skill	N	Mean	Standard Deviation
Problem Solving Skill	600	5.37	2.24
Reasoning Skill	600	5.08	2.19
Communication Skill	600	**6.13**	2.03
Connection Skill	600	**4.57**	2.03
Representation Skill	600	5.89	1.93

Relationships among the Mathematics Process Skills of the Students

The Pearson product-moment correlation was used to determine the interrelationships among five mathematics process skills (see Table 4). According to Gay and Airasian (2003), the correlation coefficient below plus or minus .35 was interpreted as low or no relation, the correlation coefficient between plus or minus .35 and .65 was interpreted as moderate relation and the correlation coefficient higher than plus or minus .65 was interpreted as high relation.

Table 4: Correlations among the Mathematics Process Skills of the Students

Correlation					
	MPS1	**MPS2**	**MPS3**	**MPS4**	**MPS5**
Problem Solving Skill (MPS1)	1	.465**	.477**	.284**	.359**
Reasoning Skill (MPS2)		1	.538**	.412**	.477**
Communication Skill (MPS3)			1	.488**	.441**
Connection Skill (MPS4)				1	.414**
Representation Skill (MPS5)					1

Note: **. Correlation is significant at the .01 level (2-tailed).
MPS = Mathematics Process Skill

The correlation between the problem solving skill and the connection skill shows a significance but low correlation (r = .284, p = .01). There were also significant positively moderate relationships among other mathematics process skills. It can be said that there were significant correlations among the mathematics process skills of the students. The direction of the correlations was positive. This means that if one of the mathematics process skills is high, the other process skills are likely to be high or if one of the mathematics process skills is low, the other process skills are likely to be low.

Discussion, Suggestions, and Conclusion

Discussion

Mathematics is an absolutely critical part of everyday life in this technologically advanced society. It equips individuals with knowledge and skills required for successful participation in such a society. The aims of teaching mathematics are to link school to everyday life, to provide skill acquisition, to prepare students for workforce and to foster mathematical thinking. As having mathematics knowledge increasingly becomes a critical component of success in the jobs of the future, everyone needs to have a profound level of mathematical knowledge and skills. Therefore, current mathematics teaching needs to provide students with the development of the understanding of mathematical knowledge together with the acquisition of mathematics process skills.

It was found that 16.70% of the students possessed low level of mathematics process skills, 64.90% of the students possessed moderate level of mathematics process skills, and 18.40% of the students possessed high level of mathematics process skills. It can be concluded that most students had moderate level of mathematics process skills. So, this finding revealed the answer of the first research question: To what extent do the students possess mathematics process skills in mathematics? Moreover, this finding points out that most students have average level of ability to solve mathematical problems, to reason mathematically, to communicate mathematical ideas, to connect mathematical concepts, and to represent mathematical ideas and concepts. Therefore, mathematics teachers need to be conscious of their students' mathematics process skills and look for the best ways and means to improve these skills.

By comparing the means of students' mathematics process skills, it was found that communication skill was the highest and connection skill was the lowest among the students. Students got moderate level in both problem solving skill and representation skill, and fairly low in reasoning skill. This finding revealed the answer of the second research question: Which process skills are the highest and lowest among the students? Moreover, this finding points out that most students are poor in connecting skill.

It was found that there were significant relationships among mathematics process skills. The direction of correlation was positive. It means that if one of these skills is high, the others will also be high and if one of these skills is low, the others will also be low. Moreover, reasoning and communicating skills had strong links to all the other processes skills. So, these findings revealed the answer of the third research question: Is there any significant relationship among mathematics process skills? Thus, mathematics teachers should be aware of the fact that mathematics process skills are interrelated, and they should emphasize the process rather than the product.

Suggestions

In a technologically advanced society, there is a call for changes in mathematics education. The current mathematics teaching needs to alter from product oriented approach emphasizing convergent right answer thinking to process oriented approach emphasizing problem solving, reasoning, mathematical communication, connection, and representation. According to the above research findings, most students have moderate level of mathematics process skills. But mathematics teachers should not be satisfied with this level, they should always try to improve their students' mathematics process skills. Moreover, mathematics teachers are responsible for creating learning experiences that can foster these mathematical processes and for promoting students' mathematics process skills. Some suggestions for the development of each mathematics process skill are presented as follows.

(1) Problem Solving Skill: For the development of students' problem solving skill, teachers should model how to select and use relevant problem solving strategies and procedures to help students develop and extend a repertoire of strategies so that they can apply when solving various kinds of problems. It is necessary for the students to get ongoing and continuous opportunities to work on interesting and rich mathematical problems. Teachers should give up some of their control over mathematical activity and allow students to initiate their own strategies to solve problems and grapple with contradictions.

(2) Reasoning Skill: For the development of students' reasoning skill, mathematics classroom should be an atmosphere of acceptance for all students' thinking. Teachers should allow students to think freely and should provide opportunities to express their thinking freely in the classroom. Teachers should ask the student to elevate thinking beyond the evidence to make a generalization. Teachers should guide students' reasoning toward the accepted view through carefully guided questions, and engage them in self-evaluation, and reflection. They should let students practice with mental computation and estimation to encourage students to think more deeply.

(3) Communication Skill: To improve their mathematical communication skill, students need to work with mathematical tasks that are worthwhile topics of discussion. Teachers should model proper use of symbols and vocabulary in oral and written form, encourage students to use new mathematical vocabulary, provide feedback to students on their use of terminology, and ask them extended questions and encourage them to ask themselves similar kinds of question. Teachers should arrange mathematics classrooms in such a way that students are able to become part of a community of learners who respect each other's ideas and can work together to reflect, think out difficult problems, and analyze their work.

(4) Connection Skill: For the development of students' connection skill, it is necessary for teachers to make reform in their teaching in which students can make connections between various mathematical concepts or procedures, mathematics concepts and life situations, and relate mathematics to other subjects. They should use contextual teaching and learning approach as learning occurs within the context that is personally relevant and with which students have had prior experience. They should use assessment strategies that focus on conceptual understanding rather than on right answers.

(5) Representation Skill: In order to foster students' oral and written representation skills, teachers should use multiple representations in classroom teaching. In mathematical representational teaching, teachers should encourage students to express their own ideas in mathematical language and explain and describe the mathematical problems by reasonable representational models. To improve their representation skill, students should try to select appropriate representation to express their understanding, represent mathematical word problems into simple mathematical language and symbols and use multiple representations as required.

To ensure that students make progress in developing mathematics process skills and can function mathematically, teachers should create classroom environment with the opportunities for students to apply and adapt a variety of appropriate strategies to solve problems, to make and investigate mathematical conjectures, to discuss their thinking as well as evaluate thinking and strategies of other students, to construct mathematical ideas through connecting their previous ideas, and to create and use multiple representation in expressing mathematical ideas. Modern active teaching methods should be applied so as to have effective teaching-learning process. It is also advisable to the teacher to use formative evaluation while teaching mathematics to measure the students' mathematics process skills.

In addition, this research study was conducted to contribute to the development of students' mathematics process skills at the middle school level. However, this study is not entirely perfect, because there were some limitations. In this study mathematics process skills of the students at the middle school level were investigated. Further studies are needed to carry out students' mathematics process skills at other various school levels, and in other regions and states for replication. And, the additional studies are also needed to explore a list of specific behaviors for each of the five process skills and specific teaching strategies that could be used to teach these process skills in the mathematics classroom.

Conclusion

Today's changing society calls for transferring mathematical knowledge and skills gained in schools to real life situations. However, students do not have the adequate level of mathematical knowledge and skills to function effectively in such a society. When thinking of the basic reasons behind these problems, it is especially the poor mathematic process skills that might cause the most problems among students.

In the light of research findings, it was found that most students have moderate level of mathematics process skills involving problem solving skill, reasoning skill, communication skill, connection skill, and representation skill. This is probably due to the lack of instructional time, the preparation for the examinations, their firmly rooted habits of memorizing, and their mental inertia due to years of mechanical work. In view of the conditions in schools, the entire atmosphere of some schools is so opposed to the true mathematical spirit that true teaching and true learning of the subject are almost impossible.

Learning mathematics with understanding is thought to occur best in situations in which learners are expected to solve problems, reason, communicate their ideas, connect mathematical ideas and represent these ideas. Teachers should emphasize these processes during teaching mathematics in the classroom. They should consider the best teaching techniques to improve students' mathematics process skills and to foster students' better mathematical understanding.

Finally, it is hoped that through this study, mathematics teachers will realize that their students need to improve in mathematics process skills and their instructional approaches need to be changed to improve the students' mathematics process skills. Although this study cannot fulfill all the aims of teaching mathematics in the middle schools, it can be hoped to some extent to foster the quality mathematics education in Myanmar. It is also expected that this research work, in a way, will help mathematics teachers towards a better understanding of the teaching and learning aspects of mathematics education.

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Appendix

Mathematics Process Skills Test

t|rwef; ausmif;om;?olrsm;\
ocFsmbmom&yfqdkif&mpGrf;&nfrsm;ppfaq;vTm

cGifhjyKcsdef (1) em&D

nTefMum;csuf/

atmufygar;cGef;rsm;udkzwf&IírSe fuefaomtajzudka&G;cs,fyg/

tydkif; (u)

jyóemajz½Sif;EdkifrIpGrf;&nf (Problem Solving Skill)

1. $\sqrt[3]{\frac{-125}{8\times10^3}}$ udk ajz½Sif;aomf -

A. $-\frac{1}{4}$ B. -4 C. $\frac{1}{4}$ D. 4 &onf/

2. $\frac{x-3y}{x}=7$ jzpfvQif $\frac{x}{y}$ \tajzrSm -

A. $-\frac{8}{3}$ B. -2 C. $-\frac{1}{2}$ D. 2 jzpfonf/

3. $\frac{x-1}{2}-\frac{x-2}{3}=\frac{1-6x}{6}$ jzpfvQif x \wefzdk;rSm -

A. 0 B. 1 C. 2 D. 3 jzpfonf/

4. vkyfom;ESpfa,mufonfvkyftm;caiG126usyfudk4 : 5jzifhcGJa0,lMu&m ¤if;wdkY\ vkyftm;aiGrsm; jcm;em;jcif;rSm - A. 24 usyf B. 34 usyf C. 14 usyf D. 30usyf jzpfonf/

5. $x + y = 5$ ESifh $x - y = 1$ nDrQjcif; ESpfckpvHk;udk ajyvnfapaom x ESifh y \

wefzdk;rSm – A. $x = 3,\ y = 2$ B. $x = 2,\ y = 3$C. $x = 1,\ y = 4$ D. $x = 2,\ y = 1$ jzpfonf/

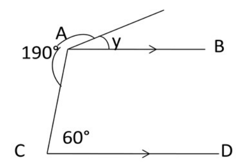
6. P $=\{x / x^2 + x - 6 = 0$ESifh$x^2 - 9 = 0\}$ jzpfvQif PtpkrSm –

A. { -3, 3, -2} B. { 3} C. { 2, -3, 3} D. { -2, 3}jzpfonf/

7. $2011_{\text{three}} - 1201_{\text{three}}$ \wefzdk;rSm –

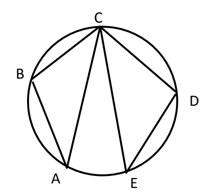
A. 210_{three} B. 110_{three} C. 120_{three} D. 220_{three} jzpfonf/

8. yHkwGify\wefzdk;rSm –



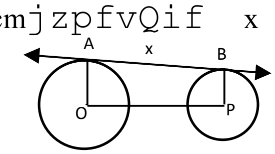
A. 50° B. 100° C. 120° D. 140°jzpfonf/

9. yHkwGif$\angle ABC = 115°$, $\angle CDE = 118°$ jzpfvQif $\angle ACE$ \wefzdk;rSm –



A. 63° B. 53° C. 52° D. 65°jzpfonf/

10. yHkwGif OA – PB = 10cm, OP = 26cmjzpfvQif x \wefzdk;rSm–



A. 16 B. 24 C. 12 D. 15jzpfonf/

tydkif; (c)

pOf;pm;awG;ac:EdkifrIpGrf;&nf (Reasoning Skill)

1. atmufygwdkYteufazmfjycsufftrSefonf –

A. $a^{-3} + a^{-3} = a^{-6}$ B. $a^{4} \div a^{6} = a^{2}$C. $a^{4} \div a^{6} = a^{-2}$D.$a^{3} \times a^{-2} = a^{5}$jzpfonf/

2. nDrQjcif; $y = -x$ *&yfay:wGif ½SdaomtrSwfrSm –

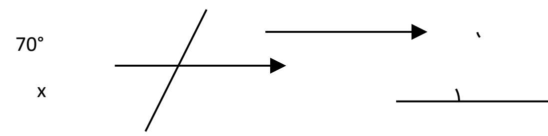
A.(1, 1) B. (-2, -2) C. (3, -3) D. (2, -3)jzpfonf/

3. $P \cup Q = \{x, y, z, u, v\}$, $P \cap Q = \{z, u\}$, $P \setminus Q = \{x, v\}$jzpfvQif $Q \setminus P$ \tajzrSm- A. $\{y, z, u\}$ B. $\{y\}$ C. $\{x, u, u, v\}$ D. $\emptyset$ jzpfonf/

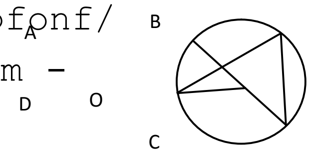
4. udef;pOf 2, 1, 3, 2, 4, …, 5, 4 wGifcsefvSyfxm;aom uGufvyfü jznfh&rnfhudef;rSm- A.3 B. 4 C. 5 D.6jzpfonf/

5. udef;pOf1, 9, 25, 49, …\ nMudrfajrmufudef;rSm –

A.$(2n+1)^2$ B. $(2n-1)^2$ C. $(2n)^2$ D.$(n)^2$jzpfonf/

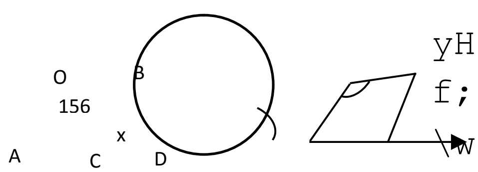
6. yHkwGifx -20\wefzdk;rSm – 

A. 70° B. 50° C. 110° D. 90°jzpfonf/

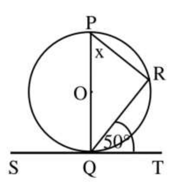
7. yHkwGifOonfpuf0dkif;\ A[dkjzpfonf/ 

$\angle AOD = 50$ jzpfvQif$\angle CBD$\wefzdk;rSm –

A. 40° B. 130° C. 65° D. 46°jzpfonf/

8. 

yHkwGifOonfpuf0dkif;\ A[dkjzpfvQif x \wefzdk;rSm – A. 156° B. 24° C. 78° D. 102°jzpfonf/

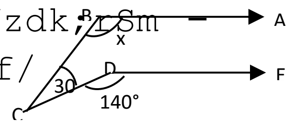
9. 

yHkwGif O onfpuf0dkif;\A[dk? PQ onf tcsif;rsOf;jzpfvQif x \wefzdk;rSm -

A. 40° B. 50° C. 80° D. 100° jzpfonf/

10. yHkwGif BA // DE jzpfvQif x \wefzdk;rSm -

A. 170° B. 120° C. 130° D. 110°jzpfonf/



tydkif; (*)

ajymqdkqufoG,fEdkifrIpGrf;&nf(Communication Skill)

1. 107, 792wGifrsOf;om;xm;aom7\ ae&mvdkufwefzdk;rSm-

A. rsOf;rom;xm;aom 7 \ ae&mvdkufwefzdk;atmuf 10 q avsmhenf;onf/

B. rsOf;rom;xm;aom 7 \ ae&mvdkufwefzdk;atmuf100 q avsmhenf;onf/

C. rsOf;rom;xm;aom 7 \ ae&mvdkufwefzdk;xuf10 q ydkrsm;onf/

D. rsOf;rom;xm;aom 7 \ ae&mvdkufwefzdk;xuf100 q ydkrsm;onf/

2. udef;wpfckESifh ¤if;\ vSefudef;aygif;v'fonf$\frac{29}{10}$jzpfonf/ ¤if;udknDrQjcif;jzifh azmfjyaomf - A. $x+\frac{1}{x}= \frac{29}{10}$ B. $x+\left(\frac{-1}{x}\right)= \frac{29}{10}$

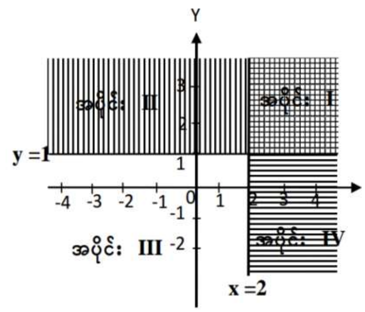
C. $x+(-x) = \frac{29}{10}$ D. $x+\frac{1}{x^2} = \frac{29}{10}$[ka&;Ekdifonf/

3. p \$\frac{1}{4}$onf q \ 3qatmuf 4 avsmhenf;\/ ¤if;udknDrQjcif;jzifhazmfjyaomf -

A. $\frac{1}{4}p = 4 - 3q$ B. $\frac{1}{4}p = 4 + 3q$ C. $\frac{1}{4}p = 3q - 4$ D. $\frac{1}{4}p = 3q + 4$

[ka&;Ekdifonf/

4. yHkwGif $x > 2$ ESifh $y > 1$ udk wpfjydKifeuf ajyvnf apaom tajzonf- A. tydkif; I B. tydkif; II C. tydkif; III D. tydkif; IV wGifusa&mufonf/



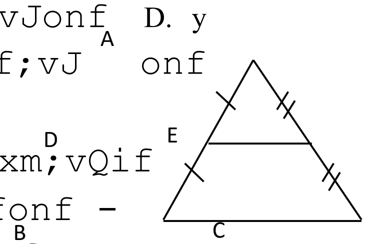
5. ykpäm $12 + 3 = 21$ udktajcpepf -

A. ESpf B.av; C.ig; D.wpfq,f jzifhwGufxm;onf/

6. ajymif;vJjcif; $y \propto x^2$ udkpmom;jzifhazmfjyygu-

A. y onf x ESifhwdkuf½dkufajymif;vJonf B. y onf x^2ESifh wdkuf½dkufajymif;vJ onf C. y onf x ESifh ajymif;jyefajymif;vJonf D. y onf x^2ESifh ajymif;jyefajymif;vJ onf [ka&;Edkifonf/

7. yHkwGif AD = DB ESifhh AE = EC [kay;xm;vQif atmufygwdkYteufazmfjycsuftrSeffonf -



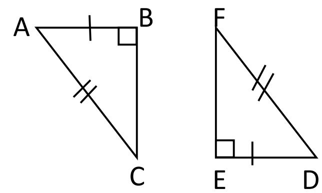
A. DE onf BC \ESpfq B. DE onf BC\wpf0uf

C. DE onf BC\oHk;q D. DE onf BC\oHk;yHkwpfyHkjzpfonf/

8. trSwfwpfckü qHkaomaxmifhrsm;\yrmPrsm;tm;

vHk;aygif;onf -
A.axmifhrSef2ckB.axmifhrSef3ckC.axmifhrSef4 ckD.axmifhrSef5ckESifhnDonf/

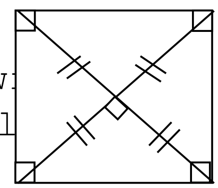
9. Δ ABCESifhΔ DEFwdkYonf–



A. ESpfem;Mum;axmifhnD
B. ESpfaxmifhESifhvdkufzu ftem;wpfem;nD
C. axmifhrSefcHtem;ESifht jcm;tem;wpfzufnD
D. tem;oHk;em;nD

rSefuefcsuft&xyfwlnDMu onf/

10. yHkwGifaxmifhjzwfrsOf;rsm;onf



A. wpfckudkwpfck xuf0ufydkif;jzw
B. xyfwl wpfckudkwpfckxuf0ufydkif;jzwf\/
C. wpfckudkwpfckaxmifhrSefusvsufxuf0ufydk if;jzwf\/
D. xyfwlnDjyD; wpfckudkwpfckaxmifhrSefusvsuf xuf0ufydkif;jzwf\/

tydkif; (C)

csdwfquffEdkifrIpGrf;&nf(Connection Skill)

1. u, v, w wdkYonfudef;ppfoHk;vHk;jzpfjyD; $u<v$, $w < 0$jzpfvQif

A. $u + w > v + w$ B. $u - w > v - w$ C. $u\ w > v\ w$ D. $u\ w < v\ w$

jzpfonf/

2. axmifhrSefpwk*Hwpfck\ tvsm;onf3 $^{k+2}$ cm ?teHonf$\sqrt{3}$ cmjzpfí{&d,mrSm81 cm^{2}jzpfvQifk \wefzdk;rSm -

A.$\frac{3}{2}$ B.$\frac{5}{2}$ C.$\frac{2}{3}$ D.$\frac{9}{2}$ jzpfonf/

3. ocFsmtpm;ykpämwpfyk'fwGifwnfudef; =D, pm;udef;=d, pm;v'f=Q ESifh tMuGif; R jzpfvQifwnfudef;udk&Sm&efyHkaoenf;rSm -

A. D = dQ - R B. D = dQ + R C. D = dR + Q D. D = RQ + d jzpfonf/

4. axmifhrSefMwd*Hwpfck\ tem;rsm;onfn , n + 1 , n + 2toD;oD; jzpfMuvQifn\wefzdk;rSm -

A.1 B. 2 C. 3 D.4jzpfonf/

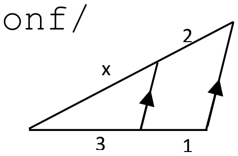
5. udef;wpfckwGif¤if;\20 %udkaygif;aomf42&½Sd\/ ¤if;udef;rSm -

A.22 B. 42 C. 35 D.7jzpfonf/

6. pwk*Hwpfck\axmifh 4 ck\tcsdK;rsm;rSm 1: 2: 3: 4 jzpfvQiftMuD;qHk;axmifhrSm -

A. 30° B. 144° C. 90° D. 108°jzpfonf/

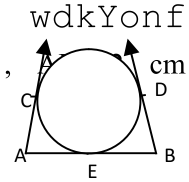
7. yHkygay;xm;csuft&xonf -



A.3 B. 2 C. 4 D. 6jzpfonf/

8. axmifhrSefMwd*HwpfckwGif axmifhusOf;ESpfck\ yrmPudk 4x ESifh 5x [kay;xm;vQif x onf - A. 20° B. 18° C. 14° D. 10°ESifhnDonf/

9. yHkwGif AC, AB ESifh BD wdkYonf 0ef;xdrsOf;rsm;jzpfMujyD;AC=5 cm , A [illegible] cm jzpfvQif BD onf -



A.10 cm B. 7 cm C. 17 cm D. 8cmjzpfonf/

10. tajc 2 ½Sdaom udef;pepfwGif
A. 10 two = 2 ten B. 10 two = 3 ten C. 10 two = 4 ten D. 10 two = 5 ten
jzpfonf/

tydkif; (i)
udk,fpm;jyKEdkifrIpGrf;&nf (Representation Skill)

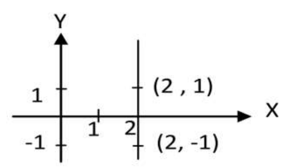
1. pHkudef;wpfckudk -
A. 2n+1 B. 2n-1 C. 2n D. n
jzifhazmfjyEdkifonf/

2. &m*Pef;on fa? q,f*Pef;onf b? ck*Pef;onf c jzpfvQifxdkudef;rSm -
A. 100 a + 10b + c B. 100 a + 10c + b C. 100 c + 10b + a
D. 100 b + 10a + c jzpfonf/

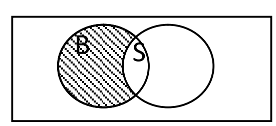
3. A \toufonf x ESpfjzpfjyD; A onf B \toufxuf 4 ESpfMuD;aomf B \ touf udk– A. x + 4 B. x - 4
C. 4x D. $\frac{x}{4}$ jzifh azmfjyEdkif onf/

4. wpfem&Da&pD;EIef;=xrdkif? wpfem&DavSavSmfEIef; =y rdkifjzpfvQifa&pkefoGm;EIef;udk -
A. x y B. $\frac{x}{y}$ C. x - y D. x + y jzifhazmfjyEdkifonf/

5. yHkwGifqGJxm;aomrsOf;ajzmifh onf
A. y = 2 B. y = 1 C. x = 1 D. x = 2
*&yfjzpfonf/



6. yHkwGifjc,frIef;xm;aomtydkif;onf
A. A ∩ B B. A ∪ B
C. A \ B D. B \ Ajzpfonf/



7. udef;pOf 2, 5, 8, 11, … \n Mudrfajrmufudef;rSm

A. 3n+2 B. 2n-1 C. 3n+1 D.3n-1 jzpfonf/

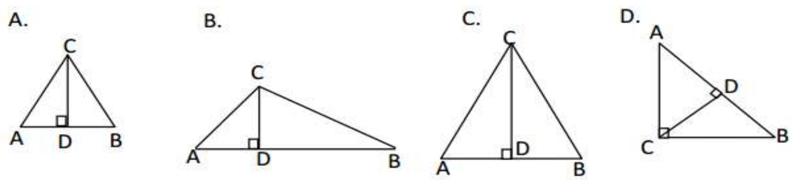
8.

x	1	2	3	4	5
y	120	60	40	30	24

txufygZ,m;t&ajymif;vJjcif; -

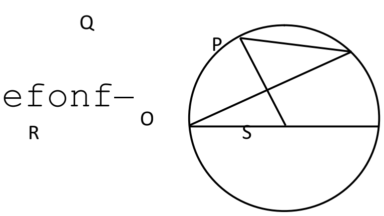
A. $y \propto x$ B. $y \propto \frac{1}{x}$ C. $y \propto x^2$ D. $y \propto \frac{1}{x^2}$ udk&onf/

9. ay;xm;csuf/ / Δ ABC onftem;rnDBwd*H, CD⊥ AB atmufygyHkrsm;teufay;xm;csufESifhudkufnDao myHkrSm



jzpfonf/

10. A[dk O ½Sdaompuf0dkif;wGif atmufygwdkYteufazmfjycsufftrSefonf–



A. ∠ ROQ = ∠ RPQ **B.** ∠ ROQ = 2∠ RPQ **C.** ∠OQP = ∠ PRS **D.** ∠ ROQ = 2∠ PRS jzpfonf/

Marking Scheme

Problem Solving Skill	Reasoning Skill	Communication Skill	Connection Skill	Representation Skill
1. A	1. C	1. A	1. C	1. C
2. C	2. C	2. A	2. A	2. A
3. A	3. B	3. C	3. B	3. B
4. C	4. A	4. A	4. C	4. D
5. A	5. B	5. B	5. C	5. D
6. C	6. B	6. B	6. B	6. C
7. B	7. C	7. B	7. D	7. D
8. A	8. C	8. C	8. D	8. B

9. B	9. B	9. D	9. B	9. B
10. B	10. D	10. D	10. A	10. B

(One mark for each item)

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THE CORRELATION BETWEEN MIDDLE SCHOOL STUDENTS' ATTITUDES AND ACHIEVEMENT IN MATHEMATICS

May Myat Moe Thein[1], Naing Naing Thein[2]

Abstract

The main purpose of this study is to study the correlation between middle school students' attitudes and achievement in mathematics. A quantitative research method was mainly used to study students' attitudes. A descriptive research design was adopted in this study that was conducted in Yangon Region. The sample schools for this study were selected randomly. Two high schools and one middle school were selected from each district, Yangon Region. Therefore, eight high schools and four middle schools were included in this study. There were (600) Grade Seven Students participated in this study. As instruments, an attitude questionnaire and an achievement test were used. For the reliability of instruments, a pilot testing with (50) Grade Seven students was conducted. The internal consistency (Cronbach's Alpha) of the students' attitudes questionnaire was (.725) and the students' achievement test was (.742). In this study, the data were analyzed by using the descriptive analysis techniques and Pearson product moment correlation. The research findings revealed that there were positive correlations between students' attitudes and their mathematics achievement (r = .705, p<.01), students' confidence in learning mathematics and students' mathematics achievement (r = .728, p < .01), effectance motivation in learning mathematics and students' mathematics achievement (r = .767, p< .01), mathematics usefulness and students' mathematics achievement (r = .786, p< .01) and the general perceptions about teaching and learning mathematics and the students' mathematics achievement (r = .641, p< .01). But there was a negative correlation between students' attitudes in terms of mathematics anxiety and their mathematics achievement (r = -.798, p< .01).

Keywords: Attitude, Mathematics, Mathematics Achievement, Confidence, Effectance Motivation

1. Junior Assistant Teacher, B.E.M.S (3) , South Dagon Township, Yangon
2. Lecture, Methodology Department, Yangon University of Education

Introduction

Mathematics is truly the gateway of engineering and all other scientific and technological fields. It is crucial not only for success in school, but in being an informed citizen, being productive in one's chosen carrier, and in personal fulfillment. An important goal of mathematics education is to develop individuals with a high level of mathematical proficiency which then supports future participation in employment and citizenship. Therefore, in order to achieve this goal, how to improve students' mathematics achievement is essential to think.

An early contribution in the study of attitudes towards mathematics was by Neale (1969, cited in Majeed, Darmawan & Lynch, 2013) who underlined that attitude plays a crucial role in learning mathematics and positive attitudes towards mathematics is thought to play an important role in causing students to learn mathematics. He claimed that there is a relationship between attitudes and achievement. Thus, attitudes towards mathematics play an essential role in the teaching and learning process of mathematics and that effect on students' achievement in mathematics. In order to teach mathematics effectively, mathematics teachers should keep in mind the importance of students' attitudes towards mathematics and cultivate positive attitudes among their students.

Statement of the Problem

According to Strengthening Mathematics and Science in Secondary Education (SMASSE) Project Report (1998, cited in Mutai, 2010), the reason for poor achievement in mathematics examination result from poor learning of the subject is likely to be due to attitudes towards the subject by the students.

Some of the reasons for poor in mathematics achievement are stated as follows.

- The students may lack confidence in learning mathematics.
- The students may have mathematics anxiety while they are learning mathematics.
- There may lack motivation that stimulates the students' desire for learning mathematics.

- The students do not understand how to apply mathematics in their everyday life and they do not know the usefulness of mathematics in their lives.

These reasons may affect the students' mathematics achievement and fall onto the students' attitudes towards mathematics. Therefore, how to promote the students' positive attitudes towards mathematics is a real problem for current mathematics classrooms in order to get high level of achievement in mathematics among the students.

Purposes of the Study

The main purpose of the study is to investigate the correlation between middle school students' attitudes and achievement in mathematics. The specific objectives are as follows:

- To examine the students' mathematics achievement.
- To investigate the students' attitudes towards mathematics.
- To study the relationship between students' attitudes and achievement in mathematics.

Research Questions

(1) To what extent do the students have the level of mathematics achievement?

(2) To what extent do the students possess the level of attitudes towards mathematics?

(3) Is there a relationship between the students' attitudes and achievement in mathematics?

Scope of the Study

This research has its own particular limitations. The first limitation is related to the fact that the participants of the study came from only twelve selected schools from Yangon Region. Eight basic education high schools and four basic education middle schools were included in this study. The second limitation is that this study is only concerned with the four scales of the Fennema-Sherman Attitude Scales. Fennema-Sherman Attitude Scales consist of (1) attitude towards success in mathematics scale, (2) mathematics as a male domain scale, (3) mother scale, (4) father scale, (5) teacher scale, (6) confidence in learning mathematics scale, (7) mathematics anxiety scale, (8) effectance motivation scale in mathematics and (9) mathematics usefulness scale. This study dealt with only four scales of Fennema-Sherman Attitude Scales (confidence in learning mathematics, mathematics anxiety, effectance motivational scale, usefulness of mathematics), and general perceptions about learning mathematics.

Definition of Key Terms

Attitude

Attitude is a mental and neutral state of readiness, organized through experience, exerting a directive and dynamic influence upon an individual's response to the objects and situations with which it is related (Allport, 1935).

Mathematics

Mathematics is the science that draws necessary conclusions (Benjamin, 1870, cited in Wikipedia, n.d.).

Mathematics Achievement

Mathematics achievement is the proficiency of performance in any or all mathematics skills usually designated by performance on a test (Thiessen & Blasius, 2008, cited in Abang, n.d.).

Significance of the Study

Zubair (2012) expressed that one of the chief objectives of education is the development of desirable attitudes in students. Attitude is a personality trait which indicates towards individual's likes or dislikes. Attitudes influence the way an individual behaves towards an object, institution or a person. Attitude towards a particular object is influenced by parents, teachers, school and society in which the individual lives. Therefore, the teacher must understand the various dimensions of an attitude. It is also kept in views that are required to develop several attitudes in the students, attitude towards studies, attitude towards self, attitude towards colleagues, attitude towards certain ideals and attitude towards subjects taught in schools (e.g. mathematics). Attitudes of a student are formed due to his experience and interaction with real situations.

Several studies have shown that positive attitudes are conducive to good performance. Michelli (2013) conducted a study deal with the relationship between attitudes and achievement in mathematics among fifth Grade students. This study was conducted to identify specifically how fifth Grade students' attitudes affect their achievement in mathematics. This study indicated that there is significant relationship between attitudes towards mathematics and achievement in mathematics. Therefore, the mathematics teachers should be aware of students' attitudes and seek to improve them in order to positively influence students' academic achievement.

Moreover, a research for studying the relationship between students' attitudes and achievement in mathematics is necessary.

Theoretical Framework

Importance of Mathematics

A person may belong to the lowest or the highest class of society, but he utilizes knowledge of mathematics in one form or another. Whoever earns and spends or uses mathematics; and there cannot be anybody who lives without earning and spending. Counting, notation, addition, subtraction, multiplication, division, weighing, measuring, selling, buying and many more are simple and fundamental processes of mathematics which have got an immense practical value in life. The knowledge and skill in these processes can be provided in an effective and systematic manner only by teaching mathematics in schools.

According to Mishra (2009), mathematics does not only help in developing and controlling the facilities of an individual, it also equips him with proper intellect, reasoning and seriousness needed to lead a responsible life. That is why a mind trained through the study of mathematics is more capable of leading a well-disciplined life. Study of mathematics is helpful in having constructive discipline. Every student of mathematics is habitual to think properly without any unnecessary biases and prejudices. He can discriminate what is good and what is bad, therefore, he does not take decisions through his emotions but tries to apply the logic and intellect. He does not believe in hear saying but tries to investigate the thing before reacting to it.

Moreover, mathematics that not only familiars with culture and civilization but also helps in preventing, promoting cultural heritage and transmitting it to future generations. Through the application of scientific and mathematical discoveries culture and civilization is undergoing constant change. The welfare of civilization is now almost wholly dependent upon scientific as well as mathematical progress. It affects view of life and a way of living as a result of which it also affects philosophy of life. Hence the teaching of mathematics plays a vital role in developing cultural heritage.

Attitudes towards Mathematics

According to Orton (1989, cited in Mubeen, Saeed & Arif, 2013), attitude is a hypothetical construct that indicates an individual's like and dislike towards an item. It may be positive, negative or neutral. Attitude is an approach, temperament, sensation, situation, etc. with regard to a person or thing; inclination or course, especially of mind. Attitude is a way of looking at things. Some students are blamed for having negative attitude towards mathematics yet most of them are not motivated to change that attitude. Students would, therefore, have some measure of success in mathematics lessons if they are motivated to develop positive attitude towards it.

Attitudes are highly composite and they can affect learning comprehensively. Attitudes influence performance and performance in turn influences attitudes. Those who have positive attitudes towards mathematics have a better performance in this subject. Understanding of student's attitude is important in supporting their achievement and interest towards a particular discipline. Attitudes towards mathematics are also the important determinants of academic success and achievement. In order to succeed in a subject, positive attitude towards mathematics is a necessary prerequisite (Schereiber, n.d., cited in Farooq & Shan, 2008).

Students' attitude towards mathematics tended to be more positive in classroom where students perceived greater leadership and helping/friendly behaviors in their teachers, and more negative in their classrooms where students perceived their teachers as admonishing and enforcing strict behaviors. Science learners engaging in mathematics activities (including participating in mathematics competitions) are affected by external and internal influences on their perceptions and attitudes towards mathematics, it was felt that an investigation into the relationship between attitude towards mathematics and performance in mathematics was important (Fisher & Rickards, 1998, cited in McCoach & Siegle, n.d.).So, students' attitude toward mathematics is very important for their successful learning.

Measurement of Attitudes towards Mathematics

The following techniques will thus be considered for the measurement of attitude toward mathematics: Thurstone scales, summated rating scales exemplified by (the most common) Likert-type scales, semantic differential scales, interest inventories and check lists, preference ranking, projective techniques, enrolment data, other forms of data gathering such as clinical and anthropological methods, and physiological responses While the majority of these techniques are examples of self-report, paper-and-pencil measures. The Fennema and Sherman (1976,cited in Choi, 2015) mathematics attitude scales are also an instrument that can be used to assess different components of attitude to mathematics.

The scale of Fennema and Sherman (1976,cited in Choi, 2015) is, in the words of Tapia and Marsh (2004,cited in Choi, 2015), the most popular measure of attitudes towards mathematics of the last three decades. The origin of this scale lies in the study of differences between men and women in their attitudes towards mathematics as well as their influence on performance. This scale has been the object of extensive studies and it has been translated into various languages, and modified for application in different situations.

In this study, the researcher will use four scales of the Fennema-Sherman Attitude Scales: the confidence in learning mathematics scale, the mathematics anxiety scale, the effectance motivational scale, the usefulness of mathematics, as sub-components of students' attitudes. The domain scales are identified and described as follows:

- The confidence in learning mathematics scale is intended to measure confidence in one's ability to learn and to perform well on mathematical tasks. The dimension ranges from a distinct lack of confidence to definite confidence.
- The mathematics anxiety scale is intended to measure feelings of anxiety, dread, nervousness, and associated bodily symptoms related to doing mathematics. The dimension ranges from feeling at ease to those of distinct anxiety.
- The effectance motivation scale in mathematics is intended to measure effectance as applied to mathematics. The dimension ranges from lack of involvement in mathematics to active enjoyment and the seeking of challenge. The scale is not intended to measure interest or enjoyment of mathematics;
- The mathematics usefulness scale is designed to measure students' beliefs about the usefulness of mathematics currently and in relationship to their future education, vocation, or other activities.

Research Methodology

Research Design

The research design used for this study was a descriptive research design.

Procedure for the Study

The students' achievement in learning mathematics is still under unsatisfactory condition. This is a problem of mathematics teacher. Then the researcher sought out the literature related to this study through books and Internet sources. After that, an attitude questionnaire and an achievement test were constructed for this study. To find the reliability of the instruments a pilot test with (50) Grade Seven students was conducted at No.(1) Basic Education High School, Thingangyun. Then, eight high schools and four middle schools from Yangon Region were selected by using a random sampling method. Six hundred Grade Seven Students were also selected as participants. The required data are collected with the help of the headmaster/headmistress of those schools and the test was administered and then the data were entered into the computer data file and were analyzed using the Statistical Package for the Social Science (SPSS 22).

Instruments

In this study, a questionnaire and an achievement test for Grade Seven students were used as instruments.

(a) Attitude Questionnaire

Questionnaire developed by Fennema and Sherman (1976, cited in Leder, 1985), which was adapted to investigate students' attitudes towards mathematics. This questionnaire was used to investigate Grade Seven students' attitudes towards mathematics. The total items were (50) on five point Likert-type scale from (1) to (5). Items (6), (7), (8), (9), (10) from each section are negative items and the rest are positive items. For positive items, the score closer to (1) indicated "Never/Strongly Disagree" and "Always/Strongly Agree" was indicated by the score closer to (5). For negative items, the score closer to (1) indicated "Always/Strongly Agree" and (5) indicated "Never/Strongly Disagree".

(b) Mathematics Achievement Test

In order to measure the mathematics achievement of the students, an achievement test was constructed. Firstly, the table of specifications was prepared including number of items according to content areas. This test covered (14) chapters: (10) chapters from mathematics textbook volume I and (4) chapters from mathematics textbooks volume II.

Population and Sample Size

All the participants in the sample were Grade Seven students. This study was conducted in Yangon Region. There are four districts in Yangon Region. One township from each district was randomly selected for this study. The sample schools for the study were selected by using a stratified random sampling technique. Two high schools and one middle school from each township were selected as the sample. Therefore, twelve schools (eight high school and four middle schools) are included in this study. The total number of students participated in this study were (600). The students in this study were selected by an equal-size (non-proportional) random sampling technique.

Data Analysis

The data were analyzed by using descriptive statistics (mean and standard deviation). Moreover, the Pearson product-moment correlation was used to describe the relationships between students' attitudes towards mathematics and the students' achievement in mathematics.

Research Findings

Findings of Students' Achievement in Mathematics

In order to find out the students' mathematics achievement, an achievement test was administered. The full score of students' mathematics achievement was (50). In order to access the students' achievement level, it was necessary to examine the percentage of students whose achievement level is low, moderate and high in all the participants.. The average mean and standard deviation by all the participants were (29.62) and (5.452) respectively. Then, (+1) standard deviation from mean and (-1) standard deviation from mean were calculated. So, based on these results, if the score was from (0) to (23), it would be defined as low achievement level. If the score was from (24) to (35), it would be defined as moderate achievement level. If the score was from (36) to (50), it would be defined as high achievement level. The findings of students' achievement in mathematics were presented in Table 1 in terms of three levels. From the total number of participants, (19%) of the students were at low level, (60%) of the students were at moderate level and (21%) of the students were at high level of mathematics achievement.

Table 1: Students' Level of Mathematics Achievement

Achievement Level	Score	Number of Student	Percentage
Low	0-23	112	19%
Moderate	24-35	362	60%
High	36-50	128	21%
Total	50	600	100%

Findings of Students' Attitudes towards Mathematics

In order to find out the students' attitudes towards mathematics, (50) items were used. The full score of students' attitudes questionnaire was (250). In order to examine the percentage of students who have the attitudes of low, moderate, high levels towards mathematics, a descriptive statistics (percentage) was used. The average mean score and the standard deviation by all the participants were (193.35) and (19.59) respectively. Then, (+1) standard deviation from mean and (-1) standard deviation from mean were calculated. So, based on these results, if the score was from (0) to (172), it would be defined as low attitudes level. If the score was from (173) to (213), it would be defined as moderate attitudes level. If the score was from (214) to (250), it would be defined as high attitudes level. From the total number of participants, (1%) of the students have low level, (83%) of the students have moderate level and (16%) of the students have high level of attitudes towards mathematics.

Table 2: Students' Level of Attitudes towards Mathematics

Attitude Level	Score	Number of Student	Percentage
Low	0-172	7	1%
Moderate	173-213	497	83%
High	214-250	96	16%
Total	250	600	100%

Findings of the Correlations between Students' Attitudes and Students' Mathematics Achievement

The correlation analysis was performed between students' attitudes (overall attitude, five sub-components of students' attitudes) and their achievements using the Pearson product-moment correlation. Table 3 shows the correlation between students' mathematics achievement and their attitudes towards mathematics in terms of confidence in learning mathematics, mathematics anxiety, effectance motivation in learning mathematics, mathematics usefulness, general perceptions, and overall students' attitudes.

Table 3: The Correlations between Students' Attitudes and Students' Mathematics Achievement

Attitude	**Correlation (Mathematics Achievement)**
Confidence in Learning Mathematics	**.728****
Mathematics Anxiety	**-.798****
Effectance Motivation in Learning Mathematics	**.767****
Mathematics Usefulness	**.786****
General Perceptions	**.641****
Overall Students' Attitudes	**.705****

**. Correlation is significant at the 0.01 level (2-tailed).

Discussion, Suggestions, Conclusion

Discussion

According to the research findings of students' achievement in mathematics, it was found that (19%) of the students possessed low level of achievement, (60%) of the students possessed moderate level of achievement, and (21%) of the students possessed high level of achievement. These findings revealed the answer to research question (1): To what extent do the students have achievement in mathematics?

Concerning with the students' attitudes towards mathematics, (1%) of the students possessed low level of attitudes, (83%) of the students possessed moderate level of attitudes and (16%) of the students possessed high level of attitudes. These findings revealed the answer to research question (2): To what extent do the students possess positive attitudes towards mathematics?

The correlation between the students' attitudes and the students' mathematics achievement was found that the correlation ($r\ (10) = .705$, $p < .01$). This result showed that the direction of correlation was positive and it indicated that if the students' attitudes were high, the students' mathematics achievement was also high and if the students' attitudes were low, the students' achievement was also low. So, this finding revealed the answer to research question (3): Is there a relationship between students' attitudes and achievement in mathematics?

Suggestions

Some suggestions for improving confidence in learning mathematics, reducing mathematics anxiety, motivating to learn mathematics, highlighting the usefulness of mathematics and promoting the students' attitudes in terms of general perceptions about learning mathematics are presented as follows.

Improving Confidence in Learning Mathematics: The teachers need to apply various methods to promote the students' attitudes in terms of confidence in learning mathematics. In the classroom, the teacher should provide opportunities for students to succeed, help young teens feel safe and trust in themselves and also praise and encourage.

Reducing Mathematics Anxiety: The students' attitudes in terms of mathematics anxiety also have impact on students' mathematics achievement. The teachers should help the students to be relax and enjoyable while teaching and learning mathematics. But the teachers should never humiliate the students and never use mathematics as a punishment. The teachers should not use the techniques of curb excessive competitiveness and speed tests. The teacher should use the techniques of praising pupils' efforts, developing a sense of humor, teaching how to read mathematics, developing spatial relations and so on. By doing so, the students would gain positive attitudes deal with mathematics anxiety and their achievement may improve.

Motivating to Learn Mathematics: The teachers also have to motivate students in learning mathematics in order to get students' high mathematics achievement.

The teacher should:

- adopt child centered approach,
- provide appropriate learning situation and environment,
- praise, reproof, reward and punishment,
- competition and co-operation,
- develop proper attitude in children which will help in setting of their mind or preparing them mentally for doing particular task of learning, and
- keep in mind individual difference of the learner while teaching.

Highlighting the Usefulness of Mathematics: Mathematics performance relates to usefulness of mathematics and the teachers should point out the activities concerned with mathematics in the students' everyday life. The teacher should point out some of out of school activities, for example- awareness of time, reading a clock or watch, planning one's routine, cost accounting, related to mathematics. Even, drinking coffee, tea, or milk, it is needed to have the knowledge of ratio and proportion which are concerned with mathematics. And also teachers should explain the students that mathematics is needed for their future work and it will help them earn a living. By doing so, the students' positive attitudes will increase and the students' mathematics achievement will improve too.

Promoting the Students' Attitudes in terms of General Perceptions about Learning Mathematics: The general perceptions concerned with parents, teachers and peers have impact on students' attitudes which in turn impact on students' mathematics achievement. The parents need to drive to develop their children's mathematical interest, to provide mathematical settings and to explore mathematical patterns and ideas with them. The parents should also give their children problems and puzzles at home and other activities deal with mathematics, for example – a set of pattern blocks. The teacher also needs to develop students' positive attitudes. The teacher should use up to date methods, have the best intentions to help students' success.

And also, the teacher should also have high expectations for the students' achievement because when students perceive a teacher has low expectations for them, they show less academic progress and will tend to act out more in negative ways. The parents and teachers should also have an understanding of the issues of negative peer influence, because it has an influence on children's academic performance. By doing so, the students' attitudes may improve and they may gain successful achievement in mathematics.

Conclusion

There were relationships between students' attitudes and the students' mathematics achievement; i.e., students' attitudes in terms of confidence in learning mathematics, of mathematics anxiety, of effectance motivation in learning mathematics, of usefulness of mathematics and of general perceptions about teaching and learning mathematics. All of these five sub-components influence the students' attitudes towards mathematics and students' mathematics achievement. In order to have high attitudes and mathematics achievement, firstly, the students can construct their own confidence based on their history of prior success. Encouragement can be most effective if the task is within the students' reach, but it can also be damaging if the task is out of reach and the students fail miserably. The students can also construct their confidence based on how they feel when they are in class or working on a particular task.

In addition, mathematics anxiety can also affect the students' attitudes towards mathematics. At about age 12, students who feel weak in mathematics start to avoid mathematics courses, do poorly in the few mathematics classes they do take, and earn low scores on mathematics achievement tests. Mathematics anxiety may also prevent students from passing fundamental mathematics courses or prevent the pursuit of advanced courses in mathematics. Therefore, teachers must reduce students' mathematics anxiety based on the suggestions mentioned above.

Similarly, motivation to learn mathematics also becomes a problem for cultivating positive attitudes towards mathematics. The students may have interest in learning mathematics when they gain sufficient motivation to lean mathematics. Both intrinsic motivation and extrinsic motivation are required. Intrinsic motivation can encourage the students to do an activity for its inherent satisfactions rather than for some separable consequence. Extrinsic motivation can encourage the students to do an activity in order to attain some separable outcomes. The teachers need to encourage students to learn mathematics based on their intrinsic motivation and by applying extrinsic motivation.

Besides, the teachers need to support the students who aim to acquire the power of the knowledge of mathematics because the knowledge of it is useful only when they know how to apply it in solving life problems. The teachers can point out that mathematics play a very important role in different vocations in everyday life. By doing so the students may appreciate the usefulness of mathematics, concentrate on this subject and have tendency to learn mathematics. Subsequently, their attitudes in terms of mathematics usefulness will improve.

Moreover, parents, teachers and peers can influence the students' attitudes towards mathematics. Parents can play crucial roles in the education of a child. In order to improve students' attitudes towards mathematics, the parents can encourage their children's learning at home because parents' support of students learning is directly correlated to students exhibiting more of a positive attitude, better attendance, increased positive outlook, higher motivation to learn, and higher test scores. The teachers' attitudes can also have a profound impact on students' education growth because the teachers' attitudes shape the treatment of students. Adolescents can also influence each other. Peer influence can provide many positive attitudes towards mathematics in an adolescent's life and also potentially have a deadly impact or other various negative effects. It is vital for both teachers and parents to understand the complex aspects of peer in order to stop these negative effects before they occur.

Research findings pointed out students' attitude is impact on their mathematics achievement. The teachers should also try to change the students' attitudes to learning mathematics just as a compulsory requirement in schooling and for realizing the functional value of mathematics. Indeed, this study cannot fulfill all the aims of teaching mathematics in the middle school, but it is hoped that it can support, to some extent, the struggle for improving middle school students' attitudes and their mathematics achievement in Myanmar.

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Appendix A
Attitude Questionnaire

þar;cGef;vTmonf tv,fwef;tqifh ausmif;om;^ausmif;olrsm;\ ocsFm bmom&yf ty:xm;&dSaom oabmxm;rsm;udk od&dSvdkygojzifh ar;jref;aom ar;cGef;vTmjzpfygonf/ ausmif;om;^ausmif;olrsm;\ ajzqdkcsufrsm;udk okawoe jyK&eftwGufom jzpfygonf/ a&;om;ajzqdkcsufrsm;ESifh ywfoufí rnfol wpfOD;wpf a,mufxHodkU owif;ay;ydkYjcif; vkH;0jyKvkyfrnf r[kwfyg/ odkUjzpfygí ar;cGef;tm;vkH;udk yGifhvif;rSefuefpGmjzifh ulnDajzqdkay;yg&ef arwåm&yfcHtyfygonf/ ajzqdkolrsm;tm; trnfazmfxkwfjcif; r&dSygaMumif;ESifh xdckdufepfemrI r&dSap&ef wm0ef,lygonf/ ulnDaqmif&Gufay;rIudk txl;aus;Zl;wif&dSygonf/

okawoD

ausmif;om;^olrsm;
ocFsmbmom&yftay:xm;&dSaom rdrdudk,fudk
,kHMunfrIqdkif&m ar;cGef;vTm
(Confidence in Learning Mathematics Scale)

atmufygtaMumif;t&m wpfckpDudk zwfíoif\ oabmxm;ESifh udkufnDaom tuGufudk (Â) oauFwjzifhjyyg/

(1)vkH;0oabmrwlyg/ (2) tenf;i,f oabmwlygonf/

(3)rqkH;jzwfwwfyg/ (4) oabmwlygonf/

(5) tvGefoabmwlygonf/

pOf	**azmfjycsufrsm;**	**1**	**2**	**3**	**4**	**5**
1	uREfkyfonf ocFsmbmom&yfudk oif,lEdkifol wpfa,mufjzpfonf[k ,kHMunfygonf/					
2	uREfkyfonfocFsmbmom&yfwGif trSwfaumif;aumif; &Edkifonf[k ,kHMunfygonf/					
3	uREfkyfonf ocFsmoifcef;pmtopfrsm;udk vG,fulpGm oif,lEdkifonf[k ,kHMunfygonf/					
4	uREfkyfonf ocsFmykpämrsm;udkajz&Sif;& mwGif enf;vrf; trsdK;rsdK; tokH;jyKum tajz&&dSatmif					

	wGufxkwfEdkif onf[k ,kHMunfygonf/					
5	uREfkyfonf ocsFmxl;cRefjydKifyGJrsm;wGif yg0if,SOf jydKifEdkifonfh t&nftcsif;&dSonf [k,kHMunfygonf/					
6	uREfkyfonf ocsFmbmom&yfwGif xl;cRefol wpfa,mufr[kwfyg/					
7	ocFsmbmom&yfonf uREkfyftwGuf tcufcJqkH; bmom&yfjzpfonf/					
8	uREfkyfonf em;vnf&ef cufcJaom t"dyÜm,f owfrSwfcsufrsm;? ay:pusLvdwfrsm;? oDtdk&rfrsm;udk rrSwfrdyg/					
9	uREfkyfonf cufcJaom ocsFmykpämrsm;udk ajz&Sif; Edkifrnfr[kwfyg/					
10	uREkfyfonf rsm;aomtm;jzifh ocsFmoifcsdefwGif q&m^q&mrrS ar;jref;aom arcGef;rsm;\ tajzukd rodyg/					

ausmif;om;^olrsm;
ocFsmbmom&yftay:xm;&dSaom
pdk;&drfrIqdkif&m ar;cGef;vTm

(Mathematics Anxiety Scale)

atmufygtaMumif;t&m wpfckpDudk zwfíoif\ oabmxm;ESifh udkufnDaom tuGufudk (Â) oauFwjzifhjyyg/

(1)vkH;0oabmrwlyg/ (2) tenf;i,f oabmwlygonf/

(3)rqkH;jzwfwwfyg/ (4) oabmwlygonf/

(5) tvGefoabmwlygonf/

pOf	azmfjycsufrsm;	1	2	3	4	5
1	ocsFmbmom&yfonf aMumufp&maumif;aom bmom&yf r[kwfyg/					
2	ocsFmbmom&yfukdoif,l&jcif;ESifhywfoufí uREkfyfonf pdwf&IyfaxG;rI r&Sdyg/					
3	uREkfyfonf rsm;aomtm;jzifh ocsFmwGuf&jcif;? oif,l&jcif;ukd aysmf&Tifygonf/					
4	uREkfyfonf rsm;aomtm;jzifh ocsFmpmar;yGJajzqkd&csdef twGif; pdwfayghyg;ygonf/					
5	uREkfyfonf tjcm;bmom&yfrsm;ukd oif,ljcif;xuf ocsFmbmom&yfukd					

	oif,l&onfukdykdí pdwf0ifpm;yg onf/					
6	ocsFmykpämrsm;onf uREkfyftm; rl;a0apygonf/					
7	ocsFmbmom&yf pmar;yGJonf uREkfyftm; aMumufvefYap ygonf/					
8	uREfkyfonf ocsFmykpämrsm;ukd rnfokdUajz&Sif;&rnfukd rpOf; pm;wwfyg/					
9	uREkfyfonf rsm;aomtm;Nzifh ocsFmoif,lcsdefwGif pdwf"gwfuswwfygonf/					
10	uREkfyfonf oif,ljyD;aom oifcef;pmrsm;ESifh topf oif,l&aom ocsFmoifcef;pmrsm;ukd rcsdwfquf wwfyg/					

ausmif;om;^olrsm;
ocFsmbmom&yftay:xm;&dSaom
vHIUaqmfrIqdkif&m ar;cGef;vTm
(The Effectance Motivational Scale)

atmufygtaMumif;t&m wpfckpDudk zwfíoif\ oabmxm;ESifh udkufnDaom tuGufudk (Â) oauFwjzifhjyyg/

(1)vkH;0oabmrwlyg/ (2) tenf;i,f oabmwlygonf/
(3)rqkH;jzwfwwfyg/ (4) oabmwlygonf/
(5) tvGefoabmwlygonf/

pOf	azmfjycsufrsm;	1	2	3	4	5
1	uREkfyfonf ocsFmESifhoufqkdifaom OmPfprf;? ya[Vdrsm;ukd MudKufESpfoufygonf/					
2	ocsFmbmom&yfonf uREkfyftm; wGufcsifpdwfNzpfatmif vIHUaqmfEkdifaom bmom&yfNzpfonf/					
3	uREkfyfonf ocsFmykpämrsm;ukd em;vnf&ef enf;vrf; rsdK;pkHNzifh MudK;pm;ygonf/					
4	uREkfyfonf ocsFmbmom&yfESifh oufqkdifaom jyify Aymkokwrsm;ukd avhvm&onfukd ESpfouf ygonf/					
5	uREkfyfonf ay;xm;aom ocsFmavhusifhcef;rsm;ESifh tdrfpmrsm;tNyif tNcm;aom OmPfprf;ykpämrsm;ukd aNz&Sif; vkdpdwf&Sdygonf/					

6	uREkfyfonf cufcJaomocsFmykpämrsm;ukd ukdifwkdiftaNz &atmif wGufonfxuf tNcm;ol\ tultnDukd ykdívkdcsifygonf/					
7	ocsmFbmom&yfukd tb,faMumifh tcsdefukefcH oif,laeMu onfukd uREkfyfem;rvnfyg/					
8	ocsFmbmom&yfwGif awGUMuKH&aom tcuftcJrsm;aMumifh uREkfyfonf ocsFmbmom&yfukd roif ,lvkdyg/					
9	ocsFmbmom&yfonf ykHaoenf;rsm;ukdom tvGwfusuf rSwf&aom bmom&yfNzpfonf/					
10	uREkfyfonf ocsFmoifcef;pmwpfckukd em;rvnf ygu em;vnfatmif rMudK;pm;bJ vufavsmh wwfygonf/					

ocFsmbmom&yf\ tokH;0ifrIqdkif&m ar;cGef;vTm

(Mathematics Usefulness Scale)

atmufygtaMumif;t&m wpfckpDudk zwfíoif\ oabmxm;ESifh udkufnDaom tuGufudk (Â) oauFwjzifhjyyg/

(1) vkH;0oabmrwlyg/ (2) tenf;i,f oabmwlygonf/

(3) rqkH;jzwfwwfyg/ (4) oabmwlygonf/

(5) tvGefoabmwlygonf/

pOf	**azmfjycsufrsm;**	**1**	**2**	**3**	**4**	**5**
1	ocsFmbmom&yfonf uREkfyf\ tem*wfwGif vkyfaqmif& rnfh vkyfief;rsm;twGuf tokH;0ifygonf					
2	ocsFmbmom&yfukd uRrf;usifNcif;onf vlYb0&yf wnfa&; twGuf rsm;pGmtaxmuftulay;ygonf/					
3	ocsFmbmom&yfonf oif,loifhaom? r&SdrNzpf vkdtyfaom bmom&yfwpfckNzpfonf/					
4	ocsFmbmom&yfonf t&m&mwkdif;ukd vufawGU usus? pepfwus pDrHwwf&ef taNccHrsm;ay;ygonf/					
5	tNcm;aombmom&yfrsm; oif,lEkdif&ef ocsFmbmom&yf onf r&SdrNzpf vkdtyfygonf/					
6	ocsFmbmom&yfonf vufawGUb0ESifh					

	ukdufnDrI r&Sdyg/					
7	ocsFmbmom&yfukd oif,lNcif;onf tcsdefjzKef;wD;rINzpf onf/					
8	atmifjrifaom tem*wfukd ykdifqkdifEkdif&ef ocsFm bmom&yf ukd uRrf;usifykdifEkdifatmif avhvmxm;&ef rvkdtyfyg/					
9	ocsFmbmom&yfonf ausmif;wGifavhvm&efom rvkdtyf aom bmom&yfwpfckNzpfonf/					
10	ocsFmbmom&yfukd wwfajrmufjcif;onf tvkyfwpfck&&Sd &eftwGuf ta&;rygyg/					

ausmif;om;^olrsm;\ ocFsmbmom&yftay:xm;&dSaom taxGaxG,lqcsufqdkif&m ar;cGef;vTm

(General Perceptions)

atmufygtaMumif;t&m wpfckpDudk zwfíoif\ oabmxm;ESifh udkufnDaom tuGufudk (Â) oauFwjzifhjyyg/

(1)vkH;0oabmrwlyg/ (2) tenf;i,f oabmwlygonf/

(3)rqkH;jzwfwwfyg/ (4) oabmwlygonf/

(5) tvGefoabmwlygonf/

pOf	azmfjycsufrsm;	1	2	3	4	5
1	uREkfyfonf ocsFmtawG;tac:opfrsm;ukd oif,lvkdaomqE´ &Sdygonf/					
2	ocsFmykpämrsm;ukdajz&Sif;&mwGif ocsFmq&m (okdUr[kwf) twef; azmfrsm;ESifhrwlaom enf;vrf;opfrsm;ukd &SmazGwGufcsuf&ef pdwftm;xufoef ygonf/					
3	uREkfyf\ ocsFmq&m^rrsm;onf ocsFmbmom&yfukd uRrf;usi fMuygonf/					
4	uREkfyfem;rvnfaom ocsFmykpämrsm;ukd twef;azmf oli,fcsif; rsm;u &Sif;jyavh&Sdygonf/					
5	uREkfyf\rdbrsm;onf uREkfyfem;rvnfaom ocsFm					

	ykpämrsm;ukd &Sif;jyavh&Sdygonf/					
6	uREkfyfonf ocsFmtdrfpmrsm; jyKvkyf&onfukd rESpfoufyg/					
7	uREkfyfonf ocsFmykpämwpfyk'fukd ajz&Sif;&ef pOf;pm;awG;ac: jcif;xuf tajzrSef&&Sdjcif;ukd ykdítav;ay;ygonf/					
8	uREkfyf\ocsFmq&m^rrsm;onf ausmif;om;^olrsm;\ ocsFm bmom&yfwGif wkd;wufrIukd pddwfr0ifpm;yg/					
9	twef;azmfoli,fcsif;rsm;ESifh twlwuG ocsFmykpämrsm;ukd ajz&Sif;&jcif;ukd rESpfoufyg/					
10	uREkfyf\ rdbrsm;onf ocsFmbmom&yfukd pdwf0ifpm;Mu olrsm; r[kwfyg/					

Appendix B
Mathematics Achievement Test

owårwef; ausmif;om;^olrsm;

ocsFmbmom&yfqdkif&m wwfajrmufrIppfaq;vTm

2016 ckESpf?------v

cGifhjyKcsdef (1) em&D

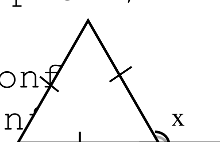
nTefMum;csuf/ / ar;cGef;tm;vkH;udk

owfrSwfxm;aom ajzvTmwGif ajzqdkyg/

tydkif;(u)

ar;cGef;tm;vkH;ajzqdkyg/

1. atmufygudef;rsm;teuf &m&Sife,fr[kwfaom udef;rSm
   (A) 0.333… (B) -8.95 (c) $\sqrt{6}$ (D) 0 jzpfonf/
2. a onf tEkwf &m&Sife,fudef;jzpfvQif
   (A) $-a > 0$ (B) $-a \geq 0$ (C) $-a < 0$ (D) $-a \leq 0$ jzpfonf/
3. $17(\frac{1}{7})^0$ tajzonf/
   (A) 17 (B) 18 (C) 19 (D)20 jzpfonf/
4. $\sqrt{17^2\text{-}8^2} =$
   (A) 12 (B)13 (C)14 (D)15 jzpfonf/
5. pwk&ef;ykH Murf;jyifwpfck\ {&d,mrSm 2.56m^2 tem;wpfzufrSm
   (A) 1.5m (B) 1.6 m (c) 1.7m (D) 1.8m jzpfonf/
6. $(x\text{-}y)^2(x+y)^2 =$
   (A) $x^2\text{-}y^2$ (B) x^2+y^2 (C) $x^4\text{-}2x^2y^2+y^4$ (D) $x^4+2x^2y^2\text{-}y^4$
7. $\frac{2x+3y}{2x+y} = 3.9, \frac{x}{y} = \ldots$ (A) $\frac{1}{2}$ (B) $\frac{3}{2}$ (C) $\frac{5}{2}$ (D) $\frac{7}{2}$
8. axmifhrSefMwd*Hwpfck\ tem;rsm;tcsdK;onf
   (A) 1:2:3 (B) 2:3:4 (C) 3:4:5 (D) 4:5:6 jzpfonf/
9. ykHwGifx \wefzdk;rSm
   (A) 90° (B) 100° (C) 110° (D) 120° jzpfonf/



10. pwk*HcGufwpfck\ axmifhwpfaxmifhonf
    (A) 360° (B) 180° (c) 90° (D) 60° xufMuD;onf/

11. axmifhjzwfrsOf;ESpfaMumif; wpfckudk wpfck axmifhrSefusvsuf xuf0ufydkif;aom pwk*Hudk (A) &Grf;Awf (B) MwmyDZD,rf (C) tem;jydKifpwk*H (D) axmifhrSefpwk*H [kac:onf/

tydkif;(c)

ar;cGef;tm;vkH;ajzqdkyg/

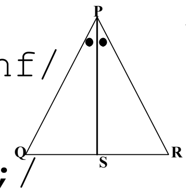
1. $\frac{1}{4}(x+5) - \frac{1}{2}(x+1) \geq 3$ udk qcGJudef;cGJyg/
2. $x^2 - 4b^2 + 4b - 1$ udk qcGJudef;cGJyg/
3. Bwd*HwpfckwGif∠ rSefaqmif tem;ESpffem;onf 2.4 cm ESifh 3.7 cm toD;oD;jzpfvQif usefwwd, tem;udk&Smyg/

tydkif;(*)

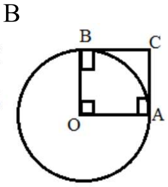
ar;cGef;tm;vkH;ajzqdkyg/

1. $a^4+2a^3-15a^2-15a+25\sqrt{b^2-4ac}$ udk a^2+3a-5 jzifhpm;vQif tMuGif;r&dSap&ef wnfudef; rS rnfrQEkwf&rnfenf;/
2. vlwpfa,mufonf c&D;wpfckudk oGm;&m c&D;\ 3 ykH 1 ykH udk wpfem&DvQif 15 rdkifEIef;usoGm;í 2 ykHudk wpfem&DvQif 20 rdkifEIef;us oGm;ojzifh pkpkaygif; 1 em&D 20 rdepfMum\c&D;tuGmta0;udk &Smyg/
3. $\frac{x+3}{x^2-4} - \frac{x-5}{x^2+9x+14}$ udk&Sif;yg/

4. Δ ABC wGif $\angle A = 90°$ jzpfonf/ $\angle$ B onf $\angle$ C \ ESpfqjzpfvQif $\angle$B ESifh $\angle$C udk &Smyg/
5. Δ PQR onf ESpfem;nD Mwd*Hwpfckjzpfí PQ = PR jzpfjyD; PS onf $\angle$QPR \axmifhxuf0ufydkif;rsOf;jzpfonf/



   (i) $\Delta PQS \cong \Delta PRS$ jzpfygovm;/
   (ii) S onf QR \ tv,frSwfjzpfygovm;/
   (iii) $\angle PSR = 90°$ jzpfygovm;/
   taMumif;jycsufjzifhajzqdkyg/
6. A[dk O ESifh tcsif;0uf 2cm &dSaom puf0dkif;wpfckudkqGJyg/ $\angle AOB = 90°$ jzpfaprnfh trSwfESpfck A ESifh B udk puf0dkif;ay:wGif,lyg/ A ESifh kUü qGJaom0ef;xd rsOf;rsm;onf C ü jz)ACB onf pwk&ef;wpfckjzpfygovm;/ ;jy csufay;yg/



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A STUDY OF THE EFFECTIVENESS OF CONCEPT MAPPING IN TEACHING SCIENCE AT THE MIDDLE SCHOOL LEVEL

Ngu Wah Soe[1]and Swe Swe Nyunt[2]

Abstract

The main purpose of this research is to study the effectiveness of concept mapping in teaching science at the middle school level. A concept map is a schematic device for representing a set of interrelated, interconnected conceptual meanings. There are three essential steps to create concept maps: (a) a list of concepts, (b) lines that represent the relational links between these concepts, and (c) labels for these linking relationships. In this study, Ausubel's model of meaningful learning was applied to develop the lesson plans including concept maps that implement into experimental study. According to the format of that design, (7) sample lessons of learning materials were constructed. The target population is Grade Seven students from Basic Education High School, Dagon Township and Basic Education High School, Mingaladon Township. Simple random sampling method was used. Therefore, (120) students and (4) science teachers participated in it. The instruments in this study were a pretest and a posttest. Learning materials were selected from Chapter (5), The Earth and Space, from Grade Seven science textbook. To study the effectiveness of concept mapping in teaching science, one of the true experimental designs, pretest-posttest control group design was used. The data were analyzed. Independent samples *t* test was used to test the hypotheses of this study. The result of this study shows that there was a significant difference in the science achievement of Grade Seven students who receive instruction with concept mapping and those who do not. The results also indicated that when students are exposed to concept mapping, they achieved significantly better in performing knowledge, comprehension and application level science questions than other students. It verifies that concept mapping in science teaching brings positive effects on students' science learning at the middle school level. Hence, concept mapping can be integrated in science teaching and learning in the classroom.

Keywords: concept map, science.

1. Senior Assistant Teacher, Basic Education High School (Branch), Gyo Pin Waine, Paukhaung Township

2. Dr, Lecturer, Department of Methodology, Yangon University of Education

Introduction

Education plays an essential role in everyone's life for bright future. Today, all countries aim to reach modernized education system. Science education is one of the pioneers in order to fulfill this aim. Science should be viewed as a way of thinking in the pursuit of understanding nature, a way of investigating, and a body of established knowledge (Collette & Chiappetta, 1989). The reasons behind the daily functioning can be explained through science. Science looks for different kinds of relationships such as relationships between different things, relationships between the properties possessed by several things, relationships between the parts of things, etc. Science teachers are responsible to help students in developing an adequate understanding of science concepts. One of the most important theories is Ausubel's theory of meaningful learning. According to this theory, meaningful learning occurs when complex ideas and information are combined with students' own experiences and prior knowledge to form personal and unique understandings. In this process, it can be said that concept maps are one of the most important teaching and learning tools that promote meaningful learning. Concept maps can represent the links of phenomena or ideas about any topics or any lessons of a subject. Negative attitudes towards the study of science are also increased. Besides, an overall lack of critical thinking skills is becoming more evident. In addition to this lack of critical thinking skills, many students are not interested in science because they believe it is boring. In an attempt to fill this gap, this research aims to study the effectiveness of incorporating concept mapping in teaching science at the middle school level.

Purposes of the Study

The purposes of this study are as follows:

1. To study the effectiveness of concept mapping in teaching science at the middle school level,
2. To compare the students' science achievement between students who receive instruction with concept mapping and those who do not, and
3. To give suggestions based on the findings from the study to improve science learning.

Research Hypotheses

1. There is a significant difference in the science achievement of Grade Seven students who receive instruction with concept mapping and those who do not.
2. There is a significant difference in the science achievement of Grade Seven students at knowledge, comprehension and application levels who receive instruction with concept mapping and those who do not.

Definitions of Key Terms

Concept Map: A concept map is a schematic device for representing a set of interrelated, interconnected conceptual meanings (Ebenezer & Connor, 1998).

Science: Science is defined as organized knowledge gained through science as activity, frequently used with a qualifying adjective to indicate a special branch of study (Good, 1959).

Review of Related Literature

In the modern world, knowledge of science becomes essential for everyone. Science provides a laboratory of common experience for development of language, logic, and problem-solving skills in the classroom. Science can be described as a particular way of thinking, developing thinking with a particular lens, and a particular way of knowing. Science is both a body of knowledge that represents current understanding of natural systems and the process whereby that body of knowledge has been established and is being continually extended, refined, and revised. One cannot make progress in science without an understanding of both. Likewise, in learning science one must come to understand both the knowledge and the process by which this knowledge is established, extended, refined, and revised. The body of knowledge includes specific facts integrated and articulated into highly developed and well-tested theories.

Learning science involves a number of distinct components that are acquiring science concepts, developing science skills and processes and appreciating the nature of science and the role of science in society. There are different perspectives on the process of science which are not mutually exclusive in considering how best to teach science. Each perspective can identify certain elements that need to be given their due attention. One of the key elements of a number of these viewpoints on science that can be summarized is as a process of logical reasoning about evidence. Science teaching directly inculcates such scientific perspectives among the students. Teaching is the process by which a person helps others to achieve knowledge, understanding, skills, and attitudes. With the help of the models of teaching, teachers can increase the capacity to reach more students, and create richer and more diverse environment for them. A teaching model is a good tool of teaching in which components are interrelated and arranged in a sequence. Ausubel's Model of Meaningful Learning will be used in planning the lesson for the study. Ausubel's theory consists of three phases of activity. Phase one is the presentation of the advance organizer, phase two is the presentation of the learning task or learning material, and phase three is the strengthening of cognitive organization. Phase three tests the relationship of the learning material to existing ideas to bring about an active learning process.

The teaching of science involves not only the teaching of concepts but also the teaching of the ways in which concepts are related. For teaching and learning to be successful, students are expected to acquire not only new knowledge in sufficient depth, but also to retain this knowledge for a long period of time after instruction. This situation can be best facilitated by concept maps. Novak and Gowin (1984) have developed a theory of instruction that is based on Ausubel's meaningful learning principles that incorporates "concept maps". Ebenezer and Conner (1998) stated that a concept map is a schematic device for representing a set of interrelated, interconnected conceptual meaning. In other words, it is a semantic net-work showing the relationships among concepts in a hierarchical fashion. Concept maps are intended to represent meaningful relationships between concepts in the form of propositions. Propositions are two or more concept labels linked by words in a semantic unit. In its simplest form, a concept map would be just two concepts connected by a linking word to form a proposition. Ebenezer and Connor (1998) produced a list to construct a concept map.

1. Choose a passage from a science textbook.
2. Circle or underline the main concepts in this passage.
3. List all the concepts on paper.
4. Write or print the concepts on small cards or stickers so that the concepts can be moved around. If teachers prefer to use a computer-based semantic network, use Sem Net, Learning Tool, Text Vision, CMap, or Inspiration software (Jonassen, 1996).
5. Place the most general or all inclusive concepts on the top of the paper.
6. Arrange the concepts from top to bottom (from most general at the top to most specific at the bottom) so that a hierarchy is indicated. In constructing this hierarchy, place concepts next to each other horizontally if they are considered to have equal importance or value.
7. Relate concepts by positioning linking verbs and connecting words on directional arrows. Support the concepts with examples.
8. Have members of a cooperative group critically analyze the concept map to improve on and further extend your ideas.

Concept maps can be constructed in the classroom using three different approaches by using concept words supplied by the teacher, identifying the concepts from an information source, and from their own personal knowledge. According to the University of Illinois, US (2002), there are four major categories of concept maps. These are distinguished by their different format for representing information.

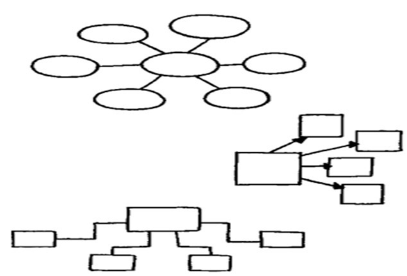

Figure 1: Spider Concept Map

The “spider” concept map is organized by placing the central theme or unifying factor inthe center of the map. It looks a bit like a spider’s web, as its name suggests.

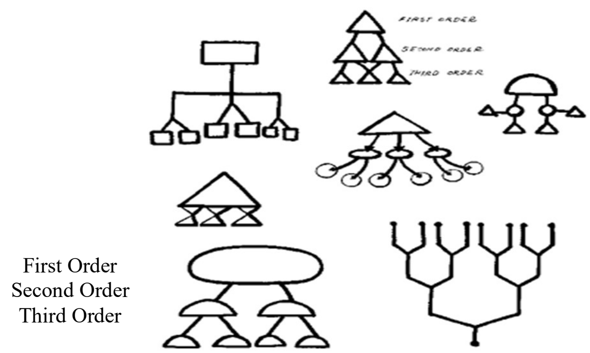

Figure 2: Hierarchy Concept Map

The hierarchy concept map presents information in a descending order of importance. The most important information is placed on the top. Distinguishing factors determine the placement of the information.

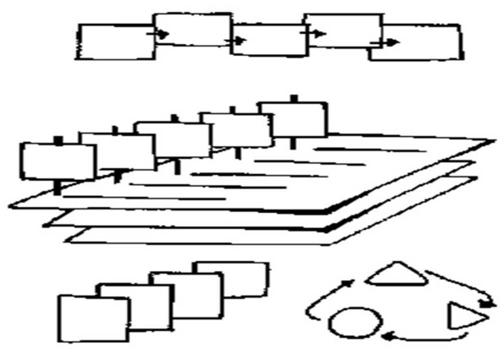

Figure 3: Flowchart Concept Map

The flowchart concept map organizes information in a linear format.

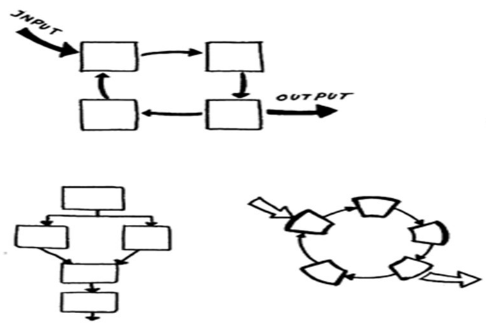

Figure 4: Systems Concept Map

The systems concept map organizes information in a format which is similar to a flowchart with the addition of 'INPUTS' and 'OUTPUTS'. It uses critical thinking skills along with problem solving skills.

Special Concept Maps include the following format types.

(a) 

(b) 

Figure 5: Picture Landscape Concept Map

These maps present information in a landscape format.

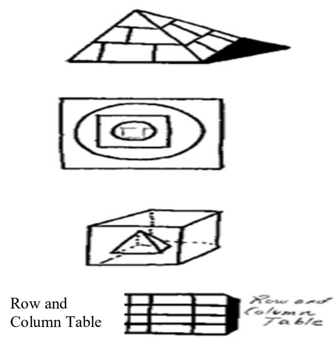

Figure 6: Multidimensional / 3-D Concept Map

These describe the flow or state of information or resources which are too complicated fora simple two-dimensional map.

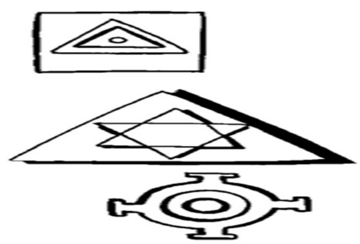

Figure (7) Mandala / Mandala Concept Map

(Source: University of Illinois at Urbana-Champaign. College of Agricultural, Consumer and Environmental Sciences, 2002)

Research Method

Participants

All participants in this study were Grade Seven students. This study was conducted in Yangon Region. Two districts, west and north districts, in this region were selected in random. After that, one high school from each district was selected and there were two sample schools. The participants in this study were selected by random sampling method and they were randomly assigned to experimental and control groups. A total of (120) Grade Seven students and (4) science teachers participated in it.

Instrument

The instruments were constructed in accordance with the selected research design to conduct this experimental research. Therefore, a pretest was used based on Chapter (2, 3 & 4) and a posttest was constructed based on Chapter (5) from Grade Seven general science textbook prescribed by the basic education curriculum, syllabus and textbook committee. The items used for the pretest were composed of (5) true/false items, (5) completion items, (5) multiple choice items, (5) short question items, and (5) long question items. Test items were based on Chapters from (2) to (4) of Grade Seven general science textbook and the allocated time for this test was (45) minutes. The total marks for this test were (50). The format of lesson plan was based on Ausubel's model of meaningful learning. It includes three phases. They are presentation of the advance organizer, presentation of learning task or learning material, and strengthening of cognitive organization. The activities involved are designed to increase the clarity and stability of the new learning material. The learning materials are the lessons from Chapter (5) "The Earth and Space". It was subdivided into (7) learning periods. A posttest involved five sections which are (5) true/false items, (5) completion items, (5) multiple choice items, (5) short question items, and (5) long question items. Test items were based on the content areas in Chapter (5) of Grade Seven general science textbook.

Procedure

In order to study the effectiveness of concept mapping in science learning, one of the true experimental designs, such as the pretest-posttest control group design was used in this study. Validity for the instruments was determined by the teachers who studied those specializations for more than fifteen years. After getting the validity of these instruments, a pilot study was conducted in December, 2016 to determine whether the instruments are applicable or not. Validity tells about the appropriateness of a test whereas reliability tells about the consistency of the scores produced. Based on the pilot study results, the reliability for each instrument was calculated by Cronbach's alpha (α) value, which determines how all items on a test relate to all other test items and to the total test, above (0.7). Therefore, these instruments were applicable for this study. After the pilot study, the experiment was launched in January 2017.The duration of this research lasts about three weeks. At the end of the study, a posttest was conducted simultaneously. The posttest scores were analyzed using independent samples *t* test of Statistical Package for the Social Sciences (SPSS). The data were analyzed by using a descriptive statistics (mean, standard deviation, percentage) and independent samples *t* test. The independent samples *t* test was used to compare the achievement of students who are taught through the use of concept mapping and that of students who are taught without concept mapping at knowledge, comprehension and application levels.

Quantitative Research Findings

The results of both groups for posttest are presented as follows.

Table 1: Independent Samples *t* Test Result for Posttest Scores

Posttest Scores	Group	N	M	SD	MD	t	df	Sig. (2-tailed)	p
Total Scores	Experimental	60	35.27	6.94	7.05	6.44	118	.000***	***p < .001
	Control	60	28.22	4.87					
Knowledge Level Scores	Experimental	60	11.98	1.69	0.78	2.84	118	.005**	**p < .01
	Control	60	11.20	1.30					
Comprehen-sion Level Scores	Experimental	60	9.92	2.18	1.75	4.90	118	.000***	***p < .001
	Control	60	8.17	1.70					
Application Level Scores	Experimental	60	13.37	4.23	4.52	6.78	118	.000***	***p< .001
	Control	60	8.85	2.96					

This table shows that the groups of experimental students who received a new treatment were found to have higher achievement in science learning than the groups of controlled students who did not.

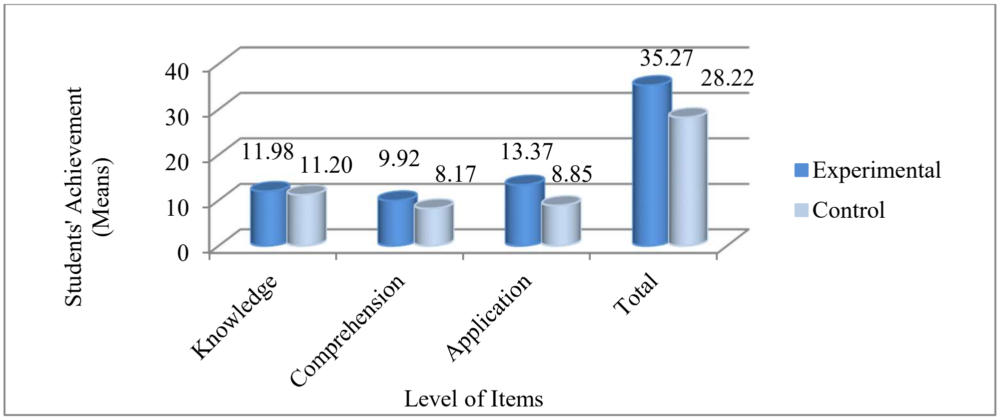

Figure 8: Graphic Illustration for Means in Posttest

This figure shows the posttest scores for all the levels of items as well as overall scores. Based on the data obtained, it can be interpreted that the experimental groups have higher achievement on the cognitive tests than the control groups. Therefore, the students of the experimental groups gained a significant effect on three levels; knowledge, comprehension and application. As such, it can be said that the experimental treatment or concept mapping has a significant positive effect on Grade Seven students' science learning. In addition to the information on statistical significance, it is important to know the size of the effect. The effect size is a numerical way of expressing the strength, or magnitude, of a reported relationship, be it causal or not. In this study, the effect size is calculated by the formula of Cohen's d $=\frac{\bar{X}e-\bar{X}c}{SDe+SDc/2}$(Gay and Airasian, 2003). By substituting the respective values, the effect size was (1.19). A numerical value of (1.19) indicates that the treatment had a strong treatment effect. Moreover, a positive effect size points that the students who received concept mapping performed better than the students who did not. That is why learning through the linkage of science concepts can enhance students' achievement to some extent.

Conclusion

Discussion

This research was to study the effectiveness of concept mapping in teaching science at the middle school level. The research findings showed that concept mapping is effective in improving students' science achievement. The major reason of this result is that concept mapping helps students to build and organize knowledge on a given topic. To be able to construct science concept maps, a teacher must find out the linkage or relationship of learned concepts into major concept. Therefore, the teacher needs to possess insight. It was found that students were happy and alive while concept mapping because it provides opportunities for active involvement of students in their learning process and hence, also improve their thinking ability.

When comparing posttest scores on knowledge level, it was found that there was a significant difference between the experimental and control groups in both sample schools. According to this result, it can be interpreted that it seems easier to retain memory to produce meaningful learning, when information is presented in vision formats while learning science concepts.

When considering students' comprehension about science concepts in the posttest items, students who did not learn through concept map could not capture the science concepts that water pollution was due to wastes and vehicles, warm air is lighter than cool air and types of clouds. One possible reason could be that they memorize those facts without having meaningful learning.

In determining students' applicability of science concepts, a few of controlled students cannot suggest the actions that are needed to prevent the loss of marine animals. They cannot even describe correctly the causes of water pollution by the actions of humans in a sequence. The reason for this is that they have been accustomed to memorizing and regurgitating information and facts. It is obvious that most students learn aspects of learning materials as isolated elements of knowledge instead of well-structured and integrated domain-specific structures. This lack of integration is suspected to be at the root of students' difficulties concerning concept learning and application of those concepts. Formation of concepts and use of them are of critical importance for the students to be successful in learning science.

Studies conducted by Asan (2007) with fifth-grade students also found that concept mapping was an effective strategy for raising students' science achievement. The results of the current study support this previous research and suggest that concept mapping can help to improve students' science achievement at the middle school settings in Myanmar.

Concept mapping improves academic performance of students due to their active involvement in learning, discussion, sharing of concepts and removal of misconceptions. According to Ausubel, meaningful learning is promoted by the understanding of hierarchical relationship and linkages between concepts. This is the main goal of concept mapping strategy, in which students are taught to identify the network of relationships between concepts rather than recitation. This can be seen obviously in this study. To sum up, the results of this study have shown the effectiveness of concept mapping in order to lead the teachers to adopt concept maps in teaching of general science.

Suggestions

Based on the research findings, concept mapping should be integrated in teaching and learning general science and it is recommended that concept mapping is beneficial in enhancing the achievement of Grade Seven students. Although it is easy to use for teaching and learning, it should be cautioned that students sometimes face the problems when developing concept maps for the first time. Therefore, before the students practice in constructing concept maps, science teachers should lead and introduce concept maps until they are familiar with the nature of concept. Meanwhile, pictures accompanying with words should be used instead of words only. It is also interesting to note that the concept mapping had an advantage when picture cards are used. Students should be taught how to construct concept maps on their own for various topics in general science because this improves the cognitive structures of the students.

It is urged to include concept maps and concept mapping activities in the general science textbooks at the middle school level in order to enhance students' comprehension and linkage of concepts. Concept maps should be used when the subject matter of a unit is hierarchical and basically conceptual. Moreover, it should be prepared for the teachers to incorporate the concept maps in teaching general science with respect to its philosophical background, theoretical basis and practical usage. It is suggested that sufficient time must be provided to construct the concept maps for the students. Since it is very time consuming to develop a concept map, teachers should practice with caution in incorporating concept mapping in instruction. It is appropriate to use one unit at a time to reduce the cognitive load and demands of the concept mapping technique.

A qualitative or quantitative research is recommended for the exploration of those variables that affect learning patterns of male and female students. As described in related literature, there are several kinds of concept maps. Each of these patterns facilitates to retain science concepts in memory. For the lessons like the formation of clouds, it was found that picture landscape concept maps were effective in promoting students' understanding in general science subject. Therefore, picture landscape concept maps should be used in such lessons.

Although developing Novak's style concept maps in Myanmar was difficult, it was found that it can enhance students' performance in general science subject at the middle school level. Since the science subjects that are taught in high school level are in English, it is suggested that other research studies should be conducted widely in the subjects such as physics, chemistry, biology, and so on. Lastly, technology is becoming increasingly important at present. Moreover, with the increase of technology, there has been a heightened interest on the effect of computer-based/multimedia learning in science. Therefore, other possible further studies would be to integrate computer-generated graphic organizers using inspiration software so that they could benefit from the incorporation of multimedia learning. However, it should be aware of the fact that this inspiration software can be used only in English language. Hence, this possible study should be conducted for science subjects that are taught in English.

Conclusion

Since a key principle of educating is to begin with what the students already know, finding this out is a very important initial step in any educational endeavor to satisfy the needs of students of the twenty-first century. It is imperative for students to be able to identify relationships between concepts and understand their connections in science learning. Concept mapping is a unique way of representing information. There are three essential steps to create concept maps that include (a) a list of concepts, (b) lines that represent the relational links between these concepts, and (c) labels for these linking relationships. So, the procedure for concept mapping starts with the generation of a list of concepts through brainstorming usually by focusing on interesting issues or lessons or questions. In this study, eleven science concept maps were used at each phase of Ausubel's model of meaningful learning. According to the results of this study, teachers should apply concept mapping in combination with this model in teaching and learning of general science in the middle school settings. In educational settings, concept mapping have been used to aid people of every age.

Concept maps encourage student-teacher interaction when creating it together as teacher-guided group activity. Additionally, after learning this technique, students get used to establish links between concepts rather than recalling concept separately. It can be used effectively for the revision of a topic. It develops the confidence level of the students. One of the benefits of using concept map is that it can provide the clarity of the concepts. It is a good way to work and prepare for the tests since it gives a big picture of the science concepts. It should be acknowledged that the use of concept mapping is an important skill for students to truly grasp scientific concepts and understand science phenomena. Concept mapping can help students sustain their relational knowledge, and guide how to learn science effectively. To sum up, the results of this study support the research hypothesis, "there is a significant difference in the science achievement of Grade Seven students who receive instruction with concept mapping and those who do not". Consequently, the use of concept mapping while learning science can accomplish the objectives of teaching general science. Hence, concept mapping is an effective tool that helps teachers to teach and students to learn more meaningfully in both teaching and learning general science at the middle school level in our country.

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Sample Lesson Plan for Grade Seven Science through the Use of Concept Mapping

1/ oifcef;pmacgif;pOf / tcef;(5) urÇmajrBuD;ESifhtmumo

ajrurÇmywf0ef;usifxdef;odrf; umuG,fa&;

/ **tmumoESifhrdk;av0o**

2/ tcsdef / 45 rdepf

3/ oif,lrIOD;wnfcsufrsm;

- wdrfjzpfay:vmyHkudk&Sif;jywwfap&ef/
- wdrftrsKd;rsKd;jzpfay:vmyHkudkajymjywwfap&ef/
- wdrfrsm;udktrsKd;tpm;tvdkufcGJjcm;azmfjywwfap&ef/

4/ oifMum;^oif,lrIjzpfpOf /Learning through the Use of Concept Mapping

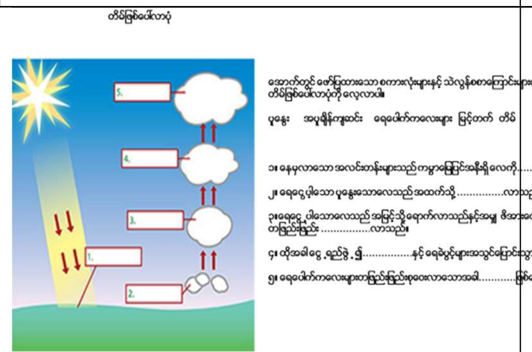
5/ oifaxmufulypönf;rsm;

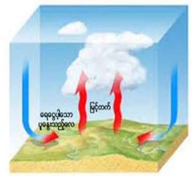
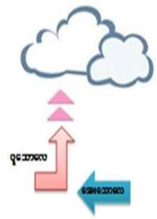
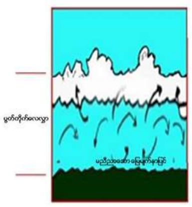
um;csyf (1) wdrfjzpfay:vmyHktodonmuGif;qufyHk
(2) wdrftrsKd;rsKd;ygaomyHkjyum;csyfrsm;
(3) wdrfrsm;udktrsKd;tpm;tvdkufazmfjyaomyHkjyum;csyfrsm;
(4) wdrftaMumif; todonmuGif;qufyHk

6/ oifMum;rnfhtpDtpOf

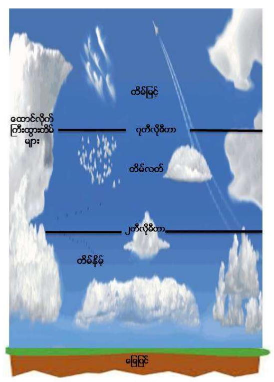
oifMum;rIy HkpH	**q&mhvkyfief;pOf**	**ausmif;om;rsm; vkyfief;pOf**
Introduction (Revision the Previous Knowledge) **oifMum;NyD;aom**	**oifMum;cJhNyD;aom yifv,faeowå0grsm; avsmhenf; qHk;yg;vmrIh taMumif;rsm; udkjyefvnfaqG;aEG;jcif;**	**ajzqdkcsufrsm;** ❖ ESpfpOfzrf;,lEdkifaomig;ta&twGufcGJwrf;rsm;

oifMum;rIy HkpH	**q&mhvkyfief;pOf**	**ausmif;om;rsm; vkyfief;pOf**
taMumif;t&m rsm;udkjyefvnf ajymjyjcif;	❖ ig;rsm; rsKd;rwHk;oGm;ap&ef vdktyfaom vkyfaqmifcsufrsm;udkazmfjyyg/	csrSwfay;xm;jcif;? ❖ arQmydkufBuD;rsm;jzifhodrf;usHK;ig;zrf;rIrsm;udkwm;jrpfay;jcif;? ❖ ig;arG;jrLa&;udkwdk;csJUvkyfudkifjcif;rsm;vkyfaqmifay;&efvdktyfygonf/
Phase One Advanced Organizer **oifcef;pmESifh ywfoufaom taMumif;t&mrsm;udk csdwfquf jyjcif;**	**q|rwef;taxGaxGodyHÜwGif oif,lcJhNyD;aom taMumif;t&mrsm;udkjyefvnfaqG;aEG;jcif;/** ❖ a&onfrnfuJhodkUtoGifajymif;íwnf&dSEdkifoenf;/ ❖ rnfonfhavonf a&aiGUudkydkío,faqmifxm;oenf;/ ❖ avonfrnfuJhodkU a&GUvsm;avh&dSoenf;/	**&&dSrnfaqG;aEG; oif,lrI&v'frsm;** ❖ taiGU?t&nf?tpdkiftcJ ❖ ylaomav ❖ zdtm;rsm;&ma'orS zdtm;enf;&ma'oodkU a&GUvsm;avh&dSjcif;/
Phase Two Presentation of Learning Task or Material **oif,l&rnfh vkyfief; odkUr[kwf**	**ay;xm;aomtodonmuGif;qufyHkudkavhvmapjcif;/**	**&&dSrnfhaqG;aEG;oif,lrI&v'frsm;udkwifjyjcif;/** (1) ylaEG;

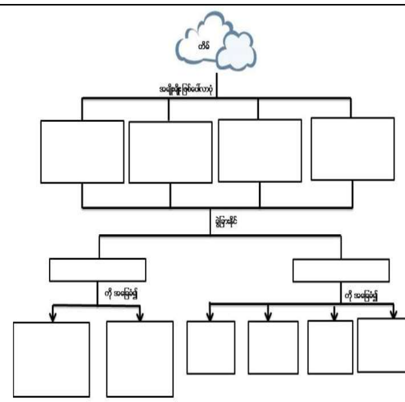
oifMum;rIy HkpH	**q&mhvkyfief;pOf**	**ausmif;om;rsm; vkyfief;pOf**
taMumif;t&m rsm;udkazm fjyjcif;	 **yHk (1) wdrfjzpfay:vmyHk todonmuGif;qufyHk(Concept Map - 1)** **ESpfa,mufwpfzGJUpDzGJUíaqG;aEG;avhvmapjcif;** ❖ wdrftrsKd;rsKd;wdkU\yHkrsm;? wdrftrsKd;rsKd;wdkU\trnfrsm;ESifht"dyÜm,frsm;ygaomuwfrsm;udkay;xm;í ,SOfwGJapjcif;? &&dSvmrnfh&v'frsm;udk aqG;aEG; wifjyapjcif;/	(2) jrifhwuf (3) tylcsdefusqif; (4) a&aygufuav;rsm; (5) wdrf **&&dSrnfhaqG;aEG;oif,lrI&v'frsm;udkwifjyjcif;/** (1) awmifwufwdrf (2) tylysHwufwdrf (3) ava0SUwdrf (4) avpdkifqHkwdrf

oifMum;rIy HkpH	**q&mhvkyfief;pOf**	**ausmif;om;rsm; vkyfief;pOf**
	 ပုံ (၁)  ပုံ (၂)  ပုံ (၃)  ပုံ (၄) **(1)awmifwufwdrf-** a&aiGUygaom wdrfpdkifwpfck onfawmifukef;jrifhudk jzwfausmfwdkufcwfonfhtcg awmifukef;jrifh\qifajcavQmtwdkif; wufoGm;NyD; jzpfay:vmaom wdrfrsKd;udk awmifwufwdrf [kac: onf/ **(2)tylysHwufwdrf-** a&aiGUygaom ylaEG;onfh av onf tjrifhodkUwufoGm;NyD; a&aiGUrsm; t&nfzGJU ojzifh jzpfay:vmaom wdrfrsKd;udk tylysHwuf wdrf[k ac:onf/ **(3)ava0SUwdrf-** rnDnmaom ajrrsufESmjyifay:odkY avjyif;rsm; wdkufcwfaomtcg ava0SUavayGrsm;	

oifMum;rIy HkpH	**q&mhvkyfief;pOf**	**ausmif;om;rsm ; vkyfief;pOf**
	jzpfay:vmNyD; yGwfwdkufavvTm twGif;&dSavwdkY onfa&maESmoGm;onf/ xdktcg ,if;avvTm\ atmufydkif;onfydkíylaEG;v mNyD; tay:ydkif;onf ydkíat;vmonf/ ydkíat;aom avtay:ydkif;rS a&rsm;aiGU&nfzGJUNyD;jzpf ay:vmaomwdrfrsKd;udk ava0SY wdrf[kac:onf/ **(4)avpdkifqHkwdrf-** xkxnftm;jzifh BuD;rm;aom avpdkifrsm;onf tvsm;vdkufa&GUvsm;NyD; ,if;wdkY rsufESmcsif;qdkif awGUqHk&mwGifavrsm; wjznf;jznf; txufodkUwufonf/ rsKd;rwlaom avpdkifESpfck awGUqHk&mwGifydkí aEG;NyD;ayghyg;aom avonf at;í odyfonf;aom avtxufodkY wGef;ydkUjcif;cH &onf/ xdktcg ylaEG;ayghyg;aom avonf wjznf;jznf; tjrifhodkY a&mufoGm;aomtcg tylcsdefusqif; vmNyD; a&aiGUrsm;	**&&dSrnfhaqG;aEG;oif,lrI&v'frsm;udkwifjyjcif;/** • a,bl,syHko@mefESifhtjrifh (5)vTmxyfwdrfrsm; (6)tpktyHkvdkufwdrfrsm; • ajrjyifrStjrifhtvdkuf (7)wdrfedrfh? wdrfvwf? wdrfjrifh? axmifvdkuf BuD;xGm;wdrfrsm;

oifMum;rIy HkpH	**q&mhvkyfief;pOf**	**ausmif;om;rsm; vkyfief;pOf**
	aiGU&nfzGJUojzifh jzpfay: vmaom wdrfrsKd;udkavpdkifqHkwdrf f[k ac:onf/ **wdrfrsm;cGJjcm;yHkudkqufvufavhvmapjcif;** ❖ wdrfrsm;\ yHkrsm;?cGJjcm;onfhtcsufrsm;? trnfrsm; ESifh t"dyÜm,frsm;ygaom uwfrsm;udkay;xm;í ,SOfwGJ apjcif;? &&dSvmrnfh&v'frsm;udk aqG;aEG; wifjyapjcif;/  ပုံ (၅)  ပုံ (၆)  ပုံ (၇) **(5) vTmxyfwdrfrsm;**-wdrf\ atmufajctvsm;onf wddrftjrifh xufBuD;onf/ **(6) tpktyHktvdkufwdrfrsm;**- wdrf\ atmufajc tvsm;onf wdrftjrifhavmufrBuD;ay/ **(7) wdrfedrfh? wdrfvwf? wdrfjrifh?**	**jznfhpGufaqG;aEG;csufrsm;udkrSwfom;apjcif;** (u)

<table>
<tr><th>oifMum;rIy HkpH</th><th>q&mhvkyfief;pOf</th><th>ausmif;om;rsm; vkyfief;pOf</th></tr>
<tr><td></td><td>axmifvdkufBuD;xGm; wdrfrsm;cGJjcm;onfhtcsufrsm;
• a,bl,syHko@mefESifhtjrifh
• ajrjyifrStjrifhtvdkuf vdktyfonfhtcsufrsm;udkjznf hpGufay;jcif;/
(u) wdrfjrifh? wdrfvwf? wdrfedrfhwdkU\ ysrf;rQ atmufajcESifh tjrifhrsm;udka'otvdkufazmfjyjcif;/
<table>
<tr><th>တိမ်မိသားစု</th><th>အပူပိုင်းဒေသ</th><th>သမပိုင်းဒေသ</th><th>ဝင်ရိုးစွန်းဒေသ</th></tr>
<tr><td>တိမ်မြင့်</td><td>၆-၁၈ ကီလိုမီတာ</td><td>၅-၁၃ ကီလိုမီတာ</td><td>၃-၈ ကီလိုမီတာ</td></tr>
<tr><td>တိမ်လတ်</td><td>၂-၈ ကီလိုမီတာ</td><td>၁-၇ ကီလိုမီတာ</td><td>၂-၄ ကီလိုမီတာ</td></tr>
<tr><td>တိမ်နိမ့်</td><td>မြေပြင်မှ ၂ ကီလိုမီတာ</td><td>မြေပြင်မှ ၂ ကီလိုမီတာ</td><td>မြေပြင်မှ ၂ ကီလိုမီတာ</td></tr>
</table></td><td></td></tr>
<tr><td>Phase Three Strengthening Cognitive Organization
oif,lxm; aomtaMumif; t&mtopfrsm;udk pkpnf;azmf jyjcif;</td><td>avhvmoif,lNyD;aom taMumif;t&mrsm;udk toHk;jyKí ay;xm;aomyHkwGifjznfhapjcif;/</td><td>ESpfa,mufwpfz GJUpD pOf;pm;íajzq dkjcif;</td></tr>
</table>

oifMum;rIy HkpH	q&mhvkyfief;pOf	ausmif;om;rsm; vkyfief;pOf
	 **yHk(2)wdrftaMumif;todonm uGif;qufyHk**(Concept Map- 2)	
Evaluation **tuJjzwf ppfaq;jcif;**	**EIwfar;EIwfajzjyKvkyfppfaq;jcif;** ❖ wdrfjzpfay:vmyHkudk azmfjyyg/ ❖ wdrfrsm;udk ajrjyifrStjrifh tvdkuftkyfpkrnf rQcGJ jcm;xm;oenf;/ ❖ tylysHwuf wdrfqdkonfrSm tb,fenf;/	**wpfOD;csif;ar;cGef;rsm;udk jyefvnfajzqdkjcif;** ❖ a&aiGUygaom avonf txufodk Yjrifhwufvm aomtcg zdtm; avsmh oGm;ojzifh xkxnf us,fjyefYvmN yD; tylcsdef usqif; oGm;aomtcg aiGU&nfzGJUí a&ayguf uav;rsm;ESif h a&cJ yGifh rsm; toGifajymif;

oifMum;rIy HkpH	**q&mhvkyfief;pOf**	**ausmif;om;rsm; vkyfief;pOf**
		oGm; NyD;wdrfjzpfay: vmjcif;/ ❖ av;rsKd;cGJj;xm;jcif;/ ❖ a&aiGUygaom ylaEG;onf avonftjrifh odkUwuf NyD; a&aiGUrsm;t&nf zGJUNyD;jzpf ay:vmaom wdrfudk tylysHwufwdrf [k ac:onf/
Conclusion **ed*Hk;csKyfqdkjcif;**	**oif,lNyD;aomtaMumif;t&mrsm;udktusOf; csKyfjyefvnfajymjyjcif;/** ❖ wdrftrsKd;rsKd;jzpfay:vmyHkudk todonmuGif;qufyHkjzifh jyefvnfajymjyjcif;/ ❖ wdrftrsKd;tpm;rsm;udk a,bk,syHko@mefESifhtjrifh tay:tajccHívnf;aumif;? ajrjyifrStjrifhtvdkuf vnf;aumif; cGJjcm;EdkifaMumif; tusOf;csKyf ajymjy jcif;/	**tajzrsm;** wdrftrsKd;tpm;rsm; ❖ awmifwufwdrf ❖ tylysHwufwdrf ❖ ava0SUwdrf ❖ avpdkifqHkwdrf

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A STUDY OF THE CONTRIBUTION OF TECHNOLOGY INTEGRATION IN TEACHING BIOLOGY TO GRADE NINE STUDENTS

Thandar Oo[1] and Su Su Khine[2]

Abstract

This research was conducted with the purpose of studying the contribution of technology integration in teaching biology to Grade Nine students. In this study, both the qualitative and quantitative research methods were used to study the contribution of technology integration. The posttest only control group design was used to compare the achievement between the students who were taught by integrating technology and those who were not. After administering a posttest, a set of attitude questionnaires was used to know the students' attitudes towards technology integration in teaching biology. For the qualitative study, biology teachers were interviewed to know their perspectives on the technology integration in the classroom. From Grade Nine biology textbook, Chapter (V), Variety of Living Organisms, the first five sub-topics of the topic, A Bony Fish, were selected as the learning materials. The result of the posttest showed that the achievement of the students who were taught by integrating technology was significantly higher than that of the students who were not. The results of No.4, Basic Education High School, Sanchaung was (t = 3.764, df = 50, MD = 7.08, p< .01) and that of No.6, Basic Education High School, Insein was (t = 4.315, df = 68, MD = 10.63, p< .001). Furthermore, the students who used technology as a learning tool in their study showed positive attitudes towards the integration of technology. The interview results showed that the teachers are willing to integrate technology in their classroom but they have some difficulties in using it in the classroom. They also admitted that if they were given opportunity, they would like to receive training in using technology in the classroom.

Keywords: Technology, Achievement, Integration, Biology

Introduction

The most notable distinction between livings and inanimate beings is that the former maintain themselves by re-newal. Life is a self-renewing process through action upon the environment. Continuity of life means

1. Senior Teacher, Basic Education High School, Kywepwe, Oktwin Township, Bago Region
2. Dr, Lecturer, Methodology Department, Yangon University of Education

continual re-adaptation of the environment to the needs of living organisms. With the renewal of physical existence goes, in the case of human beings, the recreation of beliefs, ideals, hopes, happiness, misery, and practices (Dewey, 1916). Singh et al., (2008) stated that man has always desired for excellence. This desire has given birth to new inventions and innovations in all works of life. Science and technology has always been instrumental in bringing efficiency and improvement in the process and product of the human work. The world of education has always been influenced by the increase use of technology. It has provided valuable help in improving the tasks of the teacher, smoothening the process of teaching learning and enriching the goals of education.

Objectives of the Study

(1) To study the contribution of technology integration in teaching biology to Grade Nine students

(2) To study the Grade Nine Biology students' attitudes towards integration of technology in teaching Biology.

(3) To study the Grade Nine Biology teachers' perspectives upon the integration of technology in the teaching Biology

Research Hypothesis

There will be a significant difference in achievement between Grade Nine Biology students who are taught by integrating technology and those who are not.

Importance of Technology Integration

In the age of technology explosion, today classrooms are moving from a pencil and paper and chalk and blackboard to technology-enriched classrooms in order to meet the needs of the society. With the aid of technology, today students especially science students can inquire and explore the required knowledge and information through the Internet (Brown, 2004). Siddiqui (2009) states technology is most powerful when it is used as a tool for problem solving, concept development and critical thinking. With technology, students can spend more time creating strategies for solving complex problems and developing a deep understanding of the subject matter. Jakes et al. (2003) cited in Mills (2006), suggests an eight-step process for inquiry-based learning using the World Wide Web or through the Internet:

1. Students begin by generating an essential question for the inquiry. An essential question requires students to make a decision or plan a course of action.
2. After the essential question has been framed, students write foundation questions, which give structure to the investigation so that students know what they need to research. Foundation questions and answers provide a factual basis for developing an answer to the essential question. Answers to foundation questions are integrated into an answer to the essential question.
3. Students use keywords from foundation questions to develop a search strategy to locate Web information.
4. Students are then ready to locate information on the Web. They can start by using a single search engine such as Google and moving on if necessary to a met-search engine or other search tools.
5. Students evaluate the Web resources they have collected, a critical process skill that students must learn. Information quality is assessed using a three-part process:
    - *Information applicability*: students determine whether the information is related to their essential questions.
    - *Information authority*: students determine whether the information originates from a readily recognizable expert, organization, or other qualified person or group.
    - *Information reliability*: students cross-reference information among websites to ensure that information is reliable.
6. Students evaluate the quality of information to determine whether there are sufficient answers to each of the foundation questions. If not, students return to the search strategy to locate new sites.

7. Students develop the answer to the question. At this point, students must organize and synthesize.

8. Students develop a product to represent the answer, that is, their knowledge about the essential question. The product can take many forms, including a Web essay. Web essays are living documents that contains multiple information types, such as text, sound, graphics, pictures and movies that are published on the Web. Students can produce Web essays as a web blog or a Web page.

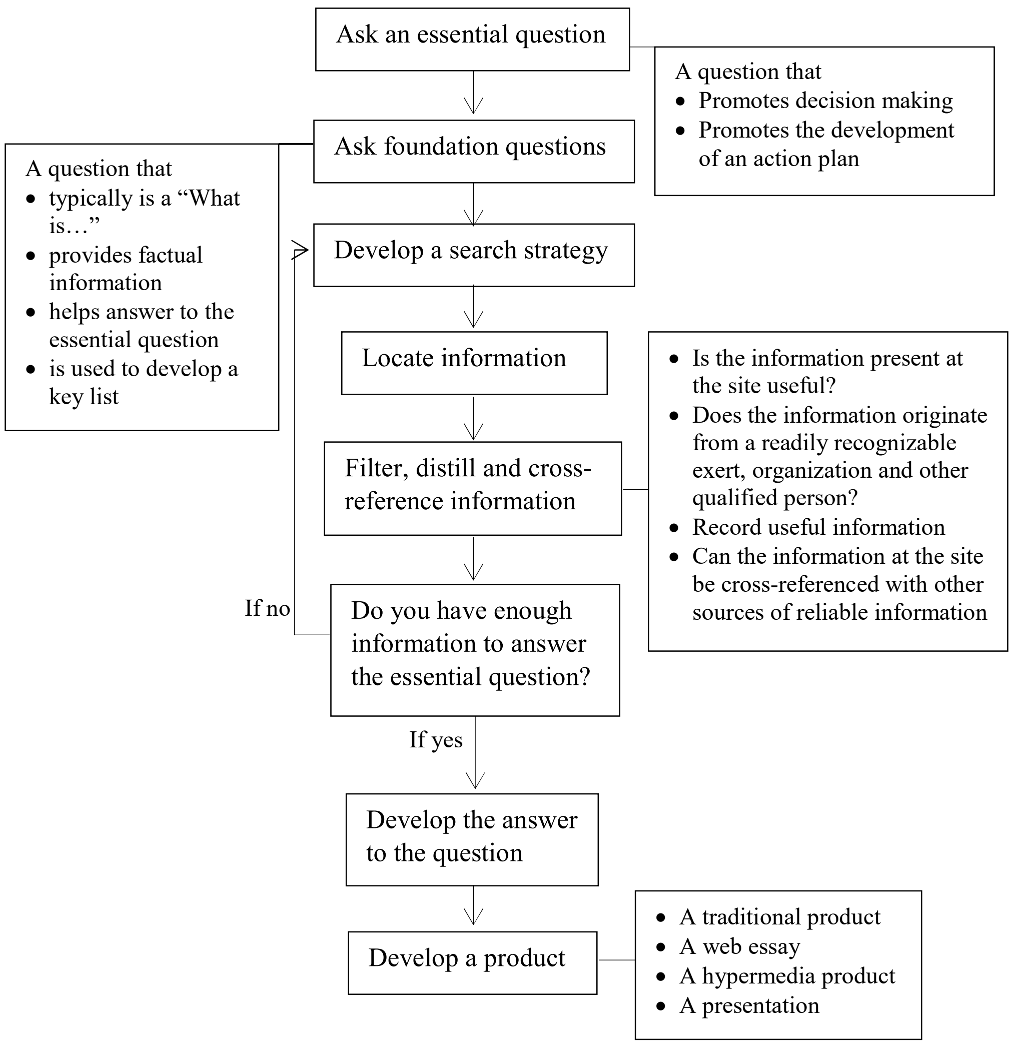

Figure 1: Inquiry-based Learning Process
Source: From Mills (2006), p. 177.

Research Method

This research is concerned with the study of the contribution of technology integration into the classroom in teaching Biology to Grade Nine students. Qualitative and quantitative research methodologies were used to compare the effects of technology integration between the two groups of experimental and control.

Population and Sample Size

This study was geographically restricted to Yangon Region. The required sample schools are selected by using simple random sampling method. The selected sample schools were No.4, Basic Education High School, Sanchaung and No.6, Basic Education High School, Insein. There were totally (52) students who are learning Biology in Grade Nine at No.4, BEHS, Sanchaung and (70) students who are learning the same subject in the same Grade at No.6, BEHS, Insein. All students from each school are grouped into two; the experimental and control groups by randomization. Therefore there were (35) students each in the experimental and control groups in No.6, BEHS, Insein and there were (26) students each in the experimental and control group in No.4, BEHS, Sanchaung. Although many experimental studies are being recommended to have a minimum of (30) subjects per group, experimental studies with tight experimental controls may be valid with as few as 15 subjects per group (Gay, 1987).The experimental group was given the treatment of technology integration in teaching and the control group was taught by using formal instruction.

Table1: Population and Sample Size

No	Township	School	Population	Number of students		
				Experimental Group	Control Group	Total
1	Insein	BEHS (6)	70	35	35	70
2	Sanchaung	BEHS (4)	52	26	26	52

Note. BEHS = Basic Education High School

Research Design

The posttest only control group design (True Experimental Design) was used to study the contribution of technology integration into the classroom in teaching Biology to Grade Nine students. This design was selected because it controls for many sources of invalidity and because random assignment of subjects to groups was possible. Administration of a pretest was not necessary because the sample subjects were grouped in accordance with the test scores of first semester examination. Major potential threat to internal validity associated with this design is mortality. This threat did not prove to be a problem, because the group sizes remained constant throughout the duration of the study.

Table 2: Experimental Design

Group	Assignment	Number		Treatment	Posttest
		S1	S2		
Experimental	Random	35	26	Technology Integrated Instruction	Achievement Test
Control	Random	35	26	Formal Instruction	Achievement Test

Note. S1= No.6, Basic Education High School, Insein
S2= No.4, Basic Education High School, Sanchaung

Instruments

Since the selected research design was posttest only control group design, the instruments for this study were constructed as a posttest and additionally a set of questionnaires. A posttest was developed to measure the achievements of Grade Nine Biology students. The test was constructed based on Grade Nine Biology Textbook according to the guidance of the supervisor. The students have to answer all the questions. Time allocation for the test is (90) minutes and the total marks given to the test is (50). True/false items for (5) marks, completion items for (5) marks, multiple choice items for (5) marks, short questions for (10) marks, long questions for (20) marks and quizzes for (5) marks. The test items were constructed based on the first three levels of Bloom's Cognitive Domain; knowledge, comprehension and application. The posttest was constructed according to the following table of specifications.

Table 3: Table of Specifications

Question Type	T/F	C	MC	SQ	LQ	Quizzes	Total Marks
Knowledge	3	3	3	6	6	-	21
Comprehension	2	2	2	2	6	4	18
Application	-	-	-	2	8	1	11
Total Marks	5	5	5	10	20	5	50

Note. T/F = True or False, C = Completion, MC = Multiple Choice, SQ = Short Question, LQ = Long Question

The marking scheme for the test was constructed according to the guidance of the experienced teachers. To measure the test reliability, Chronbach's Alpha was calculated. Since the acceptable value was within 0.6 to 0.7 and 0.7 to 0.9, the calculated value of the test (0.73) was accepted. A set of questionnaires was used to know the attitudes of the students who were participated in the experimental research. The questionnaire was constructed based on the five levels of Bloom's Affective Domain; receiving, responding, valuing, organization and characterization. Since there were (5) items for each level, the total items for attitude test was (25) items. These items were constructed in five point likert scale format (strongly disagree to strongly agree). To validate the questionnaire, it was modified according to the suggestions and guidance of five experienced teachers. Then, the questionnaire was piloted with (20) students inNo.1, Basic Education High School, Sanchaung. The Chronbach's Alpha value was .734. After testing the students of both experimental and control groups with the posttest question, the experimental group was tested again with the attitude questionnaires. The demographic data of the attitude questionnaire was collected from the students. Finally, formal interview was conducted to know the attitudes of the Biology teachers towards the integration of technology in teaching Biology. Biology teachers from two selected sample schools were interviewed by using an interview guide.

Procedure

Before the experiment was conducted, the experimental group was trained how to use technology especially the way to search information with Laptop, tablet and smart-phones linked with Internet access for three days. In this study, the teachers who participated to teach the control groups have the same Degree, B.Ed. Both teachers taught their control groups according to their formal lesson plans. The experimental group was given a treatment with the integration of technology by the researcher. The duration for the treatment took three weeks excluding the posttest and training duration. After teaching with the different lesson plans for each group, the posttest questions were developed to evaluate the achievements of each group. The participation and performance of the experimental group was observed by the researcher and mainly used rubrics for the students' performance. Finally, a set of questionnaires was used to study the attitudes of the students towards the integration of technology into the classroom. And then, Biology teachers from the selected sample schools were interviewed.

Before the experiment was conducted, validation for posttest and questionnaires was determined by five experienced teachers in Yangon University of Education. According to their suggestions, the instruments were modified again. On 12th December, 2016, the pilot study was conducted with (20) Grade Nine students inNo.1, Basic Education High School, Sanchaung. By the results of the pilot study, the instruments were revised and modified to conduct the experiment in the selected sample schools. Finally, the results of the experiment were compared by using the independent samples *t*-test.

Learning Materials

Biology is the study of living things. Living things include both plants and animals. Thus, biology deals with the study of all plants and animals that live or have ever lived on the earth. Biology is also the basic to many applied sciences such as medicine, animal husbandry, agriculture and forestry. According to Myanmar Education System, biology is taught as one of the elective subjects in Grade Nine and Ten. There are five chapters in Grade Nine biology including the basis of both plants and animals. From these chapters, Chapter (V); Variety of Living Organisms: A Bony Fish was selected as the learning materials for this study. There are about ten sub-topics under the topic of A Bony Fish. Among them, such sub-topics as Characteristics of bony fish, External features of bony fish, Muscular system, Swim bladder and Digestive system of bony fish were selected. The same sub-topics were taught to both experimental and control groups with different lesson plans.

Research Findings

Experimental Research Findings

This study is designed to find out the contribution of technology integration in teaching biology to Grade Nine students. After administering the posttest in each selected school, the data were recorded and analyzed by using the independent samples *t*-test to explore the difference between the experimental and control groups.

Table 4: *t*-Values for Posttest Biology Achievement Scores

School	Group	N	M	SD	MD	*t*	*df*	Sig. (2 tailed)
BEHS (4)	Experimental	26	39.77	3.648	7.08	3.764	50	.001**
	Control	26	32.69	8.867				
BEHS (6)	Experimental	35	36.69	9.116	10.63	4.315	68	.000***
	Control	35	26.06	11.368				

Note. $^{**}p < .01$, $^{***}p < .001$

BEHS (4) = No.4, Basic Education High School, Sanchaung
BEHS (6) = No.6, Basic Education High School, Insein

According to the results, the means of the experimental groups were significantly higher than that of the control groups in two selected schools. It showed that there was a significant difference between the students who were taught by integrating technology especially through the Internet resources and those who were not for the scores on biology achievement in both selected schools.

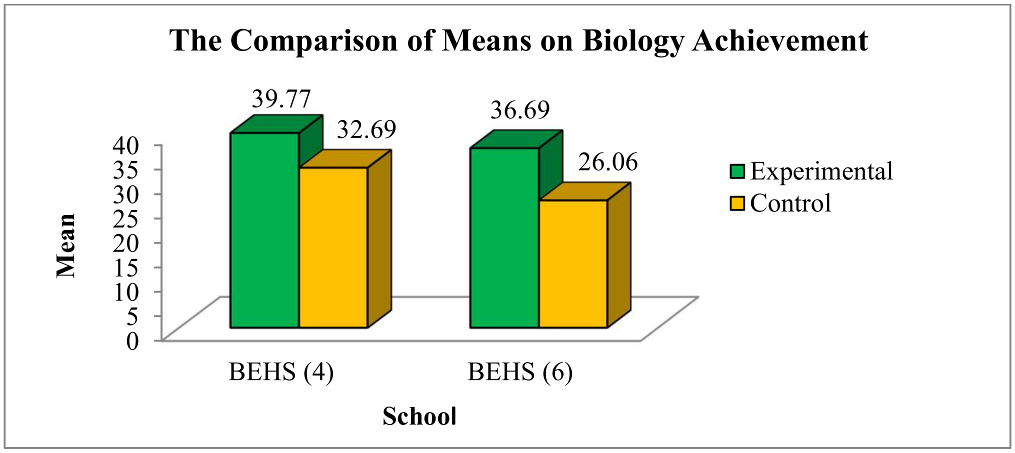

Figure 2: The Comparison of Means on Biology Achievement

In accordance with the findings, it can be interpreted that teaching biology by integration technology has significant effect on biology achievement of the students. Therefore, teaching biology by integration technology positively contributes to teaching biology for Grade Nine students.

Table 5: *t*-Values for Scores on Knowledge Level Questions

School	Group	N	M	SD	MD	*t*	*df*	Sig. (2 tailed)
BEHS (4)	Experimental	26	18.60	1.755	2.02	2.246	50	.029*
	Control	26	16.58	4.235				
BEHS (6)	Experimental	35	17.60	4.009	4.00	3.506	68	.001**
	Control	35	13.60	5.430				

Note. $*p < .05$, $**p < .01$

BEHS (4) = No.4, Basic Education High School, Sanchaung

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

The results of the knowledge level questions showed that the means of the experimental groups were significantly higher than that of the control groups in two selected schools. Therefore, it showed that there was a significant difference in the scores of knowledge level questions between the students who received inquiry-based learning through Internet resources and those who didn't in both selected schools.

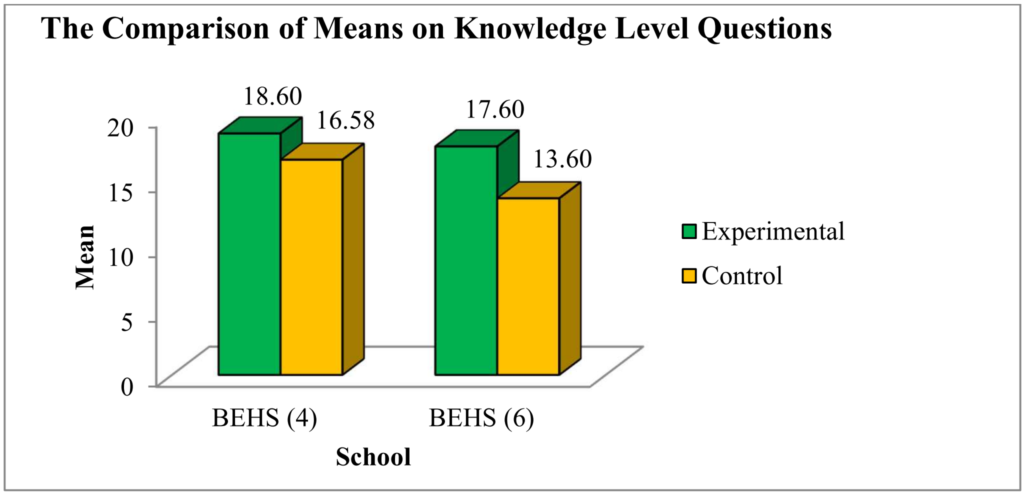

Figure 3: The Comparison of Meanson Knowledge Level Questions

Since there was a significant difference on the scores of knowledge level questions between the experimental and control groups in both selected schools, it can be interpreted that teaching biology by the integration of technology supports the improvement of students' recognition and recall ability.

Table 6: *t*-Values for Scores on Comprehension Level Questions

School	Group	N	M	SD	MD	*t*	*df*	Sig. (2 tailed)
BEHS (4)	Experimental	26	14.29	1.940	3.17	4.383	50	.000***
	Control	26	11.12	3.141				
BEHS (6)	Experimental	35	13.29	4.342	5.03	5.016	68	.000***
	Control	35	8.26	4.039				

Note **.** ***p< .001

BEHS (4) = No.4, Basic Education High School, Sanchaung

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

According to the results of comprehension level questions, the means of the experimental groups were significantly higher than that of the control groups in both selected schools. So, it proved that there was a significant difference on the scores of comprehension level questions between the students who received inquiry-based learning through Internet resources and those who didn't in both selected schools.

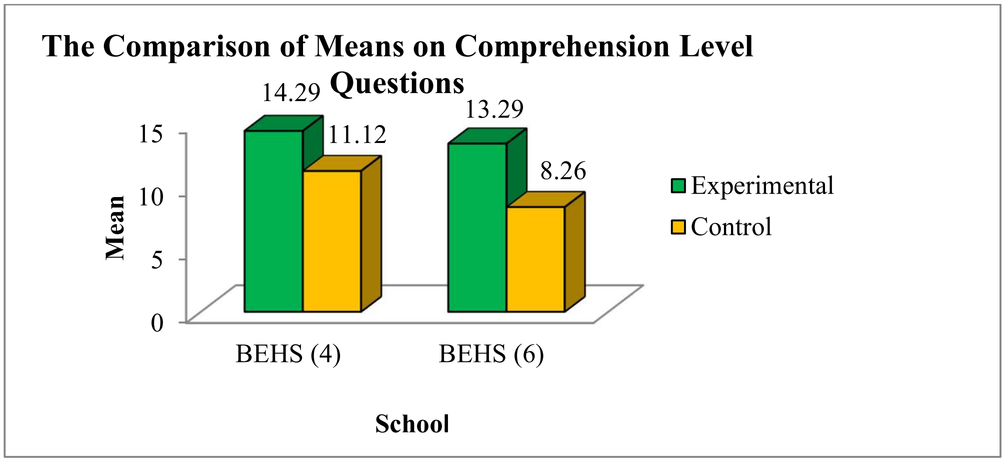

Figure 4: The Comparison of Means on Comprehension Level Questions

According to the findings of the comprehension level questions, it can be interpreted that teaching biology by the integration of technology positively contributes to improve the ability of the students to grasp and understand the meaning of the learned materials.

Table 7: *t*-Values for Scores on Application Level Questions

School	Group	N	M	SD	MD	*t*	*df*	Sig. (2 tailed)
BEHS (4)	Experimental	26	6.79	1.491	2.173	4.278	50	.000***
	Control	26	4.62	2.118				
BEHS (6)	Experimental	35	6.11	2.069	2.2	3.965	68	.000***
	Control	35	3.91	2.548				

Note. ****p* < .001

BEHS (4) = No.4, Basic Education High School, Sanchaung

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

According to the results of the application level questions, the means of the experimental groups were significantly higher than that of the control groups in two selected schools. Thus, it proved that there was a significant difference on the scores of application level questions between the students who received inquiry-based learning through the Internet resources and those who didn't in both selected schools.

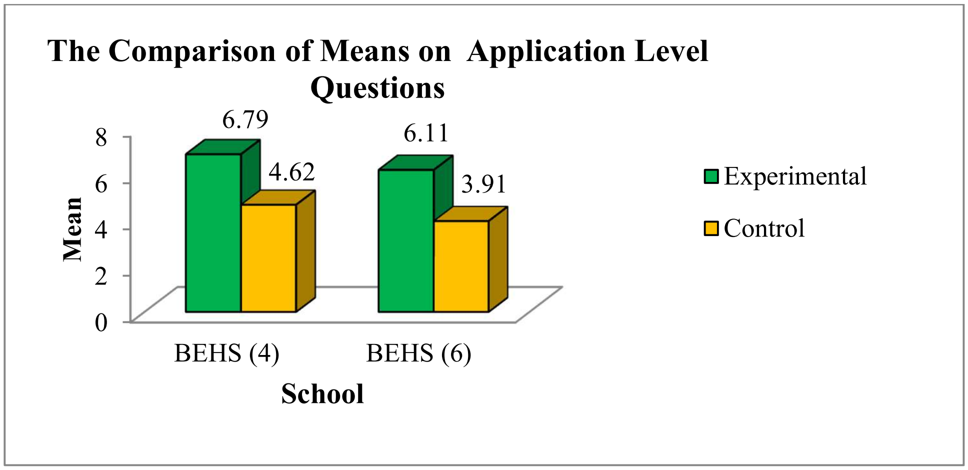

Figure 5: The Comparison of Means on Application Level Questions

According to the findings with respect to the application level questions, it can be interpreted that teaching biology by integration technology could bring about the improvement of students' ability to use the learned materials in new and concrete situations.

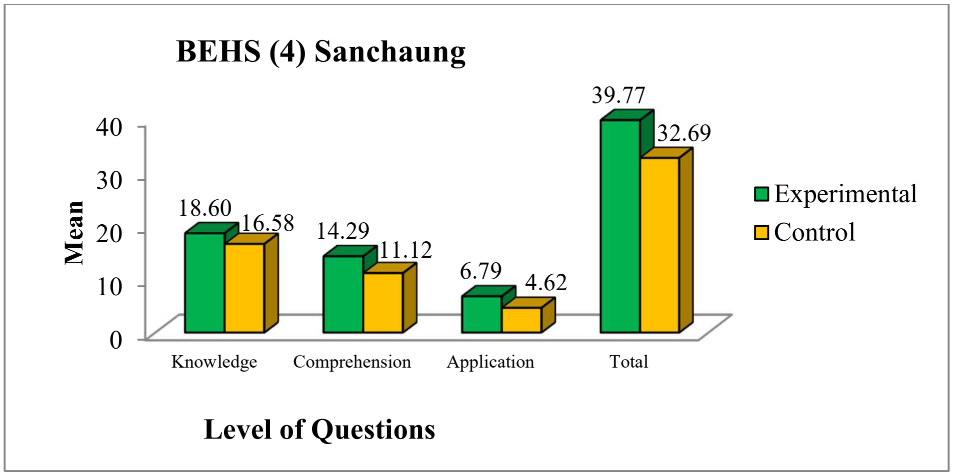

Figure 6: The Comparison of Means on Posttest for BEHS (4) Sanchaung

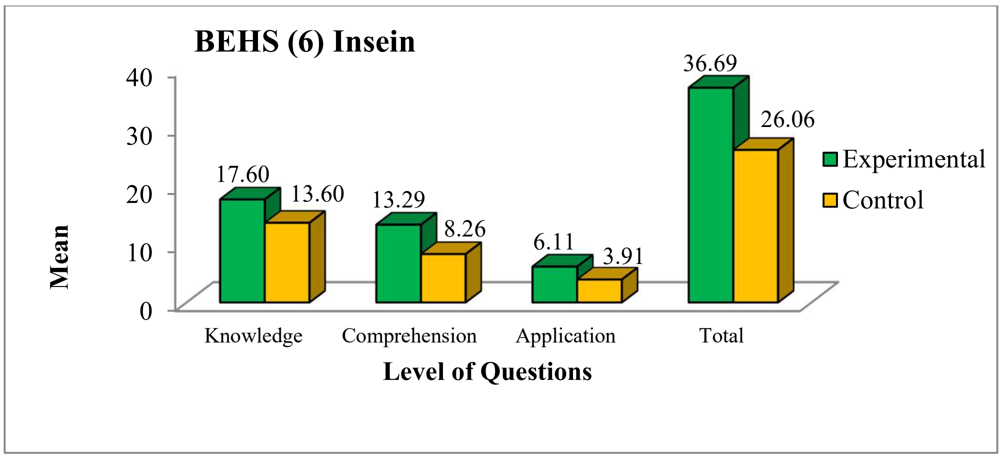

Figure 7: The Comparison of Means on Posttest for BEHS (6) Insein

Summary of the Experimental Findings

The results of the research findings for two selected schools are as follows:

- There were significant differences on the achievement (overall scores) of biology between the students who were taught by integrating technology and those who were not in both selected schools.

- There were significant differences on the scores of knowledge level questions between the students who were taught by integrating technology and those who were not in both selected schools.
- There were significant differences on the scores of comprehension level questions between the students who were taught by integrating technology and those who were not in both selected schools.
- There were significant differences on the scores of application level questions between the students who were taught by integrating technology and those who were not in both selected schools.
- In this study, technology integration was supportive not only for the development of students' cognition but also for the improvement of technology skills and higher order thinking skills such as problem solving, cooperative and presentation skills. This is because the students had to search the information by themselves to solve the problems collaboratively, had to decide whether or not the information is suitable and enough to solve the problem, had to create a product of their work and finally they had to share their product with the whole class.

Descriptive Research Findings

In order to find out the attitudes of the students who were taught by technology integration, the experimental groups in both selected schools were asked the questions concerning the attitudes of the students towards the integration of technology in teaching biology. The results were shown as positive, neutral and negative in percentage form in order to distinguish their feelings and attitudes towards integrating technology in learning biology.

Table 8: Students' Attitudes towards Technology Integration in Teaching Biology

No.	Items	BEHS (4) Sanchaung (%)			BEHS (6) Insein (%)		
		(-)	(0)	(+)	(-)	(0)	(+)
1.	***Receiving level*** I enjoy doing practical works when	8	8	84	14	14	72

No.	Items	BEHS (4) Sanchaung (%)			BEHS (6) Insein (%)		
		(-)	**(0)**	**(+)**	**(-)**	**(0)**	**(+)**
	learning biology.						
2.	I enjoy creating pictures and charts by finding related information when learning biology.	4	19	77	9	23	68
3.	I enjoy searching information related with biology lessons on websites.	19	12	69	8	20	72
4.	I like to search related information collaboratively when learning biology.	12	19	69	14	14	72
5.	I like to discuss and share information with others when learning biology.	19	19	62	11	22	67
	Students' Attitude for Receiving Level	**12**	**15**	**73**	**11**	**18**	**71**
1.	***Responding Level*** I participate in doing practical works when learning biology.	5	11	84	11	20	69
2.	I create pictures and charts by finding related information when learning biology.	8	12	80	14	17	69
3.	I search information related with biology lessons on websites.	23	11	66	12	14	74
4.	I search related information collaboratively when learning biology.	11	12	77	6	20	74
5.	I discuss and share information with others when learning biology.	8	23	69	12	17	71
	Students' Attitude for Responding Level	**10**	**14**	**76**	**10**	**18**	**72**
1.	***Valuing Level*** I prefer doing practical works to rote memorization when learning biology.	2	10	88	11	12	77
2.	I value to search information related with biology lessons on websites.	5	15	80	14	15	71
3.	I recognize learning by using modern technologies makes learning biology more meaningful and effective.	0	12	88	2	26	72
4.	I recognize technology integration in learning biology is helpful to make	0	11	89	2	20	78

No.	Items	BEHS (4) Sanchaung (%)			BEHS (6) Insein (%)		
		(-)	(0)	(+)	(-)	(0)	(+)
	learning process more authentic.						
5.	I accept that modern communication technologies are helpful to discuss the lessons with friends, teachers and experts.	0	8	92	3	5	92
	Students' Attitude for Valuing Level	**1**	**10**	**89**	**6**	**16**	**78**
1.	***Organization Level*** I adjust and use the learned biological knowledge and information in real life.	3	23	74	11	31	58
2.	I learn and develop new biological knowledge by relating with the old knowledge.	3	30	67	14	20	66
3.	Learning biology by using modern technologies is helpful to improve knowledge.	11	19	70	20	20	60
4.	I modify the learned information by discussing with others when learning biology.	3	30	67	17	28	55
5.	I practice to search further information by using modern technologies when learning biology.	7	8	85	14	31	54
	Students' Attitude for Organization Level	**7**	**23**	**70**	**15**	**26**	**59**
1.	***Characterization Level*** I always participate in doing practical works when learning biology.	19	22	59	17	25	58
2.	I always cooperate and discuss with others when learning biology.	15	19	66	20	28	52
3.	I always search information related with biology lessons by using modern technologies.	19	5	76	17	28	54
4.	I always use modern communication technologies to discuss and solve the	19	15	66	22	31	45

No.	Items	BEHS (4) Sanchaung (%)			BEHS (6) Insein (%)		
		(-)	**(0)**	**(+)**	**(-)**	**(0)**	**(+)**
	problems when learning biology.						
5.	Learning biology by integrating technology supports to understand more about biological concepts.	19	22	59	8	37	55
	Students' Attitude for Characterization Level	**18**	**17**	**65**	**17**	**30**	**53**

Note. (-) refers to the percentage of negative attitudes of the students.
(0) refers to the percentage of neutral attitudes of the students.
(+) refers to the percentage of positive attitudes of the students.

According to the results of the table, although some students seem to be unable to decide (neutral) because of some of the limitations of using technological devices such as smart-phones, tablets, laptops, etc. in most basic education schools, most of the students in both selected schools showed the highest percentage in positive attitudes towards the integration of technology in teaching biology for each level. When compared, the total percentage of attitude for each level, the students in No.6, BEHS, Insein showed less percentage in positive attitude than the students in No.4, BEHS, Sanchaung. The reason may be due to the socioeconomic status of the students. Because most of the students in No.6, BEHS (Insein) were found to be unable to use and unfamiliar with modern technologies. When the results of both selected schools were combined, it exhibited that (11%) of the students showed negative, (19%) could not determine whether they accept or reject the technology, and (70%) of the students admitted that they were willing to integrate technology in learning biology.

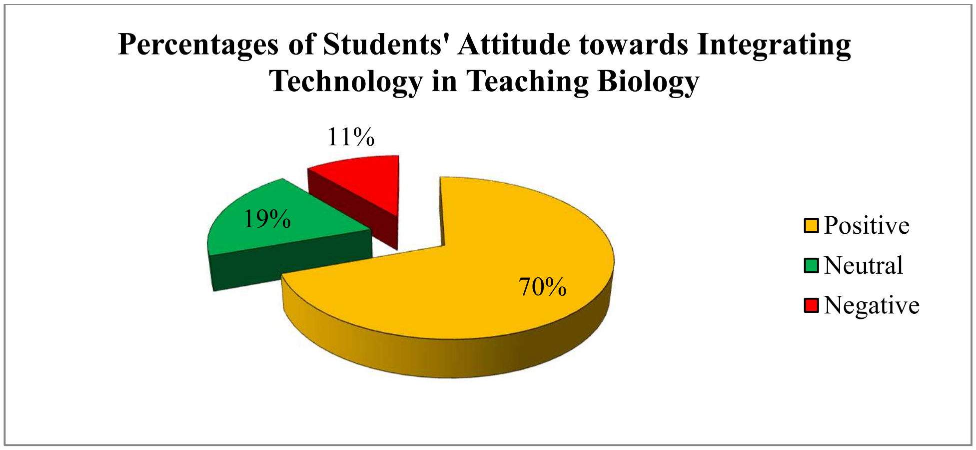

Figure 8: Pie Chart Showing the Percentages of Students' Attitude towards the Technology Integration in Teaching Biology

According to the results of attitude questionnaire, it can be interpreted that most of the students who are taught by technology integration are willing to use technology in their learning process and they are eager to inquire further information, to solve the problems collaboratively and to create their own product by using modern technologies such as computers, laptops, smart-phones provided with Internet access in learning biology.

Research Findings from the Interview of Biology Teachers

After experimenting with technology integration in teaching biology for Grade Nine students, the respective Grade Nine biology teachers were interviewed to know their attitudes and opinions. They admitted that they find difficulties to get further knowledge beyond the content of the prescribed textbook, to get further colorful diagrams, and to get the ways to demonstrate the practical works. They wondered when they know the ways to get further knowledge, colorful diagrams and video files of demonstrations of practical works with the help of Internet technologies. In spite of knowing that integrating technology in the classroom is helpful to motivate students' curiosity and attention, they do not have enough knowledge to use technological devices and also do not get enough technological devices. Even they do have such knowledge and devices, they cannot use more time to spend in integrating technology because they have to teach the content of the textbook according to the limited time span. Nevertheless, they all are eager to receive trainings in using technology in the classroom to upgrade their existing content and technological knowledge and to teach their students effectively and meaningfully especially by using inquiry-based learning process through the Internet access.

Discussion, Suggestions and Conclusion

Discussion and Suggestions

The objective of the study is to study the contribution of technology integration in teaching biology to Grade Nine students. So, a posttest, questionnaires for testing the attitude of the students and semi-structured interviews were used in this study. The results of the posttest showed that the means of the experimental groups in both selected schools are higher in all of the knowledge, comprehension and application levels than that of the control groups. Therefore, technology integration in teaching biology contributed positively to the achievement of the students.

The integration of technology in teaching biology not only improves the achievement of the students but also supports the students' innate ability and creativity. Through inquiry-based learning, the students can think about the problem, search the ways to solve the problems, solve the problems in the most effective ways in collaboration with peers and others. When teaching biology, most of the biological concepts can be engaged sufficiently by using colorful images and videos, showing real objects and sometimes the real events. Some of the biology lessons can only be understood when seeing lively (video) such as reproduction of animals, fertilization, circulation of the blood, etc. In such situation, the teacher needs to search relevant aids for the lessons but these audio-visual aids and further information of biology lessons are all available on the Internet. Technology allowed in-depth exploration of a smaller number of ideas and related facts around authentic, challenging tasks (Means and Olson, 1997 cited in Koc, 2005). Therefore, when students are using technology as a tool or a support for communicating with others, they are in an active role rather than the passive role of recipient of information transmitted by a teacher, textbook, or broadcast. The student is actively making choices about how to generate, obtain manipulate, or display information.

Integrating technology not only involves the attainment of computer skills but also consists of a process in which learners try, fail, access, evaluate, analyze and apply meaningful tasks including but not limited to researching, analyzing data, applying and representing knowledge, communication and collaborating. The results of authentic assessment showed that the students who integrated technology in learning biology are better not only in their computer skills but also in their collaborative, problem solving and presentation skills. Thus, the integration of technology into education is useful as a tool to teach the subject matter, and to promote problem-solving and higher-order thinking skills of the students.

According to the results of the students' attitude questionnaires, it showed that most of the students admitted that they enjoy exploring further information of biology, and to do practical works cooperatively with peers and to discuss and share the searched information with the whole class. Besides, the findings of the authentic assessment, they explore information to solve the problems and finally they create a product by using technology such as power point presentation, worksheets or booklets about the topic. During their work, they gave strong attention to their learning because of the motivation of the multimedia environment which includes text, sound, pictures, video, animation etc. that they have never learned. Learning is authentic and meaningful in such multimedia environment. Thus, inquiry-based learning incorporated with technology can provide meaningful and authentic learning environment to the students. Williams and Williams (1997) cited in Koc (2005) also supported that effective technology use should incorporate a variety of applications that focus on problem-solving and help development of creativity, adaptability and collaborative problem-solving skills. Thus, it is sure that technology integration not only contributes to improve the achievement of the students but also supports them to emerge their innate ability, curiosity and creativity.

According to the findings of the semi-structured interview of biology teachers, they showed similar difficulties that Onyegegbu stated in his research including; (a) Lack of technological skills and knowledge of using the technological devices in the classroom (lack of training), (b) Non-availability of new devices in the classroom, and (c) Large class size and (d) Lack of time to integrate technology in the classroom because of the limited monthly and yearly course plans in Myanmar. Such authentic works as inquiry-based learning takes more time than the formal teaching methods so it is challenging for Myanmar teachers to integrate technology in the classroom even though they have desire to do so. However, they can use technology to search necessary and related information such as diagrams and other supportive software first, and then integrate them into their teaching to improve the students' interest and understanding of the content.

It is obvious that technology integration is necessary to make 21st century teaching learning process more effective and efficient. Students' successful use of technology mainly depends on the way of teacher's systematic modeling. However, some teachers may want to side step technology and they want to omit it because they are scared to change to their normal state of recitation and repetition. Teachers' beliefs about knowledge acquisition and effective use of technology are correlated with the ways they use technology in their classrooms (Hannafin and Freeman 1995, cited in Koc, 2005). And the teacher's view of learning may be another factor to successful technology integration. Therefore, teachers should be trained systematically so that technology can be successfully integrated in the classroom. In Myanmar, teacher trainings should be first incorporated with the technology integration courses because the successful technology use of the students mainly depend on the teachers' successful technology integration in the classroom.

Furthermore, teachers should be provided with the required technological devices to incorporate in their teaching learning process. To become more effective in technology integration, learning environments should be changed from passive to active. The role of the teacher should be as a facilitator, coach or guide of the students' learning. In this way, the students may become the active manipulators of their learning process. To do so, teachers need to have enough time and appropriate class size. The following points would like to be suggested with respect to this study.

- Firstly, technology integration should be effectively implemented at the higher education level especially in the teacher training colleges and universities as a module before it is implemented in the basic education level.

- Secondly, in-service teachers should be given special trainings to improve their technological skills and to know the ways to integrate technology effectively in their classrooms.
- Technology integration ought to be done from primary and middle to secondary levels in basic education schools. And if necessary, International Society for Technology in Education (ISTE) National Educational Technology Standards for teachers and students should be followed.
- Instead of paper and pencil testing system which favors memorization, authentic assessments such as performance-based assessment (using rubrics) should be used so that technology integration becomes more meaningful and effective.
- It is necessary to support sufficient time, suitable class size and appropriate devices for successful technology integration.
- When integrating technology in the classroom, teachers-team system which includes all respective subject teachers who cooperate with each other may be a solution to overcome large class size problem.
- To implement such integration programs as rapidly as possible, the collaboration of community and the State may be a solution to the budget problem of supporting sufficient man and non-human resources.
- When using inquiry-based learning through the Internet resources in Myanmar basic education schools, there may be some difficulties to understand the language (mostly written in English) posed on the online websites. Therefore, to be able to more effectively inquire through the Internet, proper command of English is necessary for Myanmar students.
- Furthermore, only with the results of this study is not sufficient to implement an innovation process, it is necessary to conduct further

valid researches in other grades with longer period and broader content areas in other regions of Myanmar.

Conclusion

Information explosion occurs in all aspects of education as soon as technology develops at top speed. Therefore, pedagogical content knowledge alone is not sufficient for 21st century teachers, technological knowledge becomes essential for the teachers to create meaningful teaching learning processes. In any aspects of education, everybody has different learning styles but teachers cannot represent all the styles in a traditional classroom environment. But technology allows teachers to better serve the diverse learning styles of the students and educate them for wider range of intelligence.

With the flexibilities and helps of technologies, meaningful classroom environments can be designed so that students can manage and construct their own representation of knowledge in their minds. Therefore, it is time to more fully integrate technology into the educational setting since skillful use of technology supports the development of process skills such as higher order thinking skills, adaptability, and collaboration that are essential to succeed in the rapidly changing information age. Koc (2005) also suggested that technology is the most valuable to teaching and learning once teachers integrate it as a tool into everyday classroom practice and into subject matter curricula

Teaching biology becomes more and more challenging to match the rapid growth of biological knowledge in this information explosion society. The world is changing drastically in the era of technology and need people of highest potential who can teach biology with understanding, with enthusiasm and success. Dewey (1916) stated that if the teachers teach today as they taught yesterday, they rob the children of tomorrow. Today teachers should not teach the children of today as they taught yesterday because it is very dangerous for the future and because it is also undeniable that the world is changing and developing constantly. Thus, today's teachers should not hesitate to change their one-size-fits-all teaching methods in a technologically oriented society. In spite of some difficulties, technology integration in the classroom becomes one of the points to be considered in creating an education system that can generate a learning society capable of facing the challenges of the knowledge age.

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A STUDY OF THE CORRELATION BETWEEN STUDENTS' CRITICAL THINKING SKILLS AND THEIR MATHEMATICS ACHIEVEMENT AT THE MIDDLE SCHOOL LEVEL

Phue Pwint Khaing[1], Naing Naing Thein[2]

Abstract

The main purpose of this study is to study the correlation between students' critical thinking skills and their mathematics achievement at the middle school level. Especially, this study aims to study students' critical thinking skills in mathematics in terms of analysis, synthesis and evaluation level of Bloom's cognitive domain. A descriptive research design was used for this study. Four townships were randomly selected from four districts in Yangon Region. Twelve schools (eight high schools and four middle schools) were randomly selected from the four townships. The participants in this study included (600) Grade Eight students. As instruments, a test for critical thinking skills and a test for mathematics achievement were used. To obtain the reliability of these instruments, a pilot test was administered. The internal consistency (Cronbach's Alpha) of the test for students 'critical thinking skills was (.782) and of the test for students' mathematic achievement was (.807). In order to address the research questions, a descriptive statistics (percentage) and Pearson product-moment correlation were used. The percentage of low, moderate and high levels of students' critical thinking skills were 13.7% (N=82), 70.1% (N=421) and 16.2% (N=97) respectively. The percentage of low, moderate and high levels of students' mathematics achievement were 22.7% (N=136), 65.3% (N=392) and 12.0% (N=72) respectively. And also there was a positive correlation between students' critical thinking skills and their mathematics achievement ($r = .748$, $p < .01$).

Keywords: critical thinking, mathematics, achievement, cognitive domain, analysis, synthesis, evaluation

Introduction

Education is a lifelong process. Education is not teaching or learning of (3) R's - reading, writing and arithmetic. It consists of development of (4) H's – head, heart, hand and health. It also consists of knowledge, skills and attitudes. According to Dr. Radhakrishnan, education, to be complete, must be

1. Junior Assistant Teacher, BEHS (1), East Dagon, Yangon
2. Lecturer, Methodology Department, Yangon University of Education

humane, it must include not only training of the intellect but also the refinement of the heart and the discipline of the spirit (Dhiman, 2007).

Nowadays, western world pays attention to the education of thinking, methods of thinking, and relying on the memories which attempt to change learning trend (Taghva et al., 2014). Especially, critical thinking has been one of the tools used in daily life to solve some problems because it involves logical reasoning, interpreting, analyzing and evaluating information to enable one take reliable and valid decisions. Mathematics and critical thinking cannot be separated from each other. Hence, teaching critical thinking in mathematics classes should be a goal of mathematics education. Critical thinking is both a process and an outcome. And also, critical thinking skill is one of the 21st century skills. So, it was very important to develop critical thinking skills in mathematics classrooms.

Statement of the Problem

Some teaching methods in Myanmar classrooms are based on the teacher-oriented methods and most of the time the learners only memorize their learned materials in short-term and then forget them easily. Indeed, the learners have not any active role and freedom in such a method. Most of the teachers use the textbooks only that involve low level thinking skills such as memorizing facts without thinking. Developing thinking capability is one of the main goals of mathematics education. It is very important to support the development of mathematical critical thinking skills in the classroom. However, today's mathematics classroom exactly cannot support students' critical thinking skills. Hence their mathematics achievement cannot be reached satisfied condition.

Purposes of the Study

The main purpose of this study is to study the correlation between students' critical thinking skills and their mathematics achievement at the middle school level. The specific purposes of this study are as follows.

- To study students' critical thinking skills in the selected schools.
- To investigate students' mathematics achievement in the selected schools.

- To find out whether there is a correlation between students' critical thinking skills and their mathematics achievement in learning mathematics.
- To give suggestions for improving critical thinking skills at the middle school level.

Research Questions

The present research will shed light on the following research questions.

(1) To what extent do students possess critical thinking skills in mathematics?

(2) To what extent do students possess mathematics achievement?

(3) Is there a relationship between students' critical thinking skills and their mathematics achievement?

Scope of the Study

This research has its own limitations. The first limitation is related to the fact that the participants of the study came from only Yangon Region. The participants in this study were (600) Grade Eight students from the twelve selected schools of the four districts (East, West, South, and North) in the academic year (2016-2017). Eight basic education high schools and four basic education middle schools were included in this study. The second limitation is that this study is only concerned with the correlation between students' critical thinking skills (analysis, synthesis and evaluation levels of thinking of Bloom's cognitive domain) and their mathematics achievement. The third limitation is the content area of the subject. The items of critical thinking skills test were constructed based on only content standards of National Council of Teachers of Mathematics (2000, cited in Wikipedia, n.d.) and sample items of North Carolina Department of Public Instruction (1999, cited in Thompson, n.d.).

Definition of Key Terms

Critical Thinking: It is defined as the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Paul, 1992, cited in Vierra, 2014).

Analysis: It refers to the ability to break down material into its component parts so that its organizational structure may be understood (Jacobsen et al., 1989).

Synthesis: It is defined as the putting together of elements and parts so as to form a whole (Jacobsen et al., 1989).

Evaluation: It is concerned with the ability to judge the value of material for a given purpose (Jacobsen et al., 1989).

Achievement: It is the result of what an individual has learned from some educational experiences (Travers, 1970).

Significance of the Study

Efforts to develop the critical thinking skills of mathematics have become the main agenda in the curriculum of mathematics education worldwide (National Council of Teachers of Mathematics, 2000, cited in Firdaus et al., 2015). In the context of mathematical problem solving, Krulik and Rudnick (1995, cited in Firdaus et al., 2015) stated that critical thinking was analytical thinking and reflection that involved testing activities, questioning, connecting and evaluating all aspects of a situation or problem. Critical thinking skills are very important in mathematics learning because these skills can improve the quality of mathematics learning in better and meaningful.

Many educators argue that thinking skills can be learned and should be taught explicitly and students should be informed about the types of thinking skills taught to them. Research by Henningsen and Stein (1997, cited in Firdaus et al., 2015) showed that students' thinking skills can be developed if teachers create a classroom environment that supports the thinking activities. Teachers do not necessarily dominate and control the learning activities but should encourage students to take an active role and demonstrate good multilateral interaction between teacher and student or student to student interaction.

Critical thinking skills are necessary for students to succeed in their future. The skills of critical thinking should be applied and developed in core curriculum and teaching and learning process to produce students who have the quality of thinking critically when they become future leaders.

Mathematics teaching not only teaches mathematical content but also develop students' critical thinking skills that are necessary for students to solve various problems in school or in social life. Therefore, it is essential and necessary to develop students' critical thinking skills in all subjects, especially mathematics.

Theoretical Framework

Importance of Mathematics

It is necessary for every person to have a basic knowledge of mathematics to lead his daily life activities properly. The knowledge and skill in the fundamental process of mathematics can be achieved through the systematic study of this subject. Most of the occupations, by which the needs of people are fulfilled cannot run without the use of mathematics. The entire business and commercial system is the best on the knowledge of mathematics. It is helpful in the study of other sciences. It is an indispensable instrument for all physical researches. The progress of a nation depends upon the progress of mathematics. It is useful in budgeting. It is correlated with other subjects. So, mathematics occupies a prominent place in daily life.

Mathematics teachers need to use the best methodology to assist each learner to do well in the curriculum. Presently in the school curriculum as well as in the society the pupils need to develop knowledge and skills to perform well in achieving objectives. The teacher needs to study each pupil carefully to notice under which conditions maximum achievement is possible. Therefore, a teacher should not be a slave of only one method. A teacher should try to imbibe the good qualities of all the methods. A mathematics teacher will able to keep himself abreast of up-to-date knowledge of all methods and will exploit their advantages to the maximum. Students should be provided maximum opportunity of participation in the teaching and learning process. Therefore, not only mathematics is essential in everyday life but also the method the teacher used in the teaching of mathematics plays an important role in the 21st century education.

Importance of Critical Thinking Skills

Educators have long been aware of the importance of critical thinking skills as an outcome of student learning. More recently, the partnership for the 21st century skills has identified critical thinking as one of several learning and innovation skills necessary to prepare students. (Lewis & Smith, 1993, cited in Lai, 2011).

Those working in the field of education have also participated in discussions about critical thinking. Benjamin Bloom's taxonomy for information processing skills is one of the most widely cited sources for educational practitioners when it comes to teaching and assessing higher order thinking skills. Bloom's taxonomy is hierarchical, with knowledge at the bottom and evaluation at the top. The three highest levels (analysis, synthesis, and evaluation) are frequently said to represent critical thinking (Kennedy et al., 1991, cited in Lai, 2011).

Critical thinking and problem solving are similar because they both encourage students to think about how they approach a problem or challenge and how to tackle the problem. Using the six steps to effective thinking and problem solving, or ''IDEALS'' (Facione, 2007, cited in Lai, 2011), the problem solver works through a case study or activity by responding to questions from the peer coach. The IDEALS are to identify, define, enumerate, analyze, list and self-correct.

I – Identify the problem: What is the real question we are facing?

D – Define the context: What are the facts that frame this problem?

E – Enumerate the choices: What are plausible options?

A – Analyze options: What is the best course of action?

L – List reasons explicitly: Why is this the best course of action?

S – Self correct: look at it again, what did we miss?

This problem solving technique guides students through the critical thinking process and utilizes learner collaboration. Haladyna (1997) expressed the complexity of thinking and learning dimensions by classifying four levels of mental processes (understanding, problem solving, critical thinking, and creativity) that can be applied to four types of content (facts, concepts, principles, and procedures). Applying a set of skills across dimensions of content fits well with the actual complex, recursive, and systemic processes of higher order thinking. Although his terminology often varies from other theorists', the territory is similar.

Haladyna's terms	**Gagné's terms**	**Bloom's terms**
facts	information	knowledge
concepts	concepts	comprehension
principles, procedures	rules	application
critical thinking	problem solving	synthesis and evaluation
creativity	no direct match	no direct match

The following procedure can be applied while solving a problem to develop critical thinking skills.

1. Identify the problem (which computational skill they need to use)
2. Conduct research (engaging with the information given)
3. Generate ideas (use previous knowledge to develop their understanding)
4. Develop possible solutions (apply your understanding)
5. Check solutions (have they used sound reasoning)

Bloom's Cognitive Education

Cognitive domain is the domain that deals with the recall and recognition of knowledge and the development of understandings and intellectual abilities and skills. Cognitive education is composed of the set of instructional methods that assist students in learning knowledge to be recalled or recognized, as well as developing students' understandings and intellectual abilities and skills. Bloom and his associates (1956, cited in Jacobsen et al., 1989) attempted and categorized the cognitive domain from simple concrete knowledge level toward the highest level of evaluation. North Carolina Department of Public Instruction (1999, cited in Thompson, n.d.) defined the following items of higher order thinking skills.

Analyzing

North Carolina Department of Public Instruction (1999, cited in Thompson, n.d.) defined analyzing as clarifying existing information by examining parts and relationships; identifying attributes and components; identifying relationships and patterns; identifying errors. The following items were labeled by North Carolina Department of Public Instruction as analyzing (higher order thinking).

(1) The formula to find the area of a circle is $A = \pi r^2$. What is the area of a circle if the diameter is 16 cm? (Use 3.14 for π)

(2) Which of the following is an algebraic expression for “twice the sum of a number and 5”?

Integrating (Synthesizing)

North Carolina Department of Public Instruction (1999, cited in Thompson, n.d.) defined integrating as combining information efficiently into a cohesive statement and changing existing knowledge structures to incorporate new information. The following items were labeled by North Carolina Department of Public Instruction as integrating or synthesizing (higher order thinking).

(1) The length of a house is 68 feet and the width is 24 feet. Find the area of the house.

(2) What is the sales tax on $10,200 automobile if the sales tax rate is 4%?

Evaluating

North Carolina Department of Public Instruction (1999, cited in Thompson, n.d.) defined evaluating as assessing the reasonableness and quality of ideas; creating standards for making judgments; confirming the accuracy of claims. The following items were labeled by North Carolina Department of Public Instruction as evaluating (higher order thinking).

(1) Which expression is equal to 144?

A. 72 + 72 B. 100 + 4 C.100 – 4 D. 225 - 64

(2) Using different data, two scientists each developed an equation for the same experiment. The equations were $y = \frac{2}{3}x - 4$ and $y = 3x + 10$. Which ordered pair is valid for both scientists?

A. (-6, -8) B. $(\frac{8}{3}, 2)$ C. $(-\frac{10}{3}, 0)$ D. (2 , 16)

In conclusion, the researcher investigated students’ critical thinking skills in mathematics by using test based on these sample items of North Carolina Department of Public Instruction.

Research Method

Research Design

Quantitative research method was used in this study. The research design for this study was a descriptive research design.

Procedure

Firstly, the researcher defined a research problem. Then, the researcher sought out the literature through reading the resources. Moreover, the researcher studied the literature from the Internet sources. From the related literature, the researcher defined analysis, synthesis and evaluation levels of thinking skills to measure critical thinking skills according to Bloom's taxonomy of cognitive domain. After that research instruments were prepared, the instruments were validated through a pilot test with (50) Grade Eight students from B.E.H.S (1) East Dagon. After the pilot test, the sample schools and students for this study were selected. Tests were administered to all the participants of the twelve sample schools with the help of the headmaster/headmistress of those schools in January, 2017. After that, students' answer sheets for both critical thinking skills and mathematics achievement were scored manually based on the marking scheme. All the data were entered in the computer data file. Finally, the data were systematically analyzed by using the Statistical Package for the Social Science (SPSS 22).

Instruments

(i) Test for Students' Critical Thinking Skills

To study the students' critical thinking skills, a test for students' critical thinking skills was used. Under this studying, firstly, the table of specifications was prepared including eleven multiple choice items scoring (1) mark, three problems scoring (3) marks and six problems scoring (5) marks. Therefore, the total score was (50) marks. All items were constructed based on higher levels of Bloom's taxonomy of cognitive domain of North Carolina Department of Public Instruction (1999, cited in Thompson, n.d.). First, four multiple choice items, one problem for (3) marks and two problems for (5) marks were based on analysis level of thinking. Second, three multiple choice items, one problem for (3) marks and two problems for (5) marks were based on synthesis level of thinking. Third, four multiple choice items, one problem for (3) marks and two problems for (5) marks were based on evaluation level of thinking. The content areas of this test were based on content standards of National Council of Teachers of Mathematics (2000, cited in Wikipedia, n.d.).

(ii) Test for Students' Mathematics Achievement

In order to measure the students' mathematics achievement, a test for students' mathematics achievement was constructed. It was based on the content areas of Grade Eight mathematics textbooks prescribed by the Department of Education, Basic Education Curriculum, Syllabus and Textbook Committee, 2013-2014 academic year. The table of specifications was prepared including ten multiple choice items scoring (1) mark, five problems scoring (3) marks and five problems scoring (5) marks. Therefore, the total score was (50) marks. This test includes (16) chapters: (13) chapters from mathematics textbook volume I and (3) chapters from mathematics textbook volume II.

Population and Sample Size

All the participants in the sample were Grade Eight students. This study was conducted in Yangon Region. There are four districts in Yangon Region. One township from each district was randomly selected for this study. The sample schools for the study were selected by using a stratified random sampling technique. Two high schools and one middle school from each township were selected as the sample. Therefore, twelve schools (eight high schools and four middle schools) were included in this study. Fifty Grade Eight students from each selected school were selected as the subjects by an equal-sized random sampling technique. The number of participants was (600).

Data Analysis

The descriptive analysis techniques were used to calculate means, standard deviation and percentage. Moreover, Pearson product-moment correlation was used to describe the correlation between students' critical thinking skills and their mathematics achievement.

Research Findings

Finding of Students' Critical Thinking Skills

In order to find out the students' critical thinking skills, a descriptive statistics (mean, standard deviation, and percentage) were used. The mean and the standard deviation by all the participants were (14.57) and (8.779) respectively. By using standard deviation, students who possessed marks above (23) were defined as high achieving students in critical thinking skills. Students who possessed marks from (6) to (23) were defined as moderate achieving students in critical thinking skills. And then students who possessed marks under (6) were defined as low achieving students in critical thinking skills. Table (1) described the percentage of students who possessed low, moderate and high levels of critical thinking skills.

Table 1 Students' Critical Thinking Skills Level

Students' Critical Thinking Skills Level	Score	No. of Student	Percentage (%)
Low	0-5	82	13.70%
Moderate	6-23	421	70.10%
High	24-50	97	16.20%
Total		**600**	**100%**

Finding of Students' Mathematics Achievement in the Selected Schools

In order to examine the students' mathematics achievement, a descriptive statistics (mean, standard deviation, and percentage) were used. The mean and the standard deviation by all the participants were (20.81) and (10.824) respectively. By using standard deviation, students who possessed marks above (32) were defined as high achieving students in mathematics. Students who possessed marks from (10) to (32) were defined as moderate achieving students in mathematics. And then students who possessed marks under (10) were defined as low achieving students in mathematics. Table (2) classified the percentage of students who possessed low, moderate and high levels of mathematics achievement.

Table 2: Students' Mathematics Achievement Level

Students' Mathematics Achievement Level	Score	No. of Student	Percentage (%)
Low	0-9	136	22.70%
Moderate	10-32	392	65.30%
High	33-50	72	12.00%
Total		**600**	**100%**

Finding of the Correlations between Students' Critical Thinking Skills and their Mathematics Achievement in the Selected Schools

To investigate the correlation between students' critical thinking skills and their mathematics achievement, Pearson product-moment correlation was used. Firstly, the correlations between sub-components of students' critical thinking skills and their mathematics achievement were presented. According to Gay and Airasian (2003), correlation coefficient below plus or minus (.35) was interpreted as low or no relation, correlation coefficient between plus or minus (.35) and (.65) was interpreted as moderate relation and correlation coefficient higher than plus or minus (.65) was interpreted as high relation.

Table 3: Correlations between Students' Critical Thinking Skills (Analysis, Synthesis and Evaluation) and their Mathematics Achievement in the Selected Schools

Correlation		
Level of Critical Thinking Skill		**Students' Mathematics Achievement**
Analysis Level of Thinking	Pearson Correlation	**.631****
	Sig. (2-tailed)	.000
	N	600
	Pearson Correlation	**.548****

Synthesis Level of Thinking	Sig. (2-tailed)	.000
	N	600
Evaluation Level of Thinking	Pearson Correlation	**.655****
	Sig. (2-tailed)	.000
	N	600
Critical Thinking Skills	Pearson Correlation	**.748****
	Sig. (2-tailed)	.000
	N	600

** Correlation is significant at the 0.01 level (2-tailed).

Discussion, Suggestions and Conclusion

Discussion

Understanding and fostering the ability to help students think critically is essential to their educational success. Duron, Limback, and Waugh (2006) defined critical thinking as the ability to analyze and evaluate information. In teaching and learning mathematics in schools, critical thinking needs to be integrated and emphasized in the curriculum so that students can learn the skills and apply it to improve their performance and reasoning ability. Assessment of critical thinking skills is an educational priority. With this view, this study seeks to address this demand by investigating the relationship between critical thinking skills and mathematics achievement.

The percentage of students who possessed low, moderate and high levels of critical thinking skills were 13.7% (N=82), 70.1% (N=421) and 16.2% (N=97) respectively. So, these findings revealed the answer to the first research question: To what extent do students possess mathematics achievement?

The percentage of students who possessed low, moderate and high levels of mathematics achievement were 22.7% (N=136), 65.3% (N=392) and 12% (N=72) respectively. So, these findings revealed the answer to the second research question: To what extent do students possess critical thinking skills in mathematics?

The correlation between students' critical thinking skills and their mathematics achievement was (r (10) = .748, $p < .01$). This result showed that the direction of correlation was positive. It was a high correlation. It is pointed out that if the students' critical thinking skills was high, their mathematics achievement was also high or if the students' critical thinking skills was low, their mathematics achievement was also low. So, this finding revealed the answer to the third research question: Is there a relationship between students' critical thinking skills and their mathematics achievement?

According to the results of the research, a generalization can be drawn that students' critical thinking skills significantly influenced the students' mathematics achievement. Therefore, it can be realized that it is crucial to foster students' critical thinking skills for improving their mathematics achievement in the middle schools.

Suggestions

Instruction which promotes critical thinking skills can foster academic achievement gains. These skills are necessary for everyone to have in rapidly changing, technologically oriented world. So, everyone should develop critical thinking skills in order to face the challenges of the 21st century. Teachers' role, students' role and classroom activities for improving higher levels of Bloom's cognitive domain (analysis, synthesis, and evaluation), instructional strategies, assessment for promoting critical thinking skills and suggestions for further study are given as suggestions.

(i) Teachers' role, students' role and classroom activities for improving higher levels of Bloom's cognitive domain (analysis, synthesis, and evaluation): In order to develop analysis level of thinking of students, the students should discuss found knowledge, dissect information into parts and understand relationships and classification of information. And also the teachers should probe students, act as resource and guide students in direction of outcomes. Moreover, in order to improve students' analysis level of thinking in all subjects, the teachers should carry out such classroom activities as presenting information in graph, presenting survey results, planning a diagram, developing questionnaire, developing a mind map, stating attributes of issues, developing outline of process and developing chart for plan of action.

In order to develop synthesis level of thinking of students, the students should generalize from facts, predict and draw conclusions and use old ideas to create new ones. And also the teachers should extend student thinking and evaluate through non-traditional ways. Moreover, in order to improve students' synthesis level of thinking in all subjects, the teachers should carry out such classroom activities as composing a song, developing a mural, writing a puppet show, skit, developing an advertisement, presenting a solution for change, discovering own invention, designing a newspaper and writing a story.

In order to develop evaluation level of thinking of students, the students should judge outcomes, disputes thoughts and ideas and form opinions. And also the teachers should lay the criteria and act as facilitator. Moreover, in order to improve students' evaluation level of thinking in all subjects, the teachers should carry out such classroom activities as participating on panel, giving a recommendation, conducting a mock trial, evaluating project, stating decisions, participating in debate, arriving at group conclusion, developing a rating scale, backing the opinions, presenting and writing and editorial.

(ii) Instructional strategies: Higher order thinking skills require students to manipulate information and ideas in ways that transform their meaning and implications. This transformation occurs when students combine facts and ideas in order to synthesize, generalize, explain, hypothesize, or arrive at some conclusion. Effectiveness in planning and teaching can improve student achievement in mathematics. The use of higher order skills from Bloom's taxonomy can serve as a guide to use good pedagogy in the classroom. Once teachers have developed the skills and understanding, these elements can be integrated into the daily activity of the classroom. The use of Bloom's taxonomy and knowing the composition of the class that makes teaching more conscious and purposeful.

Questioning should be used purposefully to achieve well-defined goals. Typically a teacher should vary the level of questions within a single lesson. Usually questions at the lower levels are appropriate for evaluating students' preparation and comprehension, diagnosing students' strengths and weaknesses and reviewing or summarizing content. Questions at higher levels of the taxonomy are usually most appropriate for encouraging students to think more deeply and critically, problem solving, encouraging discussions and stimulating students to seek information on their own. The teacher should plan a lesson, which includes a variety of activities and questions, forcing students to think and function at each level of the Bloom's taxonomy. Mathematics teachers should prepare questions and activities related to all levels of Bloom's taxonomy directly related to the content of study.

(iii) Assessment for promoting critical thinking skills: Open-ended problem types may be more appropriate than traditional multiple-choice formats. For this reason, the researcher studied critical thinking skills using a test of mixed item format, both multiple-choice and open-ended. Teachers should adopt different assessment methods, such as exercises that allow students to self-construct answers, assignments that facilitate the practice of strategic use of thinking skills in everyday contexts, and when adopting multiple-choice exercises, follow-up questions should be given to probe students' underlying reasoning.

(iv) Suggestions for further study: No study is perfect in a single effort. This study was dealt with the students' critical thinking skills such as analysis, synthesis and evaluation from Bloom's cognitive domain. Therefore, further studies should be conducted with other thinking skills such as inference, inductive reasoning, deductive reasoning, interpretation and so on.

Conclusion

Education is important because it gives people the baseline skills to survive as adults in the world. These skills include basic literacy and numeracy, as well as the ability to communicate, complete tasks and work with others. Among the skills, thinking skills are essential in solving problems of mathematics. Without thinking, students cannot require real achievement in mathematics. They cannot solve new problems. Thus the teachers should teach mathematics to their students with thinking and not with rote memorization

If a critically thoughtful approach helps students better understand what they are learning, it makes sense to invite students to make decisions about every aspect of mathematics, including selecting strategies for building number sense and mastery of basic facts, deciding how to approach a problem for which they have no ready-made solution or procedure, choosing the most appropriate way to represent a mathematical situation, monitoring their problem solving progress and adjusting as necessary, analyzing their own responses, communicating their mathematical ideas effectively and connecting mathematics with their own lives and the wider world.

According to the literature, critical thinking is important in life. It can lead to the development of students' judgment, evaluation and problem solving abilities. Learning critical thinking skills can also enhance students' academic performance. Students with critical thinking skills become more independent, self-directed learners rather than relying on teachers and others. If the students have the ability to analyze, synthesize and evaluate critically, then their mathematics achievement will be high. So, every teacher should create a learning environment in which students think critically and creatively rather than memorizing facts. Teachers should develop interesting classroom activities to enhance thinking skills of students. Although this study cannot fulfill all the aims of teaching and learning mathematics in the middle schools, it can be a support for teachers to foster the middle school students' critical thinking skills in Myanmar.

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Appendix A

(Test for Students' Critical Thinking Skills)

t|rwef; (Grade Eight) ausmif;om;^olrsm;
ocFsmbmom&yfqkdif&m aMumif;usdK;qufpyf
pOf;pm;awG;ac:EdkifaompGrf;&nf ppfaq;vTm

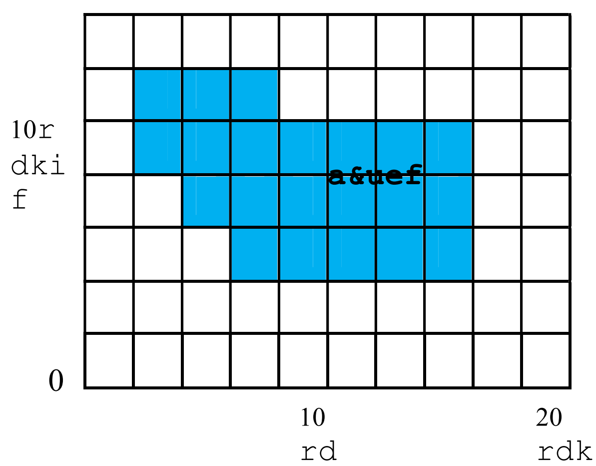
2017 ckESpf
cGifhhjyKcsdef (1;30) em&D

nTefMum;csuf/ / atmufygar;cGef;rsm;
tm;vHk;udkajzqdkyg/

tydkif; (u)

cGJjcrf;pdwfjzmEdkifrI (Analysis)

1.



yHkygay;xm;csufrsm;t& a&uef\ pkpkaygif; ywfvnftvsm;udk a&G;cs,fyg/

A. 22 rdkif B. 44 rdkif C. 48 rdkif D. 56 rdkif E. 84 rdkif

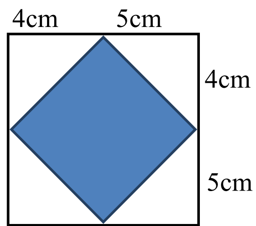
2. atmufygazmfjycsufrsm;teuf rSefuefonfhazmfjycsufudk a&G;cs,fyg/

A. $3\frac{2}{3} < 3\frac{1}{3} < 2\frac{2}{3}$, B. $3\frac{2}{3} < 2\frac{2}{3} < 3\frac{1}{3}$, C. $3\frac{1}{3} > 2\frac{2}{3} > 3\frac{2}{3}$

D. $3\frac{2}{3} > 3\frac{1}{3} > 2\frac{2}{3}$, E. $3\frac{1}{3} < 3\frac{2}{3} < 2\frac{2}{3}$

3. ay;xm;aomyHkwGif jc,frIef;xm;aom pwk&ef;\ {&d,mudk a&G;cs,fyg/

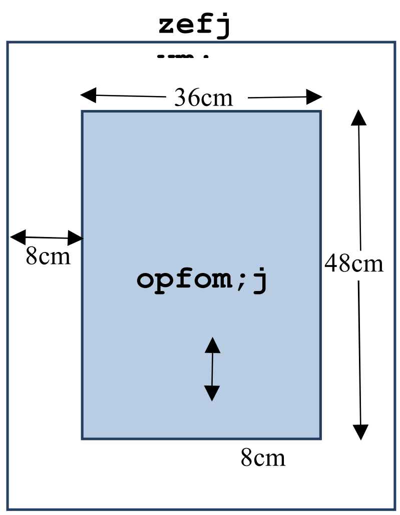
A. $20cm^2$ B. $36cm^2$ C. $41cm^2$ D. $61cm^2$ E. $81cm^2$



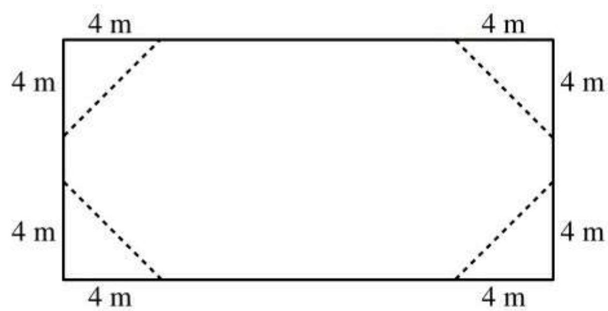
4. 4^2 ESifh 4^3 wdkYMum;wGif&Sdaom tjynfhudef; ta&twGuf pkpkaygif;udkazmfjyyg/

A. 45 B. 46 C. 47 D. 48 E. 49

5. pm;yGJwpfvHk;\ rsufESmjyifudk zefjym;jzifhjyKvkyfxm;\/ twGif;ydkif;udk opfom;jym;jzifh jyKvkyfxm;\/ zefjym;onf opfom;jym;xuf 8cm ywfvnfydkus,faomf zefjym;\ pkpkaygif;ywfvnftem;udk&Smyg/



6. axmifhrSefpwk*Hwpfck\ tvsm;onf 20m &Snfí teHonf 10m &Snf\/ axmifhrSefpwk*HrS Mwd*Hav;ckudk z,fvdkufvSsif usefaomtydkif;\ {&d,mudk&Smyg/



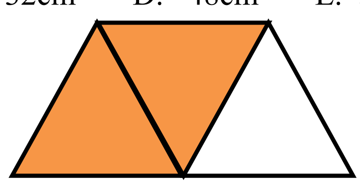
7. armifarmifonf urf;ajcrS tdrfodkY oJ $1\frac{1}{3}$ aygif o,fvmonf/ xkdoJrsm;udk armifarmifonf ykvif;rsm;xJodkY xnfh\/ ykvif;wpfvHk;vQif oJ $\frac{2}{9}$ aygifom qHh\/ xdktcg armifarmifhtwGuf oJtm;vHk;xnfh&ef ykvif;pkpkaygif; rnfrSsvdktyfoenf;/

tydkif; (c)

aygif;pyfpkpnf;EdkifrI (Synthesis)

1. ay;xm;aom MwmyDZD,rfyHkudk wlnDaom Mwd*H oHk;cktjzpf tydkif;ydkif;xm;ygonf/ jc,frIef;xm;aom tem;jydKif pwk*H\ {&d,mrSm 16cm^2 jzpfcJhvQif MwmyDZD,rf\ {&d,mudk wGufyg/

A. 8cm^2 B. 24cm^2 C. 32cm^2 D. 48cm^2 E. 56cm^2



2. atmufazmfjyyg udef;pOfwGif vkdtyfaeaomudef;udk cefYrSef;ajzqdkyg/

1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
1 5 10 10 5 1
1 6 15 ... 15 6 1

A. 5 B. 20 C. 21 D. 10 E. 425

3. $\frac{1}{2}+\frac{1}{4}=\frac{3}{4}$

$\frac{1}{2}+\frac{1}{4}+\frac{1}{8}=\frac{7}{8}$

$\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}=\frac{15}{16}$

$\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+\frac{1}{32}=\frac{31}{32}$ jzpfcJhvQif

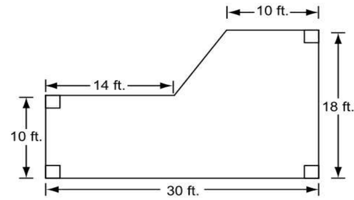
$\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+\ldots+\frac{1}{1024}=\ ?$

xdkudef;wef;\ aygif;v'fudk cefYrSef;ajzqdkyg/

A. $\frac{1001}{1024}$ B. $\frac{1010}{1024}$ C. $\frac{1023}{1024}$ D. $\frac{1025}{1024}$ E. $\frac{1022}{1024}$

4. jrjronf ol\acG;udk aeYpOf tpm 8 atmifpauGs;onf/ &ufaygif; 40 Mumaomf jrjr\ acG;onf tpmpkpkpkaygif; aygif rnfrQ pm;cJhoenf;/

5. ay;xm;aomyHk\ {&d,mudk wGufyg/ (ft. = ay)



6. vl 4 a,m aumfzDrIefYyHk;rsm; 0,f,l\/ vlwpfa,mufvQif wpfyHk;om

0,f,lcGifh&Sdonf/ odkUaomf wpfyHk;pDwGif yg0ifaom aumfzDrIefUatmifpESifh aps;EIef;rsm;onf

rwlnDMuay/ xdktcg rnfol\ aumfzDrIefYyHk;onf aps;EIef;toufomqHk; jzpfrnfenf;/

	aumfzDyHk;aps;EIef;	yg0ifaomatmifp
yxrvl	3.84 a':vm	24 atmifp
''kwd,vl	3.90 a':vm	30 atmifp
wwd,vl	4.48 a':vm	32 atmifp
pwkw¬vl	4.25 a':vm	25 atmifp

tydkif; (*)

tuJjzwfwGufcsufEdkifrI (Evaluation)

1. $x = 3, y = 5$ jzpfcJhvQif $3x^2 - 2y$ \wefzdk;onf $2x^2 - 3y$ \wefzdk;xuf rnfrQydkoenf;/

A. 4 B. 14 C. 16 D. 20 E. 50

2. ay;xm;aomZ,m;wGif x ESifh y wdkU\ qufoG,fcsufudk toHk;jyKí vdktyfaom y \wefzdk;udk azmfjyyg/

x	y
1	3
1.5	4.5
2	6
2.5	
3	9
3.5	10.5

A. 5 B. 6.5 C. 7 D. 7.5 E. 8

3. $(11x + 2) + (6x + 4) + (x + 5) > 90$

¤if;rS x \wefzdk;udk azmfjyyg/

A. $x > \frac{79}{18}$

B. $x > \frac{79}{17}$

C. $x > \frac{101}{18}$

D. $x > \frac{101}{17}$

E. $x > \frac{78}{17}$

4. em&DwpfvHk;wGif em&DvufwHwpfckom&Sd\/ xdkem&DvufwHonf 4 em&DESifh 5 em&DMum; $\frac{2}{5}$ ae&modkY

a&mufaeaomf em&DnTefjyaeaom tcsdefudkazmfjyyg/

A. 04:10 B. 04:20 C. 04:22 D. 04:24 E. 04:26

5. ay;xm;aomZ,m;udktoHk;jyKí vkdtyfaomudef;ESpfvHk;\ wefzdk;udk azmfjyyg/ x ESifh y wdkU\

qufoG,fcsufudk azmfjyyg/ (Z,m;udkjyeful;í jznfhyg)

x	y
0.5	2
1	1
2	0.5
4	0.25
5	
10	

6. ausmfausmfonf 20% aps;avQmhxm;aom wD&Syfwpfxnfudk 15%avQmhay;aom ol\ ulyGefuwfjzifh

0,fcJh\/ wD&Syf\ rlvwefzdk;onf 37000usyfjzpfaomf ausmfausmfonf wD&Syfudk rnfhonfhaps;EIef;jzifh

0,fcJhoenf;/

7. udef;pOf 9, 10, 13, 18, … rS 13 Mudrfajrmuf udef;udk azmfjyyg/

udef;pOf $1, \frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \ldots$ rS 8 Mudrfajrmuff udef;udk azmfjyyg/

udef;pOf 1×2, 2×3, 3×4, 4×5, ... rS n Mudrfajrmufudef;udk azmfjyyg/

udef;pOf 1, 0.1, 0.01, 0.001, … rS 7 Mudrfajrmuf udef;udk azmfjyyg/

udef;pOf 3, 9, 27, 81, … rS n Mudrfajrmufudef;udk azmfjyyg/

Appendix B

(Test for Students' Mathematics Achievement)

t|rwef;(Grade Eight) ausmif;om;^olrsm;
ocFsmbmom&yfqkdif&m wwfajrmufrIppfaq;vTm

2017 ckESpf
cGifhhjyKcsdef (1;30) em&D

nTefMum;csuf/ atmufygar;cGef;rsm; tm;vHk;udkajzqdkyg/

tydkif; (u)

atmufygwkdYrS tajzrSefudk a&G;cs,fyg/

1. $\sqrt{2}-\dfrac{2}{\sqrt{2}}$ udk&Sif;vQif atmufygwdkUteuf rnfonfhudef;ESifh wlnDoenf;/

A. 0 B. $\sqrt{2}$ C. $\dfrac{1}{\sqrt{2}}$ D. $-\dfrac{1}{\sqrt{2}}$

2. V = $\dfrac{4}{3}\pi r^3$ yHkaoenf;rS π udk &Sm&ef yHkaoenf;rSm atmufygwdkUteufrS rnfonfhtcsuf jzpfoenf;/

A. $\dfrac{3r^2}{4V}$ B. $\dfrac{4V}{3r^3}$ C. $\dfrac{4r^3}{3V}$ D. $\dfrac{3V}{4r^3}$

3. $2x + 3y = 16$

$x + 3y = 11$ jzpfvQif $x + 2y$ \ wefzdk;udk&Smyg/

A. 12 B. 9 C. 6 D. 3

4. x 0if&dk;ay:&Sd trSwfwkdif;\ y udkMo'dedwf wefzdk; udk&Smyg/

A. 1 B. -1 C. 2 D. 0

5. $1\times2\times3,\ 2\times3\times4,\ 3\times4\times5,\ \ldots$ udef;pOf \ pwkw¬ajrmufudef; udk&Smyg/

A. $3\times5\times7$ B. $4\times5\times6$ C. $5\times6\times7$ D. $2\times4\times6$

6. tajcoHk;jzif 102 + 212 udk&Sif;vQif &&Sdrnfhtajzrsefudka&G;cs,fyg/

A. 321 B. 1021 C. 1201 D. 1102

7. trSm;cefYrSef;&mwGif tvsm; 3.6 cm &Sd rsOf;wpfaMumif;twGuf ti,fqHk;rlwnfudef;onf

atmufygwdkUteuf rnfonfhtvsm; jzpfoenf;/

A. 1 cm B. 0.01 cm C. 0.1 cm D. 0.001cm

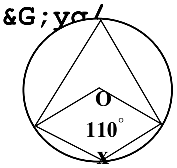
8. Mwd*Hwpfck\ tem;wpfzuf\ tv,frSwfudkjzwfí tem;wpfzufESifh jydKifatmif qGJaomrsOf;onf

usefwwd,tem;udk rnfodkYydkif;jzwfoenf;/

A. xuf0uf B. av;yHkwpfyHk C. oHk;yHkESpfyHk D. oHk;yHkwpfyHk

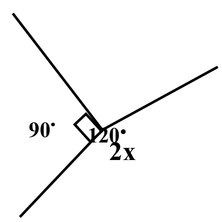
9. **yHkygay;xm;csufrsm;t&** x**\wefzdk;udka&G;yg/**

A. 20° B. 70° C. 110° D. 125°



10. yHkygay;xm;csuft& x onf atmufygwdkUteuf rnfonfhwefzdk;ESifh nDoenf;/

A. 5° B. 80° C. 55° D. 45°



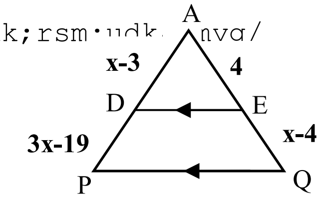
tydkif; (c)

1. $3^{2x-1} \times 3^{4x+8} = (\frac{1}{27})^{2x-5}$ jzpfvQif x udk&Smyg/

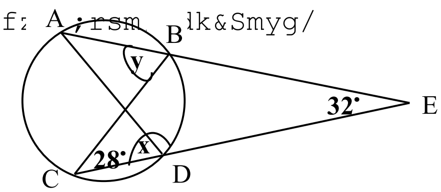
2. ydkvDEdkrD,,f $\frac{83}{7}y+\frac{18}{5}y^2-\frac{6}{7}y^3$ udk ydkvDEdkrD,,f $\frac{6}{5}y^2+\frac{1}{7}y^3-\frac{2}{7}y^5$ rS Ekwfyg/

3. $\dfrac{x^2+9x+14}{x^2-3x} \times \dfrac{2x^2+2x}{x^2+6x-7} \div \dfrac{x}{x-3}$ udk&Sif;yg/

4. yHkwGif $DE \parallel PQ$ jzpf\/ x \ wefzdk;rsm;udk&Smyg/



5. yHkwGif x ESifh y wkdU\ wefzdk;rsm;udk&Smyg/



tydkif; (*)

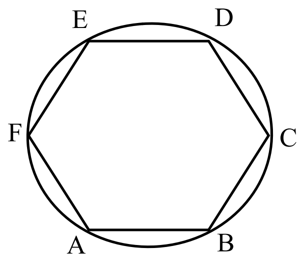
1. axmifhrSefpwk*Hwpfck\ Murf;jyif{&d,monf 144 pwk&ef;ay jzpf\/ ¤if;tcef;\ tvsm;onf teHxuf 10 ayydkí &Snfaomf tcef;\ tvsm;ESifh teHudk&Smyg/

2. pufavSwpfpif;onf acsmif;wpfcktwGif; ckwfarmif;&m a&qefwGif 5 rdkifc&D;armif;Edkifonfh tcsdeftwGif; a&pkefü 9 rdkifc&D;armif;Edkif\/ xdkacsmif;\ a&pD;EIef;rSm wpfem&D 2 rkdifjzpfvQif a&jidrfü xdkpufavSonf wpfem&D rkdifrnfrQ ckwfarmif;Edkifoenf;/

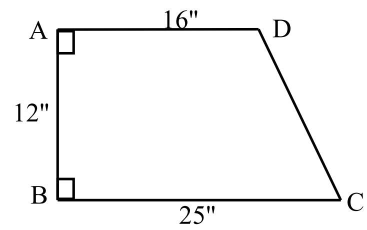
3. $A = \{2, 3, 5, 7, 9\}$, $B = \{2, 3, 5, 4, 5\}$ ESifh $C = \{2, 4, 6, 7, 8, 9\}$ jzpfvQiff atmufygwdkUudk&Smyg/
(i) $A \cap B$ (ii) $B \cap C$ (iii) $(A \cap B) \cap C$ (iv) $A \cap (B \cap C)$
(v) $(A \cap B) \cap C = A \cap (B \cap C)$ jzpfygovm;/

4. ay;csuf || ABCDEF onf puf0dkif;wGif;us q|*H jzpfonf/

oufaojy&ef || $\angle FAB + \angle BCD + \angle DEF = 360°$



5. ay;xm;aomMwmyDZD,rfyHkrS BD, AC ESifh CD wdkUudk&Smyg/



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A STUDY OF THE EFFECTIVENESS OF DEMONSTRATION METHOD ON GRADE NINE STUDENTS' ACHIEVEMENT IN PHYSICS

Myint Shwe Soe [1] and Swe Swe Nyunt [2]

Abstract

The main purpose of the present study is to study the effectiveness of demonstration method on Grade Nine students' achievement in physics. Demonstration method was used as a method of teaching that relies heavily upon showing the learner a model performance. Demonstration method includes five main parts: purposing, planning, demonstration proper, executing and evaluation. The design used in this study was a true experimental design; pretest-posttest control group design. According to the format of that design, (7) sample lesson plans of learning materials were constructed. The target population is Grade Nine students who are learning physics. Two high schools situated in Dagon and Mingalardon Townships were selected by random sampling method. Science combination students were selected. A total of (120) students and (4) physics teachers participated in it. Treatments were conducted separately in two groups. The experimental groups were taught according to the principles of demonstration method. The control groups were taught as usual. Learning materials were selected from "Some Applications of Mirror Formula" in Chapter (9), "Reflection of Light" and "Electric Charges, Matter and Electricity, Conductors and Insulators, Charging by Induction and Materials and Magnets" in Chapter (10), "Electricity and Magnetism" from Grade Nine Physics Textbook. Independent samples *t* test was used to test the hypotheses of this study. The result shows that there was a significant difference in the achievements of physics between the students who were taught by using demonstration method and those who were not. It can be suggested that the demonstration method should be used in the classroom in teaching physics. Therefore, it verifies that demonstration method bring positive contributions to the physics teaching as well as learning at the high school level. Finally, discussion, and suggestions were provided by the researcher based on the data for improving teaching physics and learning at the high school level.

Keywords: Effectiveness, Demonstration method, Physics, Achievement.

1. Senior Assistant Teacher, Basic Education High School, Taguseik, Einme Township.
2. Dr. Lecturer, Methodology Department, Yangon University of Education

Introduction

In earlier time, education is regarded as the richest and highest treasure of man. In the twenty-first century, science and technology are going to leading the way and moving at an extremely rapid pace. Therefore, teachers need to ensure that all students are keeping up with the national standards. In the study of mankind, the advent of science is the greatest blessing. Science has been defined as a systematic body of wisdom and knowledge which can give rise to greater and greater invention (Arun, 2008).

The National Science Teachers Association (NSTA) endorses the proposition that science, along with its method, explanations and generalizations, must be the sole focus of instruction in science classes to exclusion of all non-scientific methods, explanations, generalizations and products (Herr, 2008). In the present age called age of science. Therefore, knowledge of physics is essential for taken up professional and applied course such as engineering, technology, medicine, space and so on. By learning physics, students have had a lot of fun because of its immerse value in nature. Moreover, it contains the concepts mechanics, heat, light, radiation, sound, electricity, magnetism, and the nature of matter. Learning often takes place best when students have opportunities to express ideas and get feedback from their peers. Students take action and interact with others to construct the contextual knowledge of the classroom. In demonstration, the teacher and the students are involved in teaching learning process. Demonstration method may be judged as the most practicable and useful method of teaching sciences in the available circumstances of our schools.

When the teacher uses demonstration method, the teacher should consider interactive teaching. Interactive teaching is not void of lecture and lecture is used in combination with demonstration method. The only suitable alternative in such a situation lies in the form of demonstration or lecture-cum-demonstration method in which the scientific facts and principles are practically demonstrated as well as explained to all students of the class simultaneously by the science teacher.

Purpose of the Study

1. To study the effectiveness of demonstration method in Grade Nine physics teaching
2. To promote students' achievement in learning physics by using demonstration method
3. To give suggestions concerning with the concepts of demonstration method to teachers

Research Hypotheses

1. There is a significant difference in the physics achievement of Grade Nine students who learn by demonstration method and those who do not.
2. There is a significant difference in the physics achievement of Grade Nine students at the knowledge level, comprehension level, application level who learn by demonstration method and those who do not.

Definition of Key Terms

1. Effectiveness: Effectiveness (effect) means having power to produce, or producing, a desired result (Cruickshank & Bainer, 1999).
2. Demonstration method: Demonstration method is a method of teaching that relies heavily upon showing the learner a model performance that he should match or pass after he has seen a presentation that is live, filmed, picture, chart and electronically operated (Good, 1973, cited in Garcia, 1989).
3. Physics: The scientific study of natural forces such as light, sound, heat, electrically, pressure (Waters, 2010).
4. Achievement: Achievement is the one's best, to do successful, to accomplish tasks requiring skill and effort and to be recognized by authority (Smith & Hudgins, 1995).

Review of Related Literature

Demonstration Method

Demonstration method is a method of teaching that relies heavily upon showing the learner a model performance that the students should match or pass after a presentation that is live, filmed, picture, chart and electronically operated. (Good, 1973, cited in Garcia, 1989).Demonstration means "to show". In lecture method, the teacher just talks but in demonstration method, the teacher also shows and illustrates certain phenomenon and applications of abstract principles through demonstration of experiments (Tulasi, 2007).A demonstration can also be given inductively by the instructor asking several questions but seldom giving answers. An inductive demonstration has the advantage of stressing inquiry which encourages students to analyze and make hypotheses based on their knowledge (Trowbridge, 1990). There are five ways in which a demonstration can be presented. These are teacher demonstration, teacher-student demonstration, student-group demonstration, individual student demonstration, and guest demonstration (Trowbridge, 1990).

Criteria and Cautions for a Good Demonstration

This method, through very popular and most widely used, may not prove, successful with some teachers. The following are some of the cautions, which if kept in view by the teacher, will assure that the demonstration will be a success.

1. While performing an experiment the teacher must be sure that each and everything is clearly visible to the pupils. There will be no difficulty if a lecture gallery is available but in its absence there are several ways of enabling the pupils to get a better view.
2. A large mirror erected at a suitable angle above the teacher's bench will enable the class to see what is going on if they look at the reflection in the mirror. This is a very useful method of enabling the pupils to have a view of each and everything which otherwise is never possible. It will enable the students to look into the test tubes while the contests are being heated.

3. Demonstration apparatus should be as large as possible such as a big model of electric bell.
4. The apparatus to be used should be placed on the left hand side of the table and arranged in order in which it will be shown.
5. The teacher must be sure that the experiments will succeed and are strikingly clear. This demands and adequate preparation on the part of the teacher and a rehearsal of the experiments under the conditions prevailing in the classroom.
6. The teacher should never complain about inadequate and faulty apparatus.
7. The experiments demonstrated must be connected with the common things seen and handled by the pupils in daily life.
8. The demonstrations must be fit into the sequence of experiments which pupils do in their practical class.
9. The teacher must be call individual members of the class, in turn, to help the teacher in the demonstration work.
10. Attention of the class is very important. The teacher should know various methods of arresting their attention and creating interest.
11. Proper account of time and season, climate conditions sometimes affect the apparatus.
12. Demonstration experiments should be supplemented with teaching aids like charts, pictures, diagrams, models, film strips and so on.
13. A large black-board behind the teacher's demonstration table is most essential. During the lesson, the teacher can use it to a great advantage. The principles arrived at, as a result of demonstration, can be summarized on the black-board. Necessary diagrams can be drawn on it (Singh & Nath, 2010).

Merits of Demonstration Method

This method is psychological because the students have not to imagine anything, instead they are shown concrete thing are living specimens. Consequently, they active interest in teaching-learning process. It, therefore, motivates their interest and enthusiasm for science.

1. It is very suitable when the apparatus is very costly or very sensitive and is likely to be damaged if handled by the students e.g., Fortin's barometer, electric dynamo, etc.
2. It is helpful in case of dangerous experiments like preparation of chlorine, burning of hydrogen etc.
3. The method is considered most economical. When apparatus is not sufficient for the students to do practical individually, the teacher may perform the experiment before the whole class. Also it saves times when a number of experiments can be performed in a short time.
4. It is a time-saving method. If compared to Heuristic, Project or Experimental methods, it saves mush time. On this score it cannot be compared to lecture method, which is too speedy.
5. Although it is not child-centered method, yet the students are kept engaged in various activities like observing, taking notes, answering questions, drawing diagrams, and sometimes involving in the actual performance of experiments.

6. It is suitable method for all types of students i.e. average, below average and above-average. There is uniformity of teaching and all learn at a common pace (Kumar, 1995).

Teaching Steps of Demonstration Method

Demonstration method can be used to provide examples that enhance lectures and to offer effective hands-on, inquiry-based learning opportunities in the classroom. Sometimes called as the initiative method, the demonstration method aims at learning skills faster and more effective when the students are shown how the job is done by using the actual tools, machines, and materials (Belen, 1962, cited in Garica, 1989). It contains five steps as follows:

1. **Purposing:** The class decides on an activity which involves the process of demonstration. The teacher may suggest it but the teacher should not impose it on them, the teacher may encourage them to go through with it but the teacher should not dictate it on them.
2. **Planning:** This phase consists of the object of the demonstration, the person or persons to conduct it, the materials to be needed, and the date, time, and place activity. If outside an outside resource speaker will be invited, necessary arrangements like a letter of invitation should be made.
3. **Demonstration proper:** the teacher needs to teach the theory of concepts to the class before demonstration. Before the demonstration is done, all the preliminaries should have been prepared-material wise, procedure–wise and the classroom physical arrangement.
4. **Executing:** Students are expected to carry out or repeat the same performance shown during the activity. During this phase, the teacher should keep close watch of the students' performance for they may likely need his assistance and further explanation.
5. **Evaluation:** this is done to access how successful the students are involving in the activities. Another aspect of evaluation is concerned with their assessment of the demonstration proper.

These steps of demonstration procedure based lessons were constructed to conduct the experimental research that is concerned with the effectiveness of demonstration method on students' achievement in physics.

Research Method

In order to explore the effectiveness of demonstration method, a quantitative research method was used to compare students' physics achievement among the two groups, namely experimental group and control group. These two groups were randomly assigned in each school. This chapter is essentially concerned with the research design, research instruments, population and sample size and data analysis.

Research Design and Procedure

The research design for this study was a true experimental design, pretest-posttest control group design: ROXO (Randomization, Test, Treatment, and Test). The pretest- posttest control group design involves at least two groups. The sample students were selected in random. The students were grouped such as experimental and control group. Both groups are administered a pretest of the dependent variable. Pretest was used to measure the initial ability of the sample students. One group receives a demonstration method treatment, and both groups are tested with posttest questions. The combination of random assignment and the presence of a pretest and a control group serve to control for all sources of internal invalidity (Gay, 2003).Finally, the achievements of experimental and control groups were compared by using the independent samples '*t*' test. Pretest question was based on the Chapters (1,2,3,4,5,6,7 & 8) and posttest questions were developed on the concepts from Chapter (9) and Chapter (10) in Grade Nine physics textbook. The pilot study was conducted in November, 2016. After the pilot study, the experiment was conducted in December, 2016.

Instruments

Pretest

The pretest was used to see whether the students were essentially the same or not on the dependent variable at the start of the study (Gay, 2003).Test items were constructed from chapter one to eight in Grade Nine physics textbook that contains physics and measurement, vectors, describing motion, forces, work and energy, heat and temperature, measurement of heat, wave concept and sound wave. The pretest contains (5) true-false items, (5) completion items, (5) short questions, and (4) long questions that cover the concepts from chapter (1) to (8).

Table 1 Table of Specifications for Pretest Items

Lesson	Mechanics			Heat			Waves & Sound			Total Marks
Section / Level	K	C	A	K	C	A	K	C	A	
Section (A)	10	7	2	5	-	-	1	3	2	30
Section (B)	3	8	4	1	2	2	-	-	-	20
Total Marks	13	15	6	6	2	2	1	3	2	50

Note: K=Knowledge Level Items
C = Comprehension Level Items
A=Application Level Items

Posttest

The treatment duration lasted only about one month. At the end of the treatment, both groups were administered a posttest. These test items include true-false items, completions items, definitions, drawings and calculations. These items were constructed on the basis of the first three levels of Bloom's Taxonomy i.e, knowledge, comprehension, and application. Therefore, the posttest questions contain (15) items for knowledge level, (15) items for comprehension level and (20) items for applications level (see Table 3.3). In other words, test items can be divided into direct or seen questions (from textbook) and indirect or unseen questions (from other source). The value of Cronbach alpha α for the posttest was above (0.7).

Table 2 Table of Specifications for Posttest Items

Section	Optic												Electricity and Magnetism												Total Marks
	K				C_1				A				K				C_1				A				
	C_2	T	S	L	C_2	T	S	L	C_2	T	S	L	C_2	T	S	L	C_2	T	S	L	C_2	T	S	L	
Section A													4	3	5	-	2	3	-	-			12		30
Section B								4				1				3				5				7	20
Total Marks								4				1	4	3	5	3	2	3		5			12	7	50

Note: K = Knowledge Level Items
C_1 = Comprehension Level Items
A = Application Level Items
C_2 = Completion Items
T = True or False Items
S = Short Answer Items
L = Long or Calculation Items

Population and Sample Size

All the participants in this study were Grade Nine students. This study was conducted in Yangon Region. There are four districts in Yangon Region. Two districts were selected in random. One township from each selected district was also selected in random. After that, one high school from each township was selected and there were two sample schools. The participants in this study were also selected by random sampling and they were randomly assigned to control group and experimental group.Total of (120) Grade Nine students participate in it. The following table shows the population and sample size.

Table 3 : Population and Sample Size

No	Township	School	Population	Sample Size		
				Experimental Group	Control Group	Total
1.	Dagon	School (1)	785	30	30	60
2.	Mingalardon	School (2)	361	30	30	60

School (1) = A High School from Dagon Township
School (2) = A High School from Mingalardon Township

Data Analysis

The data were analyzed by using a descriptive statistics (mean, standard deviation, percentage) and independent samples '*t*' test. The independent samples '*t*' test was used to compare the achievement of students who learned through the use of demonstration method and that of students who learned without using demonstration method at knowledge, comprehension, and application levels.

Research Findings

Findings of Students' Achievement in the Pretest

In order to find out the background knowledge of the selected sample students in the experimental and control groups, pretest was administered in two schools.

Table 4: '*t*' Values for the Pretest Means of Experimental and Control Groups

Sample	Group	N	M	SD	MD	*t*	*df*	Sig. (2- tailed)
School 1	Experimental	30	37. 96	4.55	0.23	0.18	58	.857 (ns)
	Control	30	37. 73	5.39				
School 2	Experimental	30	39.03	5.13	0.70	0.52	58	.608 (ns)
	Control	30	38.33	5.37				

Note: ns= no significance
School (1)= A School from Dagon Township
School (2)= A School from Mingalardon Township

Table (4) shows '*t*' values for the experimental and control groups on the pretest items. As shown in table, the means of the experimental and control groups were (37.96) and (37.73) for the sample high school from Dagon Township. And also the means of the experimental and control groups were (39.03) and (38.33) for the sample high school from Mingalardon Township. These data showed that there was no significant difference between the experimental and control groups on the background of physics in both schools. So, initial group equivalency was seen at the start of study.

Finding of Students' Achievement in the Posttest

Table 5: Independent Samples *t* test Result of Posttest Means

Posttest Scores	Group	Samples	Mean	Standard Deviation	Mean Difference	*t*	*df*	Sig. (2-tailed)
S	G	N	$\bar{X}$	SD	MD	*t*	*df*	Sig. (2-tailed)
Total Scores	Experimental	60	29.69	4.39	6.47	8.16	118	.000***
	Control	60	23.22	4.30				
Knowledge level Scores	Experimental	60	9.89	2.01	1.37	3.47	118	.001**
	Control	60	8.52	1.97				
Comprehension level Scores	Experimental	60	9.48	1.93	2.00	4.76	118	.000***
	Control	60	7.48	2.30				
Application level Scores	Experimental	60	10.32	2.56	3.10	5.97	118	.000***
	Control	60	7.22	3.35				

Note: $^{**}p < .01$, $^{***}p < .001$

Table (5) shows the results of the independent samples *t* test. The *t* test for independent samples was used to compare the means of the experimental and control groups to test whether the students in one group did better or worse than the students in other group. This table shows the sample size, the means and standard deviation for each group. The means on the overall posttest were (29.69) and (23.22). Then, the means on knowledge level, comprehension level, and application level of posttest in those two comparison groups were (9.89) and (8.52) , (9.48) and (7.48), as well as (10.32) and (7.22). As shown in table (4.6), the variable, posttest means and its respective level means were separately compared for two sample groups. Moreover, mean difference, *t* value, degree of freedom, Sig. (2-tailed) and the *p* value (probability value) that describes a statistically significant difference level were described. This table shows that the groups of the experimental students who received a new treatment were found to have more effective achievement in physics learning than the groups of control students who do not.

Results

From the experimental findings, the following results were found.

1. There were significant differences in physics achievement of Grade Nine students who learnt by demonstration method and those who did not.
2. There were significant differences in physics achievement at the knowledge level, comprehension level, and application level of Grade Nine students who learnt by demonstration method and those who did not.

Finally, meta-analysis developed by Glass (1981) was used on the result of this experimental study. The effect size of this study was 1.49. A numerical value of 1.49 indicates that the treatment had a strong treatment effect. A positive effect size means that the students who received demonstration method performed better than the students who received formal learning or without demonstration method. It can be interpreted that there was a strong positive effect of treatment used as a new instructional design.

Discussion and Conclusion

The main purpose of the present study was to study the effectiveness of demonstration method on Grade Nine students' achievement in physics, to promote students achievement in learning physics by using demonstration method, and to give some suggestions concerning with the aspects of demonstration method to teachers. In this study, demonstration method was used for learning "Some Application of Mirror Formula" in Chapter (9), "Reflection of Light" and "Electric Charges, Matter and Electricity, Conductors and Insulators, Charging by Induction and Materials and Magnets" in Chapter (10), "Electricity and Magnetism". The nature of the selected materials that are taken from two chapters is relatively difficult and they include very new physics concepts. In learning those physics concepts, the teacher need to emphasize on some essential points such as its meanings, related symbols, mathematical equations, units for different systems, illustration diagrams, sign convections of mirror formula, direction of light, conceptual questions and so on. At the basic education level, Grade Nine is one of the most important one because of the nature of curriculum and subject matter contents.

Findings from this study show that the students in the experimental group who received new treatment has higher achievement in learning physics than the control students who received formal treatment. Statistical results verified that demonstration method was superior in improving students' physics achievement. This may be because the exposure to this method allows students to use concrete experiences. Another result was observed that the students in the experimental group can perform better in answering knowledge level, comprehension level, and application level items than those in the control group. Therefore, it can be interpreted that there is significant difference in achievement between Grade Nine physics students who learnt by demonstration method and those who learnt by formal learning. Similarly, the teachers who were assigned for the experimental groups were interested in the new design of teaching. Most of the students in both groups made errors in the concepts on sign convections of mirror formula because there were two chapters concerned with sign convections in physics content. All of the students have no background knowledge in applying these concepts in previous Grades. Moreover, most students in both groups made errors in the concepts on another type of magnet. Some students who received formal treatment made errors in illustrating neutral beryllium atom and illustrating the poles of a bar magnet because they do not have enough concrete experiences in studying those concepts. But, students who received new treatment had performed well in those physics concepts because they had to learn these concepts in hand-on experiences. According to Trowbridge and Bybee (1990), a good demonstration is the process of showing something to another person or students. Demonstration method can serve as simple observations of materials and verification of a process and may also be experimental in nature. Instead of talking about a concept, procedure or set of facts, laws, the teacher may be able to walk through demonstration of the information in action. Therefore, the students who received demonstration method obtained a sound experience to actively participate in demonstration activities in the classroom.

Generally, students mismatch in the usage of subject terms concerning electric charges, permanent magnet, and properties of magnet. Some students were weak in clarifying conductors and insulators and northern end of the earth and southern end of the earth. They also made errors in the abstract concepts concerning the nature of electric charges, the nature of atom, and principle of conservation of electric charge because they had learnt the early physics concepts in rote learning. Based on the posttest answers, the students who received new treatment can respond more precisely than the other students concerning description of subject terms, relevant concepts, laws and drawing illustration diagram. The results show that the treatment equally effects in overall posttest means and application level means. It also supported the research hypothesis; there is a significant difference in the physics achievement of Grade Nine students who learnt by demonstration method and those who did not. So, this finding pointed out that demonstration method has positive contribution to the achievement of the students in physics learning. The study of demonstration method on physics teaching brought positive and productive effects. Demonstration method is rooted in good teaching practice for all levels of students. Moreover, it is the most economical and time-saving method for all teachers. The students are interested in demonstration lessons and hence they participated in the teaching of physics. It motivates students' interest and enthusiasm for science.

Based on the research findings and interpretations, demonstration method should be used in classroom teaching but this study in not perfect because there were some limitations in this study such as time duration and content area. With respect to the research findings, the researcher wants to suggest the following facts.

(1) The teacher should tell the students the basic concept and allow the students to participate in teaching learning process and the teacher should guide the students and help them when they need.

(2) The teacher should provide help, encouragement and attention for their students to learn effectively and to participate actively in learning activities.

(3) The teacher should provide opportunities for the students to apply their knowledge in science activities which is involved in teaching learning process.

(4) The teacher needs to relate the science content with the real life situations so that the students will be interested in their learning.

(5) By teaching physics concepts through demonstration method, the teacher should study other science books such as science stories, science magazines, newspapers and internet sources which can improve teaching learning process.

(6) By using demonstration method, the teacher should allow the students to study by themselves to think critically, to solve the problems by themselves. Instead of memorizing the physics concepts, laws, and formula, the teacher needs to create the instructional procedure in which students explore those concepts in hand-on activities.

(7) The teacher who uses demonstration method should create an intellectual learning community that is continuously creating opportunities for teaching and learning.

(8) The teacher who uses demonstration method has valuable opportunities to provide students with a clear understanding of a particular idea or physics concepts including illustration diagrams and calculations.

(9) The teachers have to teach the relationships between theories and laws.

(10) By using demonstration method, the classroom teacher can create a valuable opportunity for the students to study about the empirical nature and subjective nature of physics concepts.

(11) Besides, in physics teaching, the teachers have to teach students to be able to draw illustration diagrams, and to label the diagrams precisely.

(12) The teacher has to teach new terms of physics concepts, their related samples, different kinds of unit systems, fundamental dimensions of basic units and derived unit systems precisely.

(13) In physics, the teacher has to teach new terms of physics concepts, their related samples, different kinds of unit systems, fundamental dimensions of basic uints and derived unit systems precisely.

(14) Moreover, in physics teaching , sign convections such as plus sign (+) for distance of real object, real image and real focus, minus sign (-) for distances of virtual object, virtual image and virtual focus must be noted clearly to be able to calculate physics problems correctly.

(15) This study is specially contributed to physics teaching at the high school level. Although this research was concerned with physics teaching, it also can be applied into the other subject matter contexts and the various school levels including primary school level and middle school level.

In conclusion, demonstration describes valuable advantages for the classroom teacher. In terms of the statistical results, students' performance between the experimental and control groups has significant difference on overall physics achievement, knowledge, comprehension, and application levels. So, it can promote students' achievement in teaching physics. During demonstration, students can perform by asking and answering questions and discussing their opinions that can enhance the student to develop concentration, self-reliance and interpersonal skills. Finally, this study shows that demonstration can be used to ask students to identify a problem, suggest of hypotheses, and modify the design of the experiments and to interpret the observation that lead to the solution of the problems. So, demonstration method has sound positive contribution to the improvement in physics teaching at the basic education high school level.

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Sample Lesson Planfor Grade Nine Physics through Demonstration Method

(45 minutes)

1. Topic/ Lesson **Chapter (10) Electricity and Magnetism: Conductors and Insulators**

2. Learning Objectives:

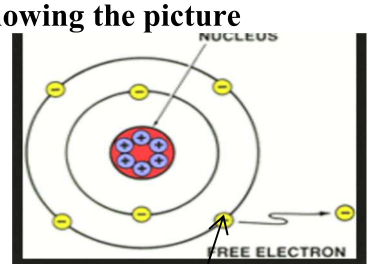
To acquire necessary foundation for further study in science
To define bound electron and free electron
To define conductors, insulators, and semiconductors
To distinguish the conductors, insulators and semiconductors
To draw the circuit symbol for conductor and insulator

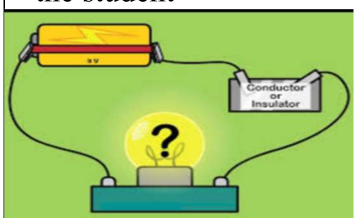
3. Background Knowledge The students have already learnt about the structure of an atom.

4. Instructional materials **Printed media**- Textbook, Whiteboard, Marker
Real objects- conductive materials, insulation materials, charts, bulb, filaments

5. Instructional Procedures Through the Use of Demonstration Method

Demonstration Procedure	Teacher's Activities	Learner's Activities
1.Purposing	Introducing about conductors and insulators Choosing the learning activity Guiding the students to participate in learning activity - bound electrons - free electrons - conductors and insulators	Discussing about the learning activities
2. Planning	Showing the instructional materials  (1)  (2)  (3)	Observing instructional materials **Students' findings:** 1. Plastic ruler 2. Glass rod 3. Gold 4. Silk

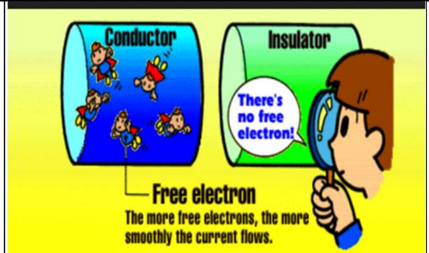
Demonstration Procedure	**Teacher's Activities**	**Learner's Activities**
	    (4) (5) (6) (7)	5. Eraser 6. Spring 7. Needle
3. Demonstrating proper	Teaching about the concepts of electricity Assessing the students' background knowledge **Teacher's Questions**; (1) What is the nature of atom? (2) State the name of two kinds of electric charges. (3) What is the nature of electron? **Showing the picture**  bound electron **Teacher's Questions:** (4)What is the direction of electron which is far from the nucleus? (5) What is direction of electron which is near to the nucleus **Teacher's Explanation** - attractive force is greater for the electrons closer to the nucleus the inner electron cannot move freely	**Students' Answers**; (1) An atom consists of a core called the nucleus around which the particles called electrons are moving. (2) Positive charge and negative charge (3) Electron is also a **negatively** charge particle. **Students' Answers:** (4)away from the nucleus (5) towards the nucleus **Students' note taking** - the inner electron cannot move freely - inner electron are tightly bound by nucleus

<table>
<tr><th>Demonstration Procedure</th><th>Teacher's Activities</th><th>Learner's Activities</th></tr>
<tr><td></td><td>- inner electron are tightly bound by nucleus
- it is called bound electron
- the electron far away from the nucleus less attractive force of the nucleus electrons are loosely bound by nucleus
- it is called free electron Demonstrating the nature of conductors, insulators, and semiconductors Showing the apparatus to the student


Testing the eraser, clip, iron, wool, pen, gold, needle, silk, lead, pencil, with apparatus.
- some substances have plenty of electron
- electricity conduct through them
- the bulb is lighting
(6) Are these substances called conductors or insulators?
some substances have no free electron
- electricity cannot conduct them
- the light switch off
(7) Are these substances called conductors or insulators?</td><td>- the electron far away from the nucleus less attractive force of the nucleus
- electrons are loosely bound by nucleus
- it is called free electron

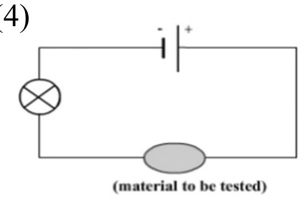
(6) conductors

(7) insulators</td></tr>
</table>

<table>
<tr><th>Demonstration Procedure</th><th>Teacher's Activities</th><th>Learner's Activities</th></tr>
<tr><td></td><td>

- some substance such as wool, silicon, and germanium have moderate amount of electrons
- these substances are neither conductors nor insulators
- it is called semiconductors.
- transistor is also made semiconductor
(8) Are wool, silicon and germanium conductors or semiconductors?</td><td>-wool, silicon, and germanium are called semiconductors

8.semiconductors</td></tr>
<tr><td>4. Executing</td><td>Assigning the students to make experiment
Guiding and supporting to students Concluding the students' findings
The substance which has plenty of free electrons is called an insulator.
e.g. copper, brass, aluminium, silver
- The substance which has very few or no free electrons is called an insulator. e.g. glass, wax, quartz, plastic</td><td>The students conduct experiment and write down their findings
<table><tr><th>Conductor</th><th>Insulator</th></tr><tr><td>Iron</td><td>Paper</td></tr><tr><td>Silver</td><td>Pen</td></tr><tr><td>Gold</td><td>Pencil</td></tr><tr><td>Needle</td><td>ruler</td></tr></table></td></tr>
</table>

Demonstration Procedure	Teacher's Activities	Learner's Activities
5. Evaluating / Performance Assessment and sharing the quiz paper	The teacher makes evaluation with the following questions. (1) What do you understand by a bound electron and a free electron	**(1) Bound electron** The electrons closer to the nucleus or the inner electrons are tightly bound by the nucleus and cannot move freely. **Free electron** The electrons far away from the nucleus or the outer electrons are loosely bound by the nucleus and can move freely.
	(2) Is your body is an insulator or a conductor?	(2) a conductor
	(3) Mention five insulators and five conductors	(3) Five conductors- iron, lead, gold, needle, spring Five insulators-plastic ruler, plastic pen, wood, paper, eraser, pencil
	(4) Draw a circuit diagram of a battery and charging a conductor or an insulator.	(4) 
	(5) State the major difference between the conductors and insulators	**(5) Conductor** -The substances through which electric charges flows are called conductors.

Demonstration Procedure	Teacher's Activities	Learner's Activities
		The substances have number of free electrons to allow the flow of electricity - Example: Copper and Aluminum - Electric charges are free to move from place to place **Insulator** - The substances through which electric charges cannot flow are called insulators. The substance do not have free electrons to allow the flow of electricity Example: Paper and wood Electric charges are fixed in one place
6. Giving Feedback	Checking each student and discussing about the students' answers. Correcting the student's quiz paper.	Students correct their mistakes. Five conductors-iron, lead, gold, needle, spring - Five insulators-plastic ruler, plastic pen, wood, paper, eraser, pencil - are loosely bound by the nucleus and can move freely can move freely. - are tightly bound by the nucleus and cannot move freely.

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AN INVESTIGATION INTO THE EFFECTIVENESS OF AUDIO AIDS AND VISUAL AIDS IN TEACHING ENGLISH AT THE PRIMARY LEVEL

Khin Phone Nwe[1] and Swe Swe Nyunt[2]

Abstract

The main purpose of this study is to investigate the effectiveness of audio aids and visual aids in teaching English at the primary level. The aids involving the sense of hearing are called audio aids. The aids which use sense of vision are called visual aids. In this study, picture cards, flash cards and audio clip were used as audio-visual media. A total of seven sample lesson plans were developed based on the events of instruction. Each step was prepared with the use of picture cards, audio file and worksheets appropriately. The pretest-posttest control group design was used in this study. The participants in this study were (120) Grade Three students from the selected sample schools, and they were also randomly selected. The instruments used in this study were pretest items, lesson plans and posttest items. The pretest items were based on the content area of Lessons (1, 6, 9 & 10) and the posttest items were based on the content area of Lessons (16 & 17) from Grade Three English textbook. The control groups were taught conventionally while the experimental groups learned through the use of audio and visual aids. The data were analyzed by using the independent samples *t* test. Research findings revealed that there was a significant difference between the language skills achievement of the Grade Three students who learned English through the use of audio aids and visual aids and those who do not. It proves that using audio aids and visual aids can bring positive effects on students' language learning. Therefore, in language classrooms, the use of audio aids and visual aids should be implemented to maximize students' understanding and application of what they have learned.

Keywords: Effectiveness, Audio Aids, Visual Aids, English

Introduction

English language, an international language, is spoken in many countries both as a native and as a second or foreign language. Sociolinguists emphasize the importance of language in learning and view learning as a

1. Senior Assistant Teacher, Basic Education High School (Branch), Theinikan, Tadar Oo Township

2. Dr, Lecturer, Department of Methodology, Yangon University of Education

reflection of the culture and community in which students live (Health, 1983b; Vygotsky, 1978, cited in Tompkins, 1998). According to Vygotsky, language helps to organize thought, and children use language to learn as well as to communicate and share experiences with others. Language is a code. Within its system, one thing (a set of sounds or printed symbols) stands for something else (e.g., an object, a concept, an emotion). When it follows a consistent pattern, the code can be understood by others. Acquiring the code is a process that may begin even before birth as the fetus begins to respond to the sounds in its environment (Health, 1983b; Vygotsky, 1978,cited in Tompkins, 1998).Primary years in school are very important for students which have greater influence throughout their lives. So, every primary teacher needs to be skillful in pedagogical knowledge as well as content. As suggested by Gardner's (1983) multiple intelligences, all the learners do not learn in the same way. Some learners are visual whereas the others are auditory or kinesthetic. Most children learn readily through all these styles, but sometimes a child will learn best through a strongly preferred style. So, there is a need to provide opportunity for children to process their learning in a variety of ways to utilize their preferred style in any area of weakness. Learning involves change in ideas, concepts, or ability, either through addition or modification. Students need experiences to help them explore and extend what they know, and to evaluate what they do. They need opportunities to apply knowledge and understanding in different contexts, and help in assessing the outcomes of their learning. The use of audio aids and visual aids as an instructional tool will enhance students learning in accordance with their differing learning styles and will help them more effectively in learning English as a foreign language.

Purposes of the Study

The main objectives of the study are to investigate the effectiveness of audio aids and visual aids on English language teaching. The specific objectives of this study are:

1. To develop teaching procedures which are based on the audio aids and visual aids,
2. To test the applicability of these aids in English language learning,

3. To compare the achievement of students taught conventionally and those who are taught by using audio aids and visual aids, and
4. To give suggestions for the improvement of language teaching-learning situation according to the results of the study.

Research Hypotheses

The hypotheses of this study are as follows.

1. There is a significant difference in the achievement of language skills between Grade Three English students who receive instruction with audio aids and visual aids and those who do not.
2. There is a significant difference in scores on the attainment of objectives: listening, speaking, reading and writing skills between Grade Three English students who receive instruction with audio aids and visual aids and those who do not.

Review of Related Literature

Cognitive development is the emergence of the ability to think and understand. It is a field of study in neuroscience and psychology focusing on a child's development in terms of information processing, conceptual resources, perceptual skill, language learning, and other aspects of brain development. Cognitive theories stress the acquisition of knowledge and internal mental (Bower & Hilgard, 1981). Those theories focus on the conceptualization of students' learning processes and address the issues of how information is received, organized, stored, and retrieved by the mind. Knowledge acquisition is described as a mental activity that entails internal coding and structuring by the learner. The learner is viewed as a very active participant in the learning process.

Effectiveness of teaching-learning process does not depend only on teacher but also upon the different types of equipment available in the lesson. The different equipment generally called audio-visual aids makes teaching-learning process to be more interesting, more stimulating, more reinforcing and more effective. Thus audio-visual aids are those instructional devices which make teaching-learning process more interesting and effective. They use multi-sensory organs in order to make the process more vivid and impressionable. It reduces the rate of verbalism by providing content in the form of concrete forms.

The proper use of audio-visual aids should

1. Reduce the danger of verbalism,
2. Increase better understanding,
3. Arouse interest in research,
4. Develop power of oral and written communication,
5. Encourage pupil participation,
6. Build up clearer and richer concepts,
7. Provide for group thinking and planning,
8. Train in efficient work and study habits,
9. Instill favorable attitudes, and
10. Foster the appreciation of beauty (Huebener, 1967).

The audio-visual aids have been classified in a number of ways according to different approaches. Some of them are as follows.

1. Technical Approach: They have been classified into two types, audio aids and visual aids.
   (a) Audio aids: The aids which use sense of hearing are called audio aids, e.g., radio, tape-recorder, records player etc.
   (b) Visual aids: Those aids which use sense of vision are called as visual aids, e.g., models, pictures, maps, bulletin board, slide, epidiascope, overhead projector etc.
   Note: Nowadays, audio-visual aids are also being used as instructional aids.
2. Audio aids and visual aids can be classified into two types.
   (a) Projected aids: Teaching aids which help in their projection on the screen are called as projected aids. For example, film stripes, slides, film projector, overhead projector, epidiascope etc.
   (b) Non-projected aids: Teaching aids which do not help in their projection on the screen are called non-projected aids. For example, chalk board, charts, actual objects, models, tape-recorders, radio etc.

Learning is a complex process and the visual aids are a great help in stimulating the learning of a foreign language. The student must use ears as well as eyes that are the primary channel of learning. Good visual materials will help maintain the pace of the lesson and the student's motivation. As students learn most through visual stimulus, the more interesting and varied these stimuli are, the quicker and more effective our learning will be.

There is a summary of the benefits of using visual aids in the language classroom.

1. They vary the pace of lesson.
2. They encourage the learners to lift their eyes from their books, which makes it easier and more natural for one to speak to another.
3. They allow the teacher to talk less, by diminishing the importance of the verbal stimuli provided by the teacher's voice, and allow the students to talk more. This visual rather than verbal approach results in less teacher talking time and more student participation.
4. They enrich the classroom by bringing in topics from the outside world which are made real and immediate by the pictures.
5. They spotlight issues, providing a new dimension of dramatic realism and clarifying facts which might pass unnoticed or forgotten. Abstract ideas of sound, temperature, motion, speed, size, distance, mass, weight, odour, taste, feel, colour and time can be taught with visuals.
6. A student with a creative imagination will often find he learns a new language easily and enjoyably through the use of pictures while he finds it difficult to learn just from a textbook and dictionary.
7. They make a communicative approach to language learning easier and more natural.
8. They help to teach listening, speaking, reading and writing and allow the teacher to integrate these skills constructively.
9. They inspire imaginativeness in both the teacher and students. Comments, guesses, interpretations and arguments newly practiced phrases into a lively give-and-take.

10. They provide variety at all levels of proficiency. A collection of visuals in the various media caters for all ages of learners and all types of groups from beginners to the most advanced and most highly specialized (Bowen, 1991).

Graphics are called non-projected teaching aids. They are two dimensional aids and related to writing, drawing, painting etc. These aids involve the use of graphic presentation in the form of graphs, maps, diagrams, charts, etc. The main graphic aids are as:

I. Diagrams: A diagram is a drawing that shows arrangements and relations as of parts to the whole. It is a visual symbol made up of lines, curves and geometrical forms. These are used for teaching science, geometry, geography etc.

II. Graphs: A graph is a diagrammatic treatment or representation of numeric or quantitative data. They are considered as pictures which self-explanatory and tell their story at a glance. They are used for analysis, interpretation, and for comparison. The different types of graphs include line, graph, bar graph, circle or pie graph, pictorial graph and flannel graph.

III. Maps: A map is an accurate representation of plain surface in the form of a diagram drawn to scale, the details of boundaries of continents, countries etc. As a teaching aid, they are indispensable in teaching fundamental concepts such as size, distance, space, distance and direction.

IV. Poster: A poster is a bold and symbolic representation of a single idea. It is used in all walks of life, to convey, forcibly the desired information to a layman.

V. Cartoons: a cartoon is a metaphorical presentation in the form of picture or a sketch. It is universal in appeal and conveys only one idea.

VI. Flash cards: Flash cards are pieces of card board or hand paper on which a word or words are written or some pictures are drawn. These can be used for word recognition, team competitions, teaching in speaking, teaching in writing, match cards, order cards.

VII. Charts: A chart is a combination of pictorial, graphic, numerical or vertical materials which presents a clear visual summary. The most commonly used types of charts include outline charts, tubular charts, and organizational charts (Rather, 2004).

The use of visual aids enhances language learning and increases the use of target language. So, work card, picture cards and funnel board can also be used in teaching a new language to young learners.

Work Cards: Work cards can include visuals as well as text. Magazine pictures, drawings, maps and diagrams can be important parts of work cards at all level, used for a variety of purposes.

Picture Cards: These are useful for presenting, practicing and revising vocabulary or as prompts for other activities, for example, to illustrate the characters in a dialogue, to help students improvise. They can be used as prompts for simple substitution drills. Instead of saying a word, teacher holds up a card.

Fennel Board: This is one the important teaching and training materials to motivate students to make posters on various issues and are to be displayed in the flannel board and also used to display collages prepare by students on different concepts. Collage will make students more active and enhance their logical thinking.

In addition to the above stated visual aids, textbooks, models, wall board, chart, poster, vocabulary wheel and overhead projectors are playing pivotal roles in helping the trainer as well as the learner in teaching and learning processes of a new language. A picture, a kind of visual aid which is readily available and most economical should be selected with the following factors.

1. Appeal: The content of the picture should capture the interest and imagination of the class members.
2. Relevance: The picture should be appropriate for the purpose of the lesson. However, fascinating the picture might be to the students, it is

of no use to the teacher in that particular lesson if it does not contribute directly to the aim of the lesson.

3. Recognition: The significant features of the picture should be within the students' knowledge and cultural understanding.
4. Size: A picture to be held up before the class should be large enough to be seen clearly by all. The details of the picture should be visible from the back of the room.

Sometimes, there are no published pictures available that fit the lesson plan so pictures have to be drawn by hand as a sketch. Large, clear, home-made drawings may look less professional but are often better than commercial products as they answer a specific need (Bowen, 1991).

Audio media are probably the oldest and most familiar of those used in education and training. It is readily available, comparatively inexpensive, relatively easy to produce, and familiar to most learners. Audio media consist of audio tapes and their recorders, records and record players, radio programs and radios, and telecommunication programs and equipment. Audio programs can be presented to learners in two basic forms, live of recorded. A program is recorded either on an audiotape or a record. A live program requires the use of radio, telephone systems, or public address systems. Such systems can be present recorded programs as well. Some types of audio aids are radio, gramophone and tape recorder. Radio is one of the learning aids to gain language skills. The programs which are broadcasted by the radio are useful to the learner to learn correct pronunciation and accent and also can develop good listening skills in addition to knowledge.

It is one of the audio teaching aids which is not in much use at present. It can be used to record the best pronunciation and accent and the clarity of language by an English teacher and can be replayed to the students in the classroom but care to be taken at the time of recording. It also can be used to record motivational speeches, by eminent speakers, writers, poets and replayed to the students so that students can be inspired by them and create interest towards English language and learn beautiful expressions of the great speakers.

Tape recorder is a good audio aid to train the students in listening skills and it offers good opportunities to students. To gain all four types of skills, correct accent and pronunciation in English language, tape recorders are more helpful.

Research Method

Participants

A total of (120) Grade student from two sample high school was participants in this study. This study was conducted in Yangon Region. In Yangon Region, the two districts were selected in random. After that, one high school from each district was selected and there were two sample high schools. Participants in this study were selected by random sampling.

Instrument

The instruments were constructed in accordance with the selected research design to conduct this experimental research. Therefore, a pretest (achievement test) was constructed based on the Lessons (1, 6, 9 & 10) and a posttest (achievement test) was constructed based on the Lessons (16 &17) in Reader Three textbook prescribed by the basic curriculum, syllabus and textbook committee. The pretest consisted of (5) completion items for writing skill, (5) items for reading skill, (5) items for listening skill and (5) items for speaking skill. Those were based on the Lesson (1, 6, 9 & 10) from Reader Three textbook and the allocated time for this test was (35) minutes. Total marks for this test were (25). The posttest consisted of (5) completion items for writing skill, (5) items for reading skill, (10) items for listening Skill and (5) items for speaking skill. It was based on the content areas of Lessons (16 & 17) from Reader Three textbook.

Procedure

In order to investigate the effectiveness of the use of audio aids and visual aids, one of the true experimental designs, such as the pretest-posttest control group design was used in this study. Validity for the instruments was determined by the teachers who studied English Language Teaching (ELT) for more than fifteen years. After the validation of these instruments, a pilot study was conducted in December 2016 to determine whether the instruments are applicable or not. Validity tells about the appropriateness of a test whereas reliability tells about the consistency of the scores produced. Based on the pilot study result, the reliability for each instrument was computed by Cronbach's alpha (α) value which determines how all items on a test relate to all other test items and to the total test, above 0.7. Therefore, these instruments were applicable for this study. After the pilot study, the experiment was launched in January, 2017.The data were analyzed by using a descriptive statistics (mean, standard, deviation, percentage) and independent samples *t* test. The independent samples *t* test was used to compare the achievement of students who learned through the use of audio aids and visual aids and that of students who learned without using audio aids and visual aids.

Quantitative Research Findings

The following table shows the result of the independent samples *t* test for each group.

Table 1: Independent Samples *t* Test Result Showing Posttest Scores

Posttest Scores	Group	N	M	SD	MD	*t*	*df*	Sig. (2-tailed)	*p*
Scores for Writing Skill	Experimental	60	3.72	0.66	0.44	3.88	118	$.000^{***}$	$^{***}p < .001$
	Control	60	3.28	0.58					
Scores for Reading and Speaking Skills	Experimental	60	8.07	1.38	1.47	5.25	118	$.000^{***}$	$^{***}p < .001$
	Control	60	6.60	1.67					
Scores for Listening Skill	Experimental	60	7.53	0.93	2.41	8.43	118	$.000^{***}$	$^{***}p < .001$
	Control	60	5.12	2.02					
Total Scores	Experimental	60	19.35	1.95	4.38	10.48	118	$.000^{***}$	$^{***}p < .001$
	Control	60	14.97	2.59					

This table shows that the groups of experimental students who received a new treatment, through the use of audio aids and visual aids were found to have more effective achievement in language learning than groups of controlled students who did not received new treatment.

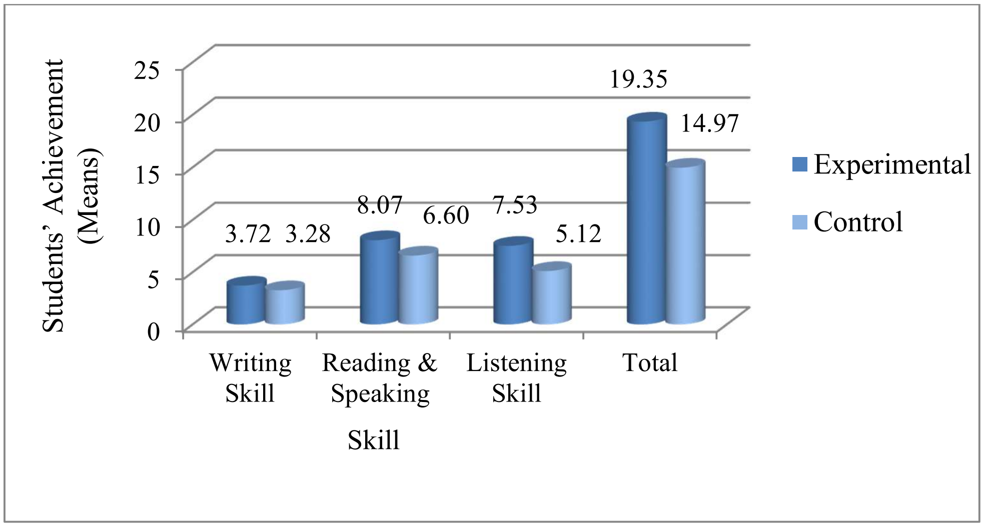

Figure (1) Graphic Illustrations for Means in Posttest

This figure shows that graphic illustration in posttest means for all level of items as well as overall scores. So, it can be interpreted that the experimental groups have better achievement on those tests than control groups. Therefore, the students of experimental groups gained a significant effect due to the new treatment for four skills of listening, speaking, reading and writing. To sum up, it can be accepted that the experimental treatment or learning through audio aids and visual aids has a significant positive effect on Grade Three students' language learning.

Discussion

There are actually many reasons to use aids in language teaching which include: (1) to attract and maintain attentions of learners, (2) to clarify meanings, concepts and utterances, (3) to increase chances of remembrance by adding as many associations as possible, (4) to simulate form of language, (5) to present authentic language, (6) to compensate lack of experience on teachers, (7) to individualize teaching and learning (8) to involve learners and (9) to add a variety of classroom teaching. A language classroom is favorable if it is provided with audio aids and visual aids. Visual aids enhance the effectiveness of teaching learning process in a classroom. Those aids were both a source of help for the teacher and provided stimulus. Variation can help learning by giving exposure to native speaker's correct pronunciation and interesting conversations between them. Many media and many styles of visual presentations are useful to the language learners. Therefore, audio-visual materials have positive contributions to language learning as long as they are used properly. The students with different learning styles must be taken into account too, using audio aids and visual aids help the teachers a way to address the needs of visual learners, auditory learners and so on. In accordance with the factors mentioned above, audio aids and visual aids can bring effectiveness in language learning.

Suggestions

Teaching English without using audio aids and visual aids can provide only writing skill, whereas teaching through the use of those aids can develop all four skills, listening, speaking, reading and writing. The natural order of language development for English as a foreign language student is listening, speaking, reading and writing. However, this order is reversed and some language skills are being omitted. This is due to lack of instructional aids and inexperienced English language teachers.

In English language, listening and reading are receptive skills (input) and speaking and writing are productive skills (output). There is a relation between the receptive skills and productive skills. The more input taken, the more output produced. So, language classrooms for primary students need to be provided with reading materials, audio device and a corner to practice language skills. Indeed, most of the students have to face some difficulties in learning English because it is a foreign language for them. So, since the primary school level, language teachers should prepare their instructional procedures including media-aided instruction that can promote students' attention. If it becomes their favorite subject, they can study the subjects that are written by English language. When they love to learn English, they get a key to open the door to the world because it is the international language and they can do further study as the result of English language competency. So, this study indicated that the use of audio aids and visual aids has a positive effect in learning English. Hence, further research is quite necessary. In this study, the sample schools were randomly selected from Yangon only. Further research should be expanded to a wider field of the study.

Conclusion

A creative platform for English language learning which is equipped with audio aids and visual aids is encouraging for successful language acquisition. Both audio aids and visual aids are the pertinent resources to teach and learn English language in an effective way. A language teacher can use audio aids to practice pronunciation and to promote students' oral fluency. Accuracy is the most important along with fluency. Practicing speaking skill is the primary step to learn any language. Beginners of English language should focus on listening and speaking skills along with learning basic grammar rules as grammar is not acquired naturally and it needs to be taught.

The evidence shows that the use of audio aids and visual aids in language classroom occupies students' interest and they got higher achievement in the test. Based on the practical research, it was found that audio aids and visual aids can arouse and maintain students' interest. It is greatly help to be increased their retention. Moreover, students' listening skill, reading skill, speaking skill and writing skill show more improvement. Some teachers are not willingly to make changes in their old teaching styles. There is a need to arouse their interests for using new teaching method in language teaching. Teachers as instructional designers should select and use different types of printed and non-printed media. When a teacher develops a lesson plan, the sequence of steps will influence learning. Teachers should use instructional aids that can facilitate learning to be more effective. Since audio aids and visual aids are really applicable to English language classrooms, language teachers should try to use audio aids and visual aids at each event of lesson in order to maintain students' attention. In conclusion, the results of this study can support language teachers and learners to some extent. Teaching language through the use of audio aids and visual aids is the most effective way to give language exposure, nature of the target language, accent, and pronunciation of the foreign language. It can reduce the probability of using the mother tongue to a minimum. It is also convenient for different learning styles. For these reasons, audio aids and visual aids are effective in teaching and learning English language.

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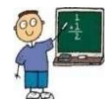
Sample Lesson for Grade Three English through the Use of Audio Aids and Visual Aids

1. Lesson Topic: Lesson 16, **A teacher, A doctor, etc.**
2. Time Allocation: (35) minutes
3. Learning Objectives: To be able to construct the sentences by using the pattern of "Sub+Verb.be+ Noun (job)"
   To be able to use the words those describe jobs in conversation
4. Instructional Materials: Printed media such as flash cards, picture cards, worksheet (Visual Aids), electronic media such as audio song (Audio Aids)
5. Instructional Procedures:

Instructional Events	**Teacher's Activity**	**Learners' Activity**
1. Gaining attention	Audio song: Teacher plays a song. "♪♪♪Nigel Naylor, he's a tailor; he makes trousers, suits and shirts. ♪♪♪" Is the sound clear enough?	No, teacher. The sound is not clear.
	Please, wait a second. I'll turn up the volume. Can you hear at the back? If you can't hear, come a bit nearer. Is that better?	Yes, teacher. That's better.
	Let's listen to the song: Listen to the words of the song. Here we go! "People Work" "♪♪♪Nigel Naylor, he's a tailor; he makes trousers, suits and shirts. Penny Proctor, she's a doctor, comes to see you when it hurts …………….♪♪♪"	Listen
	Let's listen to it once more. Now you've listened to the song two times. Before we go on, I'll ask you some questions. Can you hear the song?	Yes, teacher. We all want to listen it again. Students' answer: - Yes, we can. - They are singing about

Instructional Events	Teacher's Activity	Learners' Activity
	What is it singing about? You're right. Now, let's see the picture cards. ***Picture cards:*** Teacher show the following picture cards. Look at these. (hold the picture cards)   **Fig (1)** **Fig (2)** Now you've seen the pictures. Before we go on, I'll ask you some questions. Can you see the picture cards? What are they doing?	their jobs. Students' answer: Yes, we can. Fig (1) - She is teaching. Fig (2) - She is carrying a kitten.
2. Informing the learner of the objectives	Teacher tells the objectives: At the end of the lesson they will: - be able to construct sentence by using the pattern of "Sub+ Verb. be+ Noun (job)" - be able to use the words describing job in conversation	Listen
3. Stimulating recall of prerequisite learning	Teacher asks the class how to use articles in front of a noun and Verb.be for singular subject and plural subjects. Example: ***Worksheet (1)*** Take the correct words. 1. (a/an) pencil   2. (a/an) eraser	Students' answer: 1. a 2. an

Instructional Events	Teacher's Activity	Learners' Activity
	3. (a/an) apple  4. I (am/is) a student.  5. She (is/are) a student.  6. They (is/are) students.  *Reviewing* - The article "a" is used for the nouns which start with consonant sounds. - The article "an" is used for the nouns which start with vowel sounds. - "am or is" is used with singular subjects and "are" is used with plural subjects.	3. an 4. am 5. is 6. are
4. Presenting the content	Teacher shows the flash cards, models pronunciation three times and explains the meaning. Teacher: Repeat after me.  1. a soldier- /ˈ**səʊldʒə/** a member of an army	Repeating after the teacher Whole class: /ˈsəʊldʒə/ Row by row: /ˈsəʊldʒə/ Individually: /ˈsəʊldʒə/

Instructional Events	**Teacher's Activity**	**Learners' Activity**
	 2. a doctor- /ˈ**dɒktə/** a person whose job is to treat people who are ill/ sick or injured  3. a sailor- /ˈ**seɪlə /** a person who works on a ship as a member of the crew  4. a nurse – **/nɜ:s /** a person whose job is to take care of sick or injured people, usually in a hospital  5. a shopkeeper- /ˈ**ʃɒpˌki:pə/** a person who owns or manages a shop/store usually a small one  6. a tailor- **/teɪlə /** a person whose job is to make men's clothes	Repeating after the teacher Whole class: /ˈdɒktə/ Row by row: /ˈdɒktə/ Individually: /ˈdɒktə/ Repeating after the teacher Whole class: /ˈseɪlə / Row by row: /ˈseɪlə / Individually: /ˈseɪlə / Repeating after the teacher Whole class: /nɜ:s / Row by row: /nɜ:s / Individually: /nɜ:s / Repeating after the teacher Whole class:/ˈʃɒpˌki:pə/ Row by row: /ˈʃɒpˌki:pə/ Individually: /ˈʃɒpˌki:pə/ Repeating after the teacher Whole class:/teɪlə / Row by row: /teɪlə / Individually: /teɪlə /

Instructional Events	**Teacher's Activity**	**Learners' Activity**
5. Eliciting the desired behavior	Teacher gives ***Worksheet (2)*** to the class.   1. He is a------- 4. -------------   2. -------------- 5. --------------   3. -------------- 6. --------------	Students answer their worksheets individually.
6. Providing feedback	Asking students row by row Asking students to do a pair work Asking students individually: Please, stand up, read out your worksheet.(with hand movement to make student understand) Student (1) Reads out answer No (1) Student (2) Reads out answer No (2) Student (3) Reads out answer No (3) Student (4) Reads out answer No (4) Student (5) Reads out answer No (5) Student (6) Reads out answer No (6)	Answering row by row Students do a pair work Students' answer: Student who is called out read his/her worksheet. He is a soldier. She is a doctor. He is sailor. He is a nurse. She is a shopkeeper. He is a tailor.

Instructional Events	Teacher's Activity	Learners' Activity
	Rewarding correct answer: Giving comments such as "It is a good job" *Correcting wrong answers:* Teacher provides oral review. *Giving feedback* Giving comments such as Please try again. Is there anyone who wants to answer? The correct answer is "She is a nurse…….etc."	
7. Assessing the lesson outcomes	*Grouping students:* Teacher asks the students to do a pair work and give them picture cards. Let them speak by using those cards.   Teacher moves around the class and check out. *Oral questioning:* Teacher chooses the pairs randomly to answer the questions. *Independent Practice:* Giving ***Worksheet (3)*** on which pictures of jobs and their names are given. Students have to match those pictures and names correctly. ***Worksheet (3)*** Match the correct pictures with correct words. a soldier a nurse a doctor a hopkeeper a sailor a tailor	Each pair tries to speak by using picture cards. Pair (1) Student (A): Who is she? Student (B): She is a nurse. Pair (2) Student (A): Who is he? Student (B): He is a doctor. Answering: Pair by Pair Answering: Individually

Instructional Events	Teacher's Activity	Learners' Activity
	  1. 4.   2. 5.   3. 6. *Giving assignment:* Teacher asks the class to write sentences by using the pattern of "**Sub+Verb.be+ Noun (job)**". Ok, time's up. Let's stop here. Goodbye class.	Students' answer: 1. My father is a doctor. 2. Khin Khin is a shopkeeper. 3. My mother is a nurse. 4.KoKo is a soldier. 5. My uncle is a tailor. 6. U Nyi is a sailor. Goodbye, teacher. Thank you, teacher.

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A STUDY OF TEACHERS' KNOWLEDGE AND PRACTICES ON SCIENCE PROCESS SKILLS IN TEACHING SCIENCE

Thandar Swe[1] and Wai Wai Oo[2]

Abstract

The primary purpose of this study was to investigate teachers' knowledge and practices on science process skills in teaching science at the middle school level. The design adopted was a descriptive research design. Four townships were randomly selected from four districts in Yangon Region. Two high schools and two middle schools were selected by using a stratified random sampling technique. The population in this study consists of (640) Grade 5 students and (77) teachers who are teaching science. Three instruments: knowledge and practices questionnaires for junior science teachers and science achievement test were employed. Teachers' knowledge and practices questionnaires involved (33) items. Science achievement test for students involved (18) items. One-Way ANOVA, dependent samples *t*-test and a correlation technique were used in this study. As a result of the research, there was a significant difference between experienced teachers and inexperienced teachers of knowledge and practices on science process skills. And, there was also a significant difference between basic and integrated science process skills of those teachers. Moreover, teachers who were well-trained got higher mean for knowledge and practices than teachers who were partially trained. Also, it was found that science teachers are familiar with basic science process skills. The research findings proved that teachers' knowledge and students' achievement were moderately related and teachers' practices and students' achievement were not correlated in all the selected schools. This indicated that if teachers' knowledge on science process skills is high, they can arrange their teaching learning situation more systematically to teach their students more effectively.

Keywords; science, knowledge, practice, science process skills

Introduction

Education is a product of experience. One of the most important and pervasive goals of schooling is to teach students to think. Science contributes its unique skills, with its emphasis on hypothesizing, manipulating the physical

1. Senior Teacher, B.E.H.S (2) Pyu, Pyu Towhship

2. Dr, Lecturer, Methodology Department, Yangon University of Education

world and reasoning from data. Science process skills are transferable intellectual skills, appropriate to all scientific endeavors (NSTA, 2002). Individuals with these skills have the ability to make a major contribution to the improvement of society and these skills can be developed interaction with their teachers. Teachers play vital role in helping students to develop their science process skills. They must be proficient and must have the knowledge and understanding about science process skills. It is important for teachers to demonstrate a sound knowledge and be able to perform well on test items involving novel situations of the science process skills. Therefore, this study attempted to examine teachers' knowledge and practices on science process skills.

Objective

The main purpose of this study is to investigate teachers' knowledge and practices on science process skills in teaching science at the middle school level.

Research Questions

(1) Is there a significant difference in the teachers' knowledge of the science process skills in teaching science by science teaching service?

(2) I s there a significant difference in the teachers' practices on science process skills by science teaching service?

(3) Are there significant correlation in teachers' knowledge and practices on science process skills and their students' academic achievement in teaching science?

The Importance of Science Process Skills

All skills have to be used in some context and scientific process skills are only scientific if they are applied in the context of science. Learning with understanding involves linking new experiences to previous ones and extending ideas and concepts to include a progressively wider range of related phenomena. Learning with understanding in science involves testing the usefulness of possible explanatory ideas by using them to make prediction or to pose questions, collecting evidence to test the prediction or answer the questions and interpreting the result; in other words, using science process skills.

The role of the process skills in this development of understanding is crucial. If these skills are not well developed, them the emerging concepts will not help understanding of the world around. Thus the development of scientific process skills has to be a major goal of science education (Harlen, 1999). The main reason must surely be the inhibiting influence of a view of science education as being concerned only with the development of scientific concepts and knowledge (Tobin et al., 1990). The technical problems can be solved where there is a will to do so. But first it is necessary to counter the argument that science education is ultimately about understanding, that using science process skills is only a means to that end and thus only the end product needs to be assessed.

Science process skills are at the heart of what learning is all about. They help teachers think critically and are the intellectual raw materials for problem solving and decision making. Science - A Process Approach (SAPA) defined these skills as a set of broadly transferable abilities, appropriate to many science disciplines, and reflective of the behavior of scientists. SAPA grouped process skills into two types. They are: basic science process skills and integrated science process skills.

Basic Science Process Skills

The basic science process skills are the skills teachers use when they do science. Students use these skills to actively explore the natural world. These skills are essential to effective elementary classroom science lessons (Rezba et al., 2007). There are seven basic science process skills.

Observing Skill

Observing is an essential part of science. Causal observation spark almost every inquiry teachers make about their environment and organized observations form the base from which every step in a structured investigation proceeds (Tek, 1999). Observing is becoming aware of an object or event by using any of the senses to identify properties. It is the fundamental science process skill. There are two types of observations: qualitative and quantitative observations (Rezba et al., 2007). The simplest observations are qualitative observations. This made using only the senses such as color, shape and texture are examples of qualities. Quantitative observations are descriptions of quantities or amounts such as length, volume, mass, weight and times are quantities.

Classifying Skill

Classifying is the process of arranging objects or events according to some property (Ebenezer & Connors, 1998). Classifying is at the root of all understanding. This progress also involves using classification schemes to identify objects or events to show similarities, differences and interrelationships.

Inferring Skill

Inferring is interpreting or explaining what is observed and suggesting relationships between objects or events. The value of inference is that it can lead to testable predictions (Ebenezer & Connors, 1998). In making an inference students use information already known from past experience and new information students directly observe through their senses (Rezba et al., 2007). In science, inferences about how things work are continuously constructed, modified and even rejected on the basis of new observations.

Predicting Skill

Predicting is making forecast of future events or conditions expected to exist. Predicting is closely related to observing, inferring and classifying. Predicting is an excellent example of one process skill being dependent on other process skills. The ability to construct reliable predictions depends on careful observations and inference made about the relationships among observed events (Rezba et al., 2007).

Measuring Skill

Measuring is one of the skills that are essential for most scientific investigation (Tek, 1999). It is making quantitative observations by comparing to a conventional standard. As science investigations require more accuracy, students will use different units and different measuring device, expending their concepts of measurement. A major goal of measurement is to learn how to select appropriate measuring instruments and read a variety of balances and scales. Measurement plays an important role in science (Ebenezer & Connors, 1998).

Communicating Skill

Communicating is a process not only of science but of all human endeavors (Tek, 1999). It is a skill that is collecting information, organizing it in meaningful way and communicating it to someone else. The teachers focused on getting children to stretch the number of ways they are able to communicate through the use of graphs, charts, maps, symbols, diagrams, mathematical equations, visual demonstrations and spoken word etc. Effective communication is clear, precise and unambiguous (Rezba et al., 2007).

Using Space / Time Relationships

Using space / time relationship is a process that develops skills in the description of spatial relationships and their change with time (Tek, 1999). It includes a study of shapes, symmetry, motion and rate of change.

In learning the science process skills, teachers not only mastered the skills but teachers also learned something about how these skills can be learned. By using this knowledge teachers can begin making some important instructional decisions about teaching science, especially the science process skills. The decisions teachers make can significantly enhance the quality of science in which their students are engaged.

Integrated Science Process Skills

When teachers have mastered the basic process skills, they will be ready to learn the skills that lead to experimenting, the integrated process skills. By combining the integrated process skills with the basic science process skills, they can create a classroom climate where children explore, investigate, and discover. In classroom where children are learning the integrated process skills, they inquire about how things work and they seek answers to their own questions by designing and conducting experiments. There are six integrated science process skills.

Operational Definitions

An operational definition is one that is made in measurable or observable terms. The major function of operational definitions is to establish the parameters of an investigation or conclusion in an attempt to gain a higher degree of objectivity (Jinks, 1997).

Hypothesizing Skill

A hypothesis is a possible explanation for a set of observations, recorded data or inferences. Hypothesizing is a complex skill which integrates several simpler skills. Thinking about observations leads scientists to seek causes for events. To broaden their understanding of their environment, they then generalize their students' explanation. This process of generation is called hypothesizing skill (Jinks, 1997).

Experimenting Skill

This process is a systematic approach to solving a problem. The purpose of the process is to judge the extent to which a hypothesis might be true and to set a standard whereby that judgment is made (Jinks, 1997).

Controlling Variables

In conducting an experiment, some of the factors that may affect the result are inclined to change. Before carrying out an experiment, teachers should therefore identify all the variables that may affect the result. The process of controlling variables is pervasive in scientific inquiry. The most definitive results of an investigation are obtained when the variables can be identified and carefully controlled (Jinks, 1997).

Interpreting Data

It provides for the development of skills that can be transferred to a variety of experiences in and out of the school. The ability to interpret data is essential in science (Tek, 1999).

Formulating Model

A simplified model of a complex system permits students to focus on the important aspects of the system that is being studied, and thus better understanding it. The teachers should also realize that drawings are also, effectively models. At higher - grade levels, the teacher might point out that even equations are effectively models. They may be considered to be models because they can predict some aspect of the behavior of a system represented by the equation, and often the equation provides a good insight (Ebenezer & Connors, 1998).

Learning these skills empowers students to answer many of their own questions. Each time teachers learn a new skill, ask themselves the questions and use their answers to guide their instructional decisions when teaching science.

Research Method

The main purpose of this study is to investigate teachers' knowledge and practice on science process skills in teaching the Grade 5 General Science Textbook.

Research Design and Procedure

The research design for this study was a descriptive research design. The sample schools were selected by using a stratified random sampling method. This research involved collecting data concerning about teachers' knowledge and practices on science process skills in teaching science. So, the knowledge and practices on science process skills questionnaires for junior science teachers and achievement test for Grade 5 students were developed based on Barbara Houtz (2008) science process skills and 5 chapters form chapter (2) to (6) in Grade 5 General Science Textbook. Validity for these instruments was determined by the expert judgments. After getting the validity of these instruments, a pilot study was conducted with (22) junior science teachers and (30) Grade 5 students in Mingalardon Township, Yangon. After the pilot study, the data collection was conducted in the selected schools.

Instruments

The instruments used for this study were teachers' knowledge and practices on science process skills questionnaires and a test to measure their students' academic achievement. They were based on Houtz (2008) and Grade 5 General Science Textbook prescribed by Basic Education Curriculum, Syllabus and Textbook Committee (2016).

Knowledge and Practices Questionnaire for Teachers

Knowledge questionnaire for teachers was developed on Houtz (2008) science process skills and it consisted (33) items with multiple choices. Validity for this instrument was determined by the expert judgments. According to their suggestions, the knowledge questionnaire was modified again. Then, a pilot testing was done with (22) junior science teachers from Mingalardon Township, Yangon. The internal consistency of the knowledge questionnaire was (0.598) by Cronbach's alpha. And also practices questionnaire for teachers was developed on Barbara Houtz (2008) science process skills and the content area is chapter (2) to (6) from Grade 5 General Science Textbook. The questionnaire items have five - point Likert - scale to be described by five responses: (1 - never, 2 - seldom, 3 - sometimes, 4 - often, 5 - always). Arbitrary scoring weight (1, 2, 3, 4, 5) was assigned for positive. After preparing the measuring scale, content validity was determined by expert judgments. Then, a pilot testing was done with a sample of (22) junior science teachers from Mingalardon Township. According to the pilot study, some items were modified to adapt to teachers' understanding. The internal consistency of the practices questionnaire was (0.728) by Cronbach's alpha.

Science Achievement Test for Grade 5 Students

In order to measure the students' science process skills an achievement test was conducted. Firstly, the table of specifications was prepared including number of items according to science process skills. The achievement test was consisted of multiple choice items, short questions and long question items. In order to get expert validity, they were distributed to corresponding subject experts. According to their suggestions, the achievement test questions were modified again. The allocated time for this achievement test was (45) minutes.

The marking scheme for the achievement test was also presented. The pilot study was administered to (30) Grade 5 students in Mingalardon Township and the reliability of achievement test items is Cronbach's Alpha (0.72).

Population and Sample Size

All participants in the sample were junior science teachers and Grade 5 students from the Yangon Region by using a stratified random sampling method. There are four districts in Yangon Region. In each district, a township was selected by using a sample random sampling method for the study.

The sample schools were selected by using a stratified random sampling technique. Two high schools and two middle schools from each township were selected. So, eight high schools and eight middle schools included in this study. The number of junior science teachers was (77) and Grade 5 students were (640). Students in this study were selected by using a systematic random sampling technique. Table 1 shows the number of population and the sample size in the selected schools.

Table 1: Population and Sample Size in the Academic Year (2016 - 2017)

No.	Township	School	Populations		Sample
			Teachers	Students	Students
1.	Shwepyitha	BEHS 1	7	476	40
		BEHS 3	4	270	40
		BEMS 3	5	226	40
		BEMS 4	3	198	40
2.	Yankin	BEHS 1	4	171	40
		BEHS 2	4	282	40
		BEMS 2	3	80	40
		BEMS 5	4	91	40
3.	Myangone	BEHS 1	8	275	40
		BEHS 2	10	555	40
		BEMS 4	2	98	40
		BEMS 5	4	162	40

No.	Township	School	Populations		Sample
			Teachers	Students	Students
4.	Dala	BEHS 1	4	254	40
		BEHS 2	7	400	40
		BEMS 1	4	277	40
		BEMS 2	4	84	40

Note. BEHS = Basic Education High School
BEMS = Basic Education Middle School

Research Findings

Findings of Teachers' Knowledge on Science Process Skills in the Selected Schools

In order to find out teachers' knowledge on science process skills, knowledge test questionnaire for teachers was used. The average mean is (18.719) and standard deviation is (2.338). The scores for teachers' knowledge on science process skills ranged from (10) to (28). According to the results, the lowest mean and the highest mean were (13.50) and (27.00) respectively. It was found that the teachers' knowledge on science process skills of BEHS (2), Yankin was the lowest and that of BEHS (1), Yankin was the highest among the selected schools.

Moreover, to measure whether there is a significant difference in teachers' knowledge on science process skills among the schools, One-Way ANOVA was used. It was found that there were significant differences among the schools concerning teachers' knowledge on science process skills (F (15, 61) = 11.168, p < .001) (see Table 2). This means that teachers' knowledge on science process skills differs among schools.

Table 2: ANOVA Results of Teachers' Knowledge on Science Process Skills in the Selected Schools

	Sum of squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	935.895	15	102.423		
Within Groups	340.806	61	5.587	11.168	.000***
Total	1276.701	76			

Note. *** $p < .001$

Table 3 shows teachers' knowledge on science process skills in schools based on the means. It was divided into three groups, namely, high, moderate and low. The full score of teachers' knowledge on science process skills test was 33. The average mean and standard deviation were (18.719) and (2.338) respectively. If the mean in the school was higher than (21.057), it is defined as high knowledge group and if the mean was between (16.381) and (21.057), it is defined as moderate knowledge group and if the mean was less than (16.381), it would be defined as low knowledge group on science process skills.

Table 3: Percentage of School Groups (Teachers' Knowledge on Science Process Skills)

Teachers' knowledge on Science Process Skills	**No. of School**	**Percent (%)**
High	5	31.25
Moderate	7	43.75
Low	4	25
Total	16	100

Based on the results, figure 1, the percentage of the levels of school knowledge on science process skills. It obviously describes the percentage of teachers' knowledge level on science process skills.

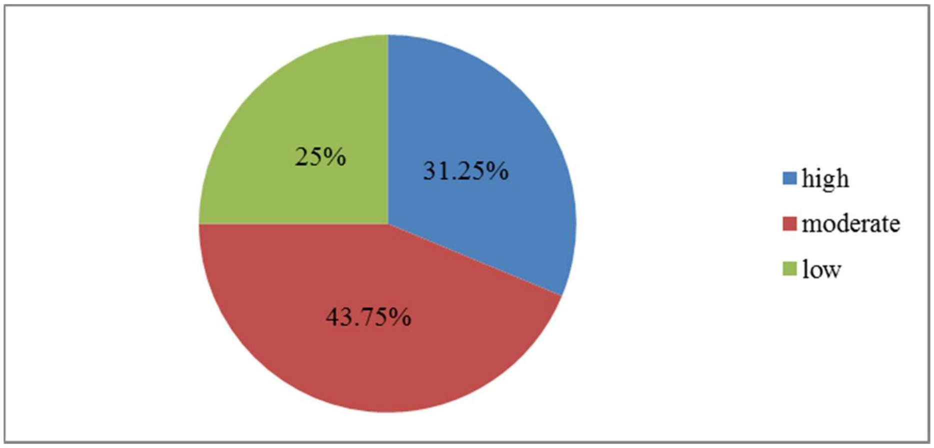

Figure 1: Percentage of School Groups (Teachers' Knowledge on Science Process Skills)

Findings of Teachers' Knowledge on Science Process Skills in terms of Science Teaching Service

The mean of teachers' knowledge on science process skills (20.74) for (≥ 21) group are higher than the mean of teachers' knowledge on science process skills (19.00) for (11 - 20) group, the mean of teachers' knowledge on science process skills (19.00) for (11 - 20) group are higher than the mean of teachers' knowledge on science process skills (16.94) for (0 - 10) group (see table 4). It can be interpreted that knowledge level of science process skills of teachers who have longer length of service in science teaching are higher than those who have shorter length of service in science teaching.

Table 4: ANOVA Results for Teachers' Knowledge on Science Process Skills in terms of Science Teaching Service

Science Teaching Service	N	Mean	Std. Deviation	*F*	*df*	Sig.
0 - 10	35	16.94	2.950	7.071	76	.002**
11 - 20	23	19.00	3.643			
≥ 21	19	20.74	5.290			
Total	77	18.42	4.099			

Note. **$p < .01$

Based on the results, figure 2 illustrate the comparison of means in terms of science teaching service.

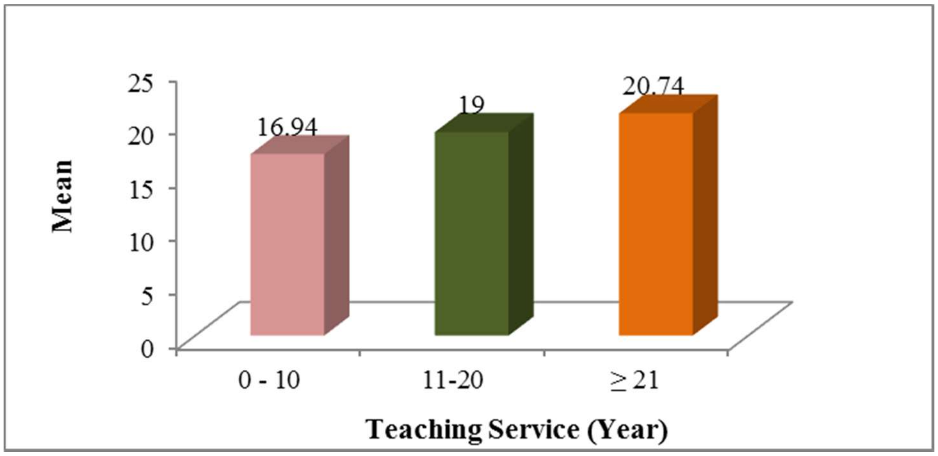

Figure 2: Comparison of Means for Teachers' knowledge on Science Process Skills in terms of Science Teaching Service

Findings of Teachers' Basic and Integrated Knowledge on Science Process Skills

Table 5 shows the means for basic knowledge and integrated knowledge on science process skills of teachers. Inspection of the group means indicates that the average mean of basic knowledge on science process skills of teachers (12.87) is higher than that of integrated knowledge on science process skills of teachers (5.57). It can be interpreted that the basic knowledge on science process skills of teachers is higher than the integrated knowledge on science process skills of teachers. There were significant differences among the basic and integrated knowledge on science process skills of teachers.

Table 5: '*t*' Value for Teachers' Basic and Integrated Knowledge on Science Process Skills

	N	Mean	Mean Percent	Std. Deviation	*t*	*df*	Sig.
Basic Knowledge	77	12.87	61.35%	2.948	23.181	76	.000***
Integrated Knowledge	77	5.57	46.65%	1.874			

Note. *** $p < .001$

Findings of Teachers' Practices on Science Process Skills in the Selected Schools

In order to find out teachers' practices on science process skills, practices questionnaire for teachers was used. The average mean is (116.365) and standard deviation is (9.942). The scores for teachers' practices on science process skills ranged from (69) to (136). According to the results, the lowest mean and the highest mean were (92.00) and (132.00) respectively. It was found that the teachers' practices on science process skills of BEMS (2), Yankin was the lowest and that of BEMS (5), Myangone was the highest among the selected schools.

One-Way ANOVA was used to examine the differences among the schools. It was found that there were significant differences among the schools concerning teachers' practices on science process skills (F (15, 61) = 2.355, $p < .05$) (see Table 6). This means that teachers' practices on science process skills differ among the schools.

Table 6: ANOVA Results of Teachers' Practices on Science Process Skills in the Selected Schools

	Sum of Squares	*df*	Mean Square	*F*	Sig.
Between Groups	6484.817	15	432.321	2.355	.01*
Within Groups	11196.170	61	183.544		
Total	17680.987	76			

Note. $^*p < .05$

Table 7 shows teachers' practices on science process skills in schools based on the means. It was divided into three groups, namely, high, moderate and low. The full score of teachers' practices on science process skills test was 165. The average mean score and standard deviation were (116.365) and (9.942) respectively. If the mean in the school was higher than (126.307), it is defined as high practices group on science process skills. If the mean in school was between (126.307) and (106.423), it is moderate practices group. If the mean was less than (106.423), it would be defined as low practices group.

Table 7: Percentage of School Groups (Teachers' Practices on Science Process Skills)

Teachers' Practices on Science Process Skills	No. of Schools	Percent (%)
High	3	18.75
Moderate	12	75.00
Low	1	6.25
Total	16	100

Based on the result, figure 3 illustrates the percentage of the levels of school practices groups on science process skills.

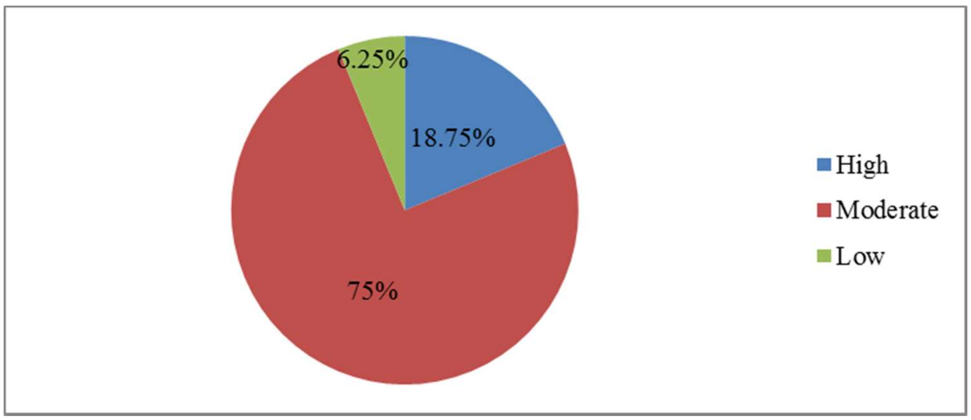

Figure 3: Percentage of School Groups (Teachers' Practices on Science Process Skills)

Findings of Teachers' Practices on Science Process Skills in terms of Science Teaching Service

Table 8 shows that the teachers who have longer length of service in science teaching were significantly different from those who have shorter length of service in science teaching. Inspection of the group means indicates that the mean of teachers' practices on science process skills (124.42) for (≥ 21) group is higher than the mean of teachers' practices on science process skills (122.04) for (11 - 20) group, the mean of teachers' practices (122.04) for (11 - 20) group is higher than the mean of teachers' practices (106.11) for (0 - 10) group. It can be interpreted that practices level on science process skills of teachers who have longer length of service in science teaching are higher than those who have shorter length of service in science teaching.

Table 8: ANOVA Results for Teachers' Practices on Science Process Skills in terms of Science Teaching Service

Science Teaching Service	N	Mean	Std. Deviation	*F*	*df*	Sig.
0 - 10	35	106.11	14.694	18.871	76	.000***
11 - 20	23	122.04	10.555			
≥ 21	19	124.42	7.891			
Total	77	115.39	14.743			

Note. *** $p < .001$

Findings of Students' Achievement in the Selected Schools

In order to find out the students' achievement for valid teachers' practices, an achievement test was administered. The scores for students' achievement ranged from (3) and (25). According to the results, the lowest mean and the highest mean were (9.578) and (15.882) respectively. It was found that the achievement level of BEHS (1), Shwepyitha was the highest and the achievement level of BEHS (1), Dala was the lowest among the selected schools.

Moreover, One-Way ANOVA was used to examine the difference among the schools concerning the students' achievement in science, (F (15,624) = 13.825, $p < .001$) (see Table 9). This means that the achievement of students in science differs among the selected schools.

Table 9: ANOVA Results of Students' Achievement in Science in the Selected Schools

	Sum of Squares	Mean Square	*df*	*F*	Sig.
Between Groups	2187.373	145.825	15	13.825	.000***
Within Groups	6581.775	10.548	624		
Total	8769.148		639		

Note. *** $p < .001$

Table 10 also shows the students' achievement in schools based on the means of students' achievement. It was divided into three groups, namely, high, moderate and low. The full score of students' achievement test in science 25.The average mean and standard deviation were (12.73) and (3. 152) respectively. If the mean in the school was higher than (15.882), it is defined as high achievement group. If the mean was between (15.882) and (9.578), it is defined as moderate achievement group. If the mean was less than (9.578), it would be defined as low achievement group (see Table 10).

Table 10: Percentage of School Group (Students' Achievement)

Students' Achievement	No. of School	Percent (%)
High	2	12.50
Moderate	14	87.50
Low	-	-
Total	16	100

Based on the results, figure 4 illustrates the percentage of the levels of school achievement groups.

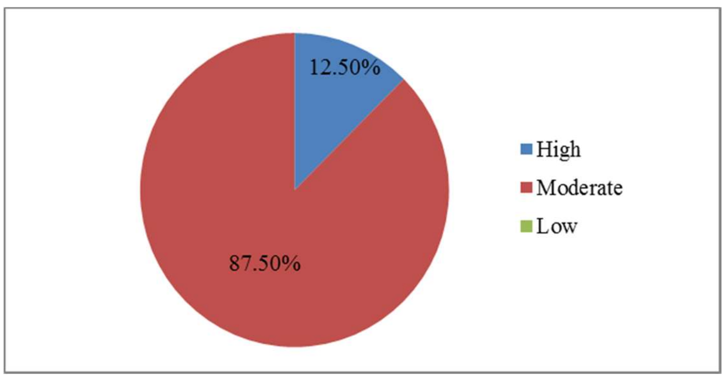

Figure 4: Percentage of School Groups (Students' Achievement)

Comparison of Teachers' Knowledge and Practices on Science Process Skills and Students' Achievement in the Selected Schools

As regards teachers' knowledge on science process skills for the selected schools, five schools gained high knowledge level, seven schools got moderate knowledge level and four schools obtained low knowledge level on science process skills. The names of schools with high level of knowledge on science process skills were BEHS (1), Yankin, BEMS (4) and BEMS (5), Myangone and BEMS (1), Dala. The schools with low level of knowledge on science process skills were BEMS (3), Shwepyitha, BEHS (2) and BEMS (2), Yankin and BEHS (2) Dala. The rest schools were moderate knowledge level.

Also as regards teachers' practices level for the selected schools, three schools obtained high practices level, twelve schools gained moderate practices level and one school got low practices level. The names of schools with high practices level were BEHS (1) and BEMS (5), Yankin, and BEMS (5), Myangone. The lowest practices level school was BEMS (2), Yankin. The rest of the schools were moderate practices level.

As regards students' achievement level for the selected schools, two schools gained high achievement level and fourteen schools obtained moderate achievement level. There was no low achievement level school. The names of high achievement level schools were BEHS (1), Shwepyitha and BEHS (1), Yankin. The rest schools were moderate achievement level. Table 4.15 points out the teachers' knowledge and practices on science process skills and students achievement level in the selected schools.

Table 11: Teachers' Knowledge and Practices on Science Process Skills and Students' Achievement Level in the Selected Schools

School No.	Teachers' Knowledge on Science Process Skills	Teachers' Practices	Students' Achievement Level
S1	21.86 (H) > 21.057	126.307 < 113.00 (M) < 106.423	17.18 (H) > 15.882
S2	21.057 < 17.75 (M) < 16.381	126.307 < 121.25 (M) < 106.423	15.882 < 12.00 (M) < 9.578
S3	13.80 (L) <1 6.381	126.307 < 120.25 (M) < 106.423	15.881 < 13.70 (M) < 9.578
S4	21.057 < 18.33 (M) < 16.381	126.307 < 117.33 (M) < 106.423	15.882 < 11.67 (M) < 9.578
S5	27.00 (H) > 21.057	128.00 (H) >126.307	16.38 (H) >15.882
S6	13.50 (L) < 16.381	126.307 < 125.25 (M) < 106.423	15.882 < 13.93 (M) < 9.578
S7	15.00 (L) < 16.381	92.00 (L) < 106.423	15.882 < 10.93 (M) < 9.578
S8	21.057 < 21.00 (M) < 16.381	131.50 (H) > 126.307	15.882 < 11.85 (M) < 9.578
S9	21.057 < 17.13 (M) < 16.381	126.307 < 106.63 (M) < 106.423	15.882 < 11.43 (M) < 9.578
S10	21.057 < 17.00 (M) < 16.381	126.307 < 111.10 (M) < 106.423	15.882 < 12.85 (M) < 9.578
S11	24.00 (H) > 21.057	126.307 <122.50 (M) < 106.423	15.882 < 14.08 (M) < 9.578
S12	22.75 (H) > 21.057	132.00 (H) > 126.307	15.882 < 11.53 M < 9.578

School No.	Teachers' Knowledge on Science Process Skills	Teachers' Practices	Students' Achievement Level
S13	14.75 (L) < 16.381	126.307 < 107.25 (M) < 106.423	15.882 < 12.45 (M) < 9.578
S14	21.057 < 17.14 (M) < 16.381	126.307 < 113.29 (M) < 106.423	15.882 < 10.30 (M) < 9.578
S15	16.75 (H) > 21.057	126.307 < 107.00 (M) < 106.423	15.882 < 11.25 (M) < 9.578
S16	21.057 < 21.75 (M) < 16.381	126.307 < 113.75 (M) < 106.423	15.882 < 12.18 (M) < 9.578

Note. L = Low Level, M = Moderate Level, H = High Level

Relationship of Teachers' Knowledge on Science Process Skills and Students' Science Achievement

To examine the relationship between teachers' knowledge on science process skills and students' science achievement in the selected schools, Pearson product - moment correlation was used. This result shows that teachers' knowledge on science process skills and students' science achievement were moderately related (see Table 12).

Table 12. Correlation between Teachers' Knowledge on Science Process Skills and Students' Science Achievement

Correlations			
		Teachers' Knowledge on Science Process Skills	Students' Science Achievement
Teachers' Knowledge on Science Process Skills	Pearson Correlation	1	.395**
	Sig. (2 – tailed)		.001**
	N	77	77
Students' Science Achievement	Pearson Correlation	.395**	1
	Sig. (2 – tailed)	.001**	
	N	77	640
**Correlation is Significant at the 0.01 level (2 – tailed)			

Moreover, it is necessary to examine the relationship of teachers' knowledge on science process skills and students' science achievement in each school. It was found to be highly related in eight schools, moderately related in five schools, and nothing related in the remaining schools. S5 has the highest significant correlation between teachers' knowledge on science process skills and students' science achievement.

Relationship between Teachers' Practices on Science Process Skills and Students' Science Achievement

Pearson's product moment correlation was conducted to examine the extent of strength and direction of relationship between teachers' practices and students' science achievement in all the selected schools. The result shows that there was no correlation between teachers' practices and students' science achievement because there were different practices among the selected schools (see Table 13). Most of the teachers applied their knowledge in teaching science. Some teachers cannot apply their knowledge in teaching science.

Table 13: Correlation between Teachers' Practices on Science Process Skills and Students' Science Achievement

		Teachers' Practices	Students' Science Achievement
Teachers' Practices	Pearson Correlation	1	.254
	Sig. (2 – tailed)		.026*
	N	77	77
Students' Science Achievement	Pearson Correlation	.254	1
	Sig. (2 – tailed)	.026*	
	N	77	640
*Correlation is Significant at the 0.05 level (2 – tailed)			

The Summary of the Findings

To sum up, the findings for teachers' knowledge on science process skills, their practices and students' science achievement in the selected schools can be generalized as follows:

- For teachers' knowledge on science process skills, the percentage of low, moderate and high level of knowledge on science process skills in all the selected schools are (25%), (43.75%) and (31.25%) respectively.
- There were significant differences in teachers' knowledge on science process skills among all the selected schools andteachers who have more science teaching service was higher than that of teachers who have less science teaching service.
- There was a significant difference between basic and integrated skills of teachers because teachers' basic knowledge on science process skills was higher than that of integrated knowledge.
- For teachers' practices, the percentage of low, moderate and high level of practices on science process skills in all the selected schools are (18.75%), (75%) and (6.25%) respectively.
- There were significant differences in teachers' practices among all the selected schools. Teachers' practices that have more teaching service on science process skills were higher than those that have less science teaching service.
- For students' science achievement, the percentage of low, moderate and high level of achievement in all selected schools are (0%), (87.50%) and (12.50%) respectively.
- Knowledge on science process skills of teachers has moderately related with science achievement of students.
- Practices of teachers on science process skills in teaching have no correlation with science achievement of students in all the selected schools. Because there were different practices among the selected schools.

Discussion, Suggestions and Conclusion

Discussion and Suggestions

Statistical analysis of the data shows that the total mean of teachers' knowledge on science process skills was (18.719) teachers who have the knowledge of science process skills teach these skills more actively in their classroom (Dowing & Gifford, 1996).

Based on the research, teachers may not be promoting a positive attitude toward science among students in their classroom because of their poor conceptual knowledge. BEHS (2), Yankin got the lowest mean in teachers' knowledge on science process skills among all the selected schools. It was assumed that some teachers have a few teaching service in science and low interest in their science teaching. Most of the science teachers in that school use lecture method and rarely use practical work. So, they got the lowest mean. BEHS (1), Yankin got the highest mean in teachers' knowledge on science process skills among the selected schools because teachers have positive attitudes towards science education. They are interested in their teaching. Thus, their classrooms are well facilitated with sufficient teaching learning materials and the separate are spatial classrooms.

Moreover, there was a significant difference between the teachers who have longer length of service in science teaching and those who have shorter length of service in science teaching. Teachers who have experience in science teaching have mastery of the subject and they are well-prepared for their teaching. They also have acquired cumulated classroom management skills and strategies to handle different classroom problems. This may imply that inexperienced teachers could get confused, do not know clearly science process skills about the topics and how to prepare for their teaching. So, teachers' knowledge on science process skills differs in terms of experience.

There are two types of science process skills, namely basic and integrated process skills. In the present study, the percentages of means are 61.35% for basic science process skills and 46.65% for integrated science process skills. The results pointed out that there was a significant difference between basic and integrated process skills. The scores of basic process skills of teachers are higher than that of integrated process skills of teachers. The interview results also indicate that most of the teachers are more familiar with basic skills than integrated skills. This result is consistent with Ergin and Aktamic (2008) who found that there was a significant difference between the basic and integrated skill scores of teachers and this difference was in favor of basic skill scores. It can be concluded that science teachers have more opportunity to develop integrated skills.

Settlage et al. (2007) stated that teaching with an eye toward science process skills is an appropriate entry point for beginning elementary and middle school teachers. They can serve as a very important way for science teaching. Therefore, teachers should possess a strong conceptual understanding and be able to perform well on the science process skills if they have to teach them effectively in their classroom.

According to the teachers' practices on science process skills, there were significant differences among the schools concerning teachers' practices on science process skills. Among them, BEMS (2), Yankin got the lowest mean in practices. In this school, teachers have low knowledge on science process skills and so they cannot use these skills in their teaching. They have a little practical work due to the large class size and spatial classroom situations. Thus, teachers from this school got low practices level on science process skills.

According to teachers' practices on science process skills in terms of teaching service, there was a significant difference between the groups. The group of more experienced teachers has strong knowledge on science process skills, so they can effectively apply these skills in their teaching and do more practical work. This result is consistent with Anderson (2002) who suggested that teachers who lack science process skills or have a poor knowledge of science process skills are less equipped to inquiry teaching strategies and as such may not be using it in their classroom. Therefore, the group of more experienced teachers should help the group of less experienced teachers to enable them to use more teaching aids in teaching science.

Despite teachers' knowledge and practices have low level on science process skills, students' science achievement is not at low level at BEMS (3), Shwepyitha, BEHS (2) and BEMS (2), Yankin and BEHS (1), Dala, teachers' knowledge and practices on science process skills are at low level. But in these schools, students' science achievement was at moderate level. One reason is that although teachers have low level of knowledge on science process skills, they can do practices about some topics. The second reason is that they may teach their lesson through repetition and drills. Thus, students understand of the content of the topic. And so, students' achievement was at the moderate level.

Based on the results of Pearson's correlation coefficients, there was a positive moderate relationship between two variables in all the selected schools. This means that teachers with a high score on knowledge on science process skills are likely to have students' science achievement. But in three schools there is a little relationship between the two variables among the selected schools. This means that teachers' knowledge on science process skills in teaching science provides no indication of students' science achievement. This situation shows that a range of studies should be conducted to develop science process skills of teachers. Mutisya et al. (2013) emphasized that teachers should understand science process skills cognitively to make their students gain these skills at a desired level.

Moreover, there was a little relationship between the teachers' practices on science process skills and students' science achievement in all the selected schools because each school has different class-size and different situation. Seven schools have a positive high relationship and six schools are a positive moderate relationship between the two variables. It means that teachers with a high score on practices are likely to have a high score on students' science achievement. But in two schools there is a little relationship between the two variables. It means that teachers' practices on science process skills in teaching science provide no indication of students' science achievement. Nevertheless, in BEHS (2), Yankin, there is a negative high relationship between the two variables. It means that although teachers' practices on science process skills are low, students' science achievement is at the high level. Teachers' competence in the science process skills has been found to promote positive attitudes towards science (Dowing, Filer & Chamberlin, 1997, cited in Miles, 2010). Thus, science process skills enable students to develop a deeper science understanding.

New research should focus more on the element of conceptual knowledge. Teachers with low conceptual knowledge of science process skills may not effectively convey the true definitions, meanings and understanding of concepts and skills to their students. Initial teachers training should support the use of practical work in science teaching. Ministry of Education should organize regular seminars and workshops for the teachers to refresh their memories about new developments and skills.

Recommendations for Further Research

This research was conducted with the junior science teachers in Grade 5 at the middle school level. More research is needed to study all grades at the middle school level. Teachers' knowledge and practices on science process skills play a key role in students' science achievement and activity-based learning through the process skills. It is also needed to carry out more studies concerning with exploration of ways and means to improve teachers' knowledge of science process skills.

As the size of the sample is small, this result may not be generalized to a bigger population. Thus, carrying out a larger research in a nationally representative area in a longer duration is highly recommended to validate the present research results.

Conclusion

Process skills in science are very important presentation of science to children. They are the basic steps for the development of useful skills and in making teaching-learning process more dynamic, stimulating and meaningful. The achievements of science have glorified the modern world and transformed the modern culture into a scientific one. According to Rauf, 2013, teachers play an important role for teaching science process skills in class through planning and arranging learning activities and teaching how to reach scientific information. So, teachers must possess an adequate level of knowledge on science process skills so that they can teach effectively their students.

Although teachers' knowledge and practices cannot be only one reason for low or high achievers in science, it is one of the reasons for low or high achievement of the students. A better understanding of scientific knowledge and practices is needed in order to help students to become high achievers in science. So, teachers must have a sound foundation of knowledge on science process skills and make classroom activities. Science process skills may be a potent vehicle in affecting students' outcomes. This study will be of great use to students and teachers to take care of science process skills in schools. Therefore, today science teachers should emphasize science process skills in their teaching for improving the quality of education.

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A STUDY OF THE RELATIONSHIP BETWEEN THE NUMBER SENSE AND PROBLEM SOLVING SKILLS IN MATHEMATICS OF MIDDLE SCHOOL STUDENTS

Aye Mon Mon Kyaw[1], Naing Naing Thein[2]

Abstract

The primary purpose of this research is to study the relationship between the number sense and problem solving skills in mathematics of middle school students. A descriptive research design was used to collect the data. In order to investigate students' number sense, their problem solving skills and the relationship of these two elements, a quantitative research method was used. A total of (600) Grade Seven students from eight high schools and four middle schools participated in this study. A number sense test and a test for students' problem solving skills were used as the research instruments. The number sense test was composed of (40) items. The test for students' problem solving skills involved (10) problems. To obtain the reliability of these tests, a pilot test was administered. The internal consistency for these two tests were (.778) and (.699). In this study, the data were analyzed by using the descriptive analysis techniques and Pearson product-moment correlation. The results revealed that 69.3% of the students possessed a moderate level of number sense. Among the five number sense strands (number concepts, multiple representations, effect of operations, equivalent expressions and computing and counting strategies), the lowest and highest means were found in multiple representations and effect of operations. Moreover, (73.7%) of the students were found in a moderate level of problem solving skills. According to Pearson product-moment correlation results, each strand of number sense was moderately and positively related with problem solving skills at (0.01) level. In addition, there was a high positive correlation of (.607) between students' number sense and their problem solving skills. Thus, the study could be concluded that Grade Seven students who were good at number sense were also good at problem solving skills or students who were weak in number sense were also weak in problem solving skills.

Keywords: number sense, problem solving, number concepts, multiple representations, effect of operations, equivalent expressions, computing and counting strategies

1. Junior Assistant Teacher, BEMS (Branch), Ywarthagyi, South Dagon Township, Yangon
2. Lecturer, Methodology Department, Yangon University of Education

Introduction

Education plays a key role in the acquisition of knowledge, skills and values of the 21st century. Similarly, the important requirement for the 21st century is sound mathematics education. To be successful in mathematics education, students must acquire a good sense of numbers early in their academic career (Witzel et al., 2012). Many mathematics educators have suggested that the process of learning and instruction of mathematics should focus towards students understanding of numbers. In this context, students should be able to understand why and how computations or algorithms are computed (Ghazali, 2001, cited in Mohamed & Johnny, 2010). Moreover, the section of number sense should be taken into account in mathematics instruction in order to develop students' number sense as a necessary skill.

The number sense component is a major topic for the understanding of mathematics since mathematics is a discipline in solving everyday problems using numbers, patterns and logic. Actually, one of the reasons for increasing focus on number sense development in the 21st century is that number sense is an essential characteristics which can distinguish man from computers. According to the researcher's experiences dealing with mathematics classrooms, students cannot perform well in solving problems including a sense of number. Therefore, it is really necessary to study whether students' number sense is correlated with their problem solving skills or not. This study will also expect to give suggestions that can improve number sense of every individual.

Statement of the Problem

In mathematics instruction, number sense and numerical operation area helps students to provide intuitions and insights and make critical judgments. Number sense is important for encouraging students to think flexibly and promotes confidence with numbers. Number sense is highly personalized and is related to what ideas about number have been established and also on how those ideas were established. However, students highly skilled at paper/pencil computations may or may not be developing number sense (Carlyle & Mercado, n. d., cited in Burns, 2007).Generally, most of the students cannot easily handle numerical problems including fractions, decimals and percentage. They do not perform well and their scores in achievement tests are in unsatisfactory condition. Therefore, the current situation of number sense in students is one of the major problems for improving mathematics education.

Purposes of the Study

The main purpose of this research is to study the relationship between the number sense and problem solving skills in mathematics of middle school students. The specific objectives are stated as follows.

- To assess students' number sense.
- To examine students' problem solving skills in mathematics.
- To explore the relationship between students' number sense and their problem solving skills in mathematics.
- To give suggestions for developing students' number sense.

Research Questions

(1) To what extent do students possess number sense?
(2) To what extent do students possess problem solving skills?
(3) Is there a relationship between students' number sense and their problem solving skills in mathematics?

Scope of the Study

This research has its own particular limitations. The first limitation is related to the fact that the participants of the study came from only twelve selected schools from Yangon Region. Eight Basic Education High Schools and four Basic Education Middle Schools were included in this study. Participants in this study were (600) Grade Seven students from the twelve selected schools in the academic year (2016-2017). The second limitation is that number sense test items were constructed based on the number sense test published by McIntosh et al. (1997) to measure middle school students' number sense in this study. The final limitation is that the problems were constructed only based on six chapters from Grade Seven mathematics textbook volume I and four chapters from volume II in order to measure students' problem solving skills in mathematics.

Definition of Key Terms

Number Sense

Number sense refers to a person's general understanding of numbers and operations along with the ability and inclination to use this understanding in flexible ways to make mathematical judgments and to develop useful and efficient strategies for handling numbers and operations (McIntosh, Reys, &Reys, 1992).

Problem Solving

Problem solving refers to mathematical tasks that have the potential to provide intellectual challenges for enhancing students' mathematical understanding and development (NCTM, n. d.).

Significance of the Study

Numbers and operations on numbers play a major role in helping individuals make sense of the world around them. Four basic mathematical operations, comparing prices, calculating and solving problems in daily life cannot be made proficiently without number sense. So, a sense of number is one of the fundamental needs for every individuals so as to manipulate various problems.

According to Yang and Wu (2010, cited in Akkaya, 2016), the necessity of teaching and learning number sense on four rationales: (i) number sense is a way to engage in flexible, creative, efficient and logical thinking; (ii) number sense is a concept that pertains to quantities, numbers, operations and their relationships with one another; (iii) digital representation and mathematical reasoning in adults depend in part on number sense; (iv) the focus on written calculation restricts not only the development of children's number sense but also their mathematical thinking and understanding.

According to McIntosh, Reys, and Reys (1992), an understanding of number and operations together with an ability and inclination to use this in flexible ways to make mathematical judgments, to develop useful strategies for handling numbers and to communicate, process and interpret information is essential in order to develop number sense.

So, it is necessary to study students' number sense and their problem solving skills which are the indispensable areas of mathematics education. Thus, this study intends to find out the relationship between students' number sense and their problem solving skills in mathematics at the middle school level. Since the middle school level is the bridge of the primary and the higher levels, it hopes to study the students' existing number sense and their problem solving skills and to provide foundations for developing number sense required at the higher level.

Theoretical Framework

Necessity of Mathematics Education

An information and technology based society requires individuals who are able to think critically about complex issues, analyze and adapt to new situations, solve problems of various kinds, and communicate their thinking effectively. The study of mathematics equips students with knowledge, skills and habits of mind that are essential for successful and rewarding participation in such a society.

The National Council of Teachers of Mathematics (1989, cited in Wynn, 2009) developed five imperatives or needs for all students in a commission. These are as follows.

(i) All students learn to value mathematics.
(ii) All students become confident in their ability to do mathematics.
(iii) All students become mathematical problem solvers.
(iv) All students learn to communicate mathematically.
(v) All students learn to reason mathematically.

According to National Council of Teachers of Mathematics (NCTM, 2000), in the 21st century, individuals who understand and can do mathematics will have significantly enhanced opportunities and options for shaping their futures. Mathematical competence opens doors to productive futures. A lack of mathematical competence keeps those doors closed. Therefore, everyone needs to understand mathematics. All students should have the opportunity and the support necessary to learn significant mathematics with depth and understanding.

Importance of Number Sense in Mathematics

According to Willoughby (1990, cited in Wynn, 2009), mathematics is a systematic approach to solving everyday problems using numbers, patterns, and logic because it encompasses number sense, estimation skills, ability to analyze data intelligently, knowledge of two and three dimensional geometry, and knowledge of probability.

Teaching mathematics with a focus on number sense encourages students to become problem solvers in a wide variety of situations and to view mathematics as a discipline in which thinking is important. Number sense was a term that become popular in the late 1980s. Number sense is a topic of great interest in school mathematics. The more clearly number sense is understood, the more likely there will be progress made in curriculum development and instruction (Walle, 2003). Therefore, number sense is an important theme in mathematics education.

Number Sense Strands

On the basis of the framework proposed by McIntosh, Reys, and Reys (1992), the following strands are developed. They are described with appropriate examples as below.

(i) Understanding of the meaning and size of numbers (Number concepts)

Understanding of the base 10 number system (whole numbers, fractions, and decimals) includes patterns and place value which provide clues to the meaning/size of a number (e.g., $\frac{5}{6}$ is a fraction less than one, it is close to one because of the relationship between the numerator and denominator). It involves relating and/or comparing numbers to standard or personal benchmarks. It includes comparing the relative size of numbers within a single representational form.

(ii) Understanding and use of equivalent forms and representations of numbers (Multiple representations)

This strand includes recognition that numbers take many different numerical and representational forms (e.g., fraction as a decimal, a whole number in expanded form, or a decimal on a number line) and can be thought about and manipulated in many ways to benefit a particular purpose. It also includes the ability to identify and/or reformulate numbers to produce an equivalent form; the use of decomposition and recomposition to reformulate numbers for ease in processing; relating and/or comparing size of numbers to a physical referent (e.g., collection of items, shaded region, or position on a number line); and crossing among various representational forms.

(iii) Understanding the meaning and effect of operations (Effect of operations)

This strand includes understanding the meaning and effect of an operation either generally or as it relates to a certain set of numbers (e.g., division means breaking a number into a specified number of equivalent subgroups or multiplying by a number less than 1 produces a product less than the other factor). It includes judging the reasonableness of a result based on understanding the numbers and operations being employed.

(iv) Understanding and use of equivalent expressions (Equivalent expressions)

This strand includes the translation of expressions to equivalent forms, often to reevaluate and/or more efficiently process a computation. It includes understanding and use of arithmetic properties (commutativity, associativity, distributivity) to simplify expressions and to develop solution strategies (e.g., the use of distributive property to multiply 7×52).

(v) Computing and counting strategies

This strand involves applying various number sense components previously described in the formulation and implementation of a solution process to a counting or computational (estimation, mental computation, paper/pencil, calculator) situation (e.g., is 29×38 more or less than 400? or how many birds do you estimate there are in this picture?).

Research Method

Research Design

The research design for this study was a descriptive research design, in which the researcher sought to determine a degree of the relationship between two or more quantifiable variables (number concepts, multiple representations, effect of operations, equivalent expressions, computing and counting strategies, and problem solving skills).

Procedure

To obtain the required data, the researcher carried out the following procedure in this study.

Step 1: Formulating the problem

Students have more difficulties in mathematics than in the other disciplines and their achievements in solving mathematical problems are not satisfactory. Moreover, their performance in solving problems involved fractions, decimals, percentage, etc. are not still mastered. In order to manipulate numbers comfortably and solve problems confidently, students must possess a sense of numbers. Furthermore, problem solving skill is an essential skill to achieve in mathematics education. In 2005, Louange and Bana also pointed out that the number sense is highly related with the problem solving skills in their research. Thus, Myanmar students' number sense, their problem solving skills, and the degree of relationship between these two elements become necessary to study.

Step 2: Compiling related literature

The researcher explored the relevant literature concerned with the research through reading the resources. Moreover, the researcher also studied the literature from the Internet sources.

Step 3: Choosing the study area

From the related literature, the researcher found five strands, such as number concepts, multiple representations, effect of operations, equivalent expressions, and computing and counting strategies, that could represent number sense. Besides, students' problem solving skill was used to study in this research. Because the researcher's purpose was to explore the relationship between students' number sense and their problem solving skills in mathematics.

Step 4: Constructing instruments and validation

The researcher constructed two tests: one for measuring the students' number sense, and the other one for measuring the students' problem solving skills in mathematics. After preparing the instruments, in order to get validation, an expert review was conducted by five experienced teachers in the field of teaching mathematics from the Department of Methodology, Yangon University of Education.

Step 5: Pilot testing

The instruments were validated through a pilot test with (50) Grade Seven students from B.E.H.S (1) East Dagon. The pilot testing for the instruments was conducted in December, 2016. The internal consistency of the number sense was (.778). The internal consistency of the test for the students' problem solving skills was (.699) by Cronbach's Alpha.

Step 6: Sampling

After the pilot test, the sample schools for this study were selected by using a stratified random sampling technique to conduct the major survey. Two high schools and one middle school from each township in Yangon Region were selected as the sample. Therefore, eight high schools and four middle schools were involved in this study. There were (600) Grade Seven students from the selected schools participated in this study.

Step 7: Data collection

The number sense test and the test for students' problem solving skills were administered to all the participants of the twelve sample schools with the help of the principals of those schools in January, 2017. The time allowed for the number sense test was anhour. The test for students' problem solving skills took for (45) minutes. After testing, the students' answer sheets for these two tests were scored manually according to the marking schemes that were validated. Then, all the data were entered into the computer data file.

Step 8: Analysis of the data

The obtained data were systematically analyzed by using the Statistical Package for the Social Science (SPSS 22) as it has been widely used in quantitative research.

Instruments

In this study, two tests, one for measuring students' number sense and the other for measuring their problem solving skills were used as the research instruments.

(i) Number Sense Test

In order to measure the students' number sense, a number sense test was constructed. It was based on number sense test published by McIntosh et al. (1997). Number sense test comprises a total of (20) multiple choice items and (20) completion items exploring five strands of number sense (see Table 1). Each correct item was scored (1) mark and thus, the total score was (40) marks. The number sense test used in this study was adapted to Myanmar version to be suitable for middle school Myanmar students.

Table 1: Table of Specifications for Number Sense Test

Strand	Number of Item								Total
	Whole Number		Fraction		Decimal		Percentage		
	MCI	CI	MCI	CI	MCI	CI	MCI	CI	
(1) Number Concepts	2	2	1	1	1	1	-	-	8
(2) Multiple Representations	2	2	1	-	-	1	1	1	8
(3) Effect of Operations	2	2	-	1	1	-	1	1	8
(4) Equivalent Expressions	2	2	1	1	1	1	-	-	8
(5) Computing and Counting Strategies	2	2	1	-	-	1	1	1	8
Total	10	10	4	3	3	4	3	3	40

Note: MCI = Multiple Choice Items, CI = Completion Items

(ii) Test for Students' Problem Solving Skills

A test for mathematical problem solving skills was constructed so as to measure the problem solving skills of the students. It was based on the content areas of Grade Seven mathematics textbooks, volume I and II, prescribed by the Department of Education, Basic Education Curriculum, Syllabus and Textbook Committee, (2015-2016) academic year. Ten problems were included for testing students' problem solving skills (see Table 2). The score of each item was (5) marks. Therefore, the total score was (50) marks.

Table 2: Table of Specifications of Test for Problem Solving Skills

Volume	Content Area	No. of Item	Mark
	Exponents	1	5
	Square and Square Roots	1	5
	Special Products and Factoring	1	5
I	Rational Algebraic Equations	1	5

Population and Sample Size

All the participants in the sample were Grade Seven students. This study was conducted in Yangon Region. There are four districts in Yangon Region. One township from each district was randomly selected for this study. The sample schools for the study were selected by using a stratified random sampling technique. Two high schools and one middle school from each township were selected as the sample. Therefore, twelve schools (eight high schools and four middle schools) were included in this study. Fifty Grade Seven students from each selected school were selected as the subjects by an equal-sized (nonproportional) random sampling technique. Therefore, the number of participants in this study was (600).

Data Analysis

The descriptive analysis techniques were used to calculate means, standard deviation and percentage. Moreover, Pearson product-moment correlation was used to describe the relationships between students' number sense and their problem solving skills in mathematics.

Research Findings

Finding of Students' Number Sense

To assess students' number sense, a number sense test was administered. Descriptive analysis techniques were used to calculate means, standard deviation and percentage of students who possessed number sense. So, all the participants were classified into three groups (low, moderate, and high) based on the mean and standard deviation of all the participants. The total score of the number sense test was (40). When the mean and standard deviation for all the participants were calculated, (22.61) and (6.603) were obtained. And then, $(+1)$ standard deviation from the mean and (-1) standard deviation from the mean were carried out. Thus, based on these results, students with scores less than (16) were identified as low group. Students with scores from (16) to (29) were considered as moderate group. Then, students with scores greater than (29) were identified as high group. In order to assess the levels of number sense, the percentage of various groups was presented in Table (3).

Table 3: Students' Level of Number Sense

Level of Number Sense	Score	No. of Student	Percentage (%)
Low	0 - 15	87	14.50%
Moderate	16 - 29	416	69.30%
High	30 - 40	97	16.20%
Total		**600**	**100%**

Finding of Students' Problem Solving Skills

To examine students' problem solving skills, a test for problem solving skills was administered. In order to calculate means, standard deviation, and percentage of students who possessed problem solving skills, descriptive analysis techniques were used. Therefore, all the participants were categorized into three groups (low, moderate, and high) based on the mean and standard deviation of all the participants. The total score of test for students' problem solving skills was (50). After the mean and standard deviation for all the participants were calculated, (19.03) and (10.407) were received respectively. And then, (+1) standard deviation from the mean and (−1) standard deviation from the mean were performed. Thus, according to these results, students with scores less than (9) were identified as low group. Students with scores from (9) to (29) were considered as moderate group. Then, students with scores greater than (29) were identified as high group. In order to examine the levels of problem solving skills, the percentage of various groups was presented in Table (4).

Table 4: Students' Level of Problem Solving Skills

Level of Problem Solving Skills	Score	No. of Student	Percentage (%)
Low	0 - 9	68	11.30%
Moderate	10 - 29	442	73.70%
High	30 - 50	90	15.00%
Total		**600**	**100%**

Finding of Relationships between Students' Number Sense and their Problem Solving Skills

Further analysis was conducted to explore the relationships between students' number sense including five strands and their problem solving skills (see Table 5). For this purpose, Pearson product-moment correlation was used.A correlation coefficient is a decimal number which is ranged from (+1.00) to (−1.00). According to Ravid (2011), an interpretation of correlation coefficients is stated as follows.

.00 to .20	Negligible to low (a correlation of .00 would be defined as 'no correlation')
.20 to .40	Low correlation
.40 to .60	Moderate correlation
.60 to .80	High correlation
.80 to 1.00	**Substantial/Very high** (a correlation of 1.00 would be defined as a 'perfect correlation')

Table 5: Correlations between Students' Number Sense and their Problem Solving Skills

Correlation		
Number Sense Strand		**Problem Solving Skills**
Number Concepts	Pearson Correlation	**.540****
	Sig. (2-tailed)	.000
	N	600
Multiple Representations	Pearson Correlation	**.469****
	Sig. (2-tailed)	.000
	N	600
Effect of Operations	Pearson Correlation	**.412****
	Sig. (2-tailed)	.000
	N	600
Equivalent Expressions	Pearson Correlation	**.508****
	Sig. (2-tailed)	.000
	N	600
Computing and Counting Strategies	Pearson Correlation	**.505****
	Sig. (2-tailed)	.000
	N	600
Total	Pearson Correlation	**.607****
	Sig. (2-tailed)	.000
	N	600

Note: ** Correlation is significant at the 0.01 level (2-tailed)

Discussion, Suggestions, and Conclusion

Discussion

In learning mathematics, number sense is regarded as an essential area. Number sense encourages students to handle various numerical situations, to develop multiple relationships among numbers and operations, to compute comfortably and judge solutions reasonably and to make sense of the mathematics they learn rather than master rules and algorithms. Number sense is a process which is nurtured gradually. It is a foundational skill in mathematics which can help students to become both good problem solvers and good estimators. Therefore, number sense is necessary for students in learning mathematics.

In determining the percentage of students who possessed number sense, (14.5%) of the students possessed low level of number sense, (69.3%) of the students possessed moderate level of number sense and (16.2%) of the students possessed high level of number sense. Therefore, most Grade Seven students had a moderate level of number sense. Thus, these findings revealed the answer to the first research question: To what extent do students possess number sense?

In examining the percentage of students who possessed problem solving skills, (11.3%) of the students possessed low level of problem solving skills, (73.7%) of the students possessed moderate level of problem solving skills and (15%) of the students possessed high level of problem solving skills. Therefore, most Grade Seven students had a moderate level of problem solving skills. Thus, these findings revealed the answer to the second research question: To what extent do students possess problem solving skills?

In exploring the relationship between students' number sense and their problem solving skills, there was a positively high relationship between them. Consequently, students' number sense could contribute to their problem solving skills directly. Thus, this finding revealed the answer to the final research question: Is there a relationship between students' number sense and their problem solving skills in mathematics?

To summarize, according to the research findings mentioned above, students' number sense are neither low nor high. This result indicated that Grade Seven students possessed a moderate level in the understanding of the number system, representations of numbers, and numerical operations. And then, they had in the moderate level of the use of arithmetic properties and various computation strategies such as estimation and mental computation. Especially, they were weak in multiple representations involved converting between fractions, decimals and percentage. They also had difficulty in producing the representations of fractions, decimals and percentage on the number line. Furthermore, some weaknesses were found in the performances of Grade Seven students in the test for problem solving skills. Particularly, they had difficulties in formulating solutions from word problems and solving geometrical figures. Moreover, research findings also revealed that Grade Seven students' number sense was positively and significantly correlated with their problem solving skills. Thus, it could be concluded that number sense must be mastered in order to solve mathematics problems proficiently.

Suggestions

Number sense is a major topic for the understanding of mathematics. It is one of the essential constituents in teaching and learning mathematics. If a person has good number sense, he or she will work confidently with numerical problems both in text and in real situations. Thus, students should be equipped with such number sense in order to become good problem solvers in the future.

The most challenging strand among five number sense strands for students was multiple representations. Similarly, students had also difficulty in the area of magnitude of numbers. This causes additional difficulty in learning such as relationships between fractions, decimals and percentage. So, it is necessary for mathematics teachers to start focusing on the relationships between fractions, decimals and percentage. Moreover, the importance of the relationships of fractions, decimals and percentage to each other should be addressed and stressed in teaching and learning mathematics.

On the basis of related literature, some suggestions are given under four headings: role of teacher in developing number sense, establishing classroom atmosphere with full of number sense, teaching strategies for building number sense and for further research studies.

(i) **Role of teachers in developing number sense:** In order to promote number sense in students, one of the essential requirements is their teacher. Teachers play a key role in building number sense, in creating classroom atmosphere which is full of number sense, in implementing teaching strategies and in selecting activities which are the most appropriate for developing number sense. Teachers should use questions that require more than a simple factual response. Such questions can stimulate discussion of an idea, which can lead to further exploration and the use of oral language to explain and justify students' thought.

Moreover, giving oral work can improve students' performances in estimation and mental computation which are essential skills in developing number sense. So, teachers should suitably use oral work in teaching-learning process to develop number sense among the students. By selecting appropriate classroom activities, teachers should cultivate number sense during all mathematical experiences. Process-oriented activities also convey the idea of mathematics as an exciting, dynamic discovery of ideas and relationships. Integration of number sense activities into mathematics instruction will play a crucial role in increasing the performance levels of students on number sense. In this way, teachers should keep in mind and implement these suggestions to cultivate students' number sense which can foster the higher achievement in mathematics.

(ii) Establishing classroom atmosphere with full of number sense: It is important to establish a classroom atmosphere which can facilitate number sense development. Teachers can build a sense of numbers in students by creating classroom environment. Teachers should establish an atmosphere in which students are able to:

- work with concrete materials and familiar ideas,
- investigate the realistic uses of numbers in their everyday world,
- gather, organize, display and interpret quantitative information,
- explore number patterns and number relationships, and
- create alternative methods of calculation and estimation.

(iii) Teaching strategies for building number sense: To become increase in number sense, teaching strategies, such as modelling different methods for computing; asking students regularly to calculate mentally; having class discussions about strategies for computing; making estimation an integral part of computing; questioning students about how they reason numerically; and posing numerical problems that have more than one possible answer, should be utilized appropriately. Teachers should consider and apply these strategies in building number sense in students.

(iv) Further research studies: Since number sense is necessary for all the individuals, further studies concerned with students' number sense should be carried out at other various school levels. Moreover, in this study, sample schools were randomly selected from Yangon Region. So, further studies should be carried out in other States and Regions for replication. Although other countries did a lot of experimental research about students' number sense, there was little experimental research about students' number sense in Myanmar. So, it seems to be good to conduct further studies concerned with number sense by using an experimental design. In addition, this study was dealt with five strands such as, number concepts; multiple representations; effect of operations; equivalent expressions; and computing and counting strategies, fostered number sense developed by McIntosh et al. (1997). There are other strands or components such as number estimation and using benchmarks for number sense can be developed by other educators. So, further studies using other strands or components of number sense should be conducted. Moreover, further studies which explore different methods that can improve number sense should be conducted and also extended to a larger population. Number sense is one of the foundations for promoting achievement level in solving problems. Therefore, any studies that can facilitate number sense development should be carried out in the future.

Conclusion

Today, mathematics plays a prominent role in education to cultivate thinking skills of everyone. Foundational knowledge and fundamental skills are important tools for later mathematics learning. Number sense, which is one of the essential elements in learning mathematics, must be acquired and mastered so as to become comfortable in later mathematics learning. Number sense as a sense-making activity plays a crucial role in teaching and learning mathematics. So, a substance that should not be forgotten for higher achieving in mathematics is number sense.

Similarly, problem solving skills are also important in teaching and learning mathematics. Problem solving is the heart of mathematics since mathematics is composed of various kinds of problems. To become problem solvers is one of the major aims of teaching mathematics. In the 21st century, number sense and problem solving become necessary. So, educators and researchers are highly interested in these two elements. Thus, many researchers have been conducted various studies concerned with the number sense and problem solving skills in different areas. In the same way, the researcher would like to study the conditions of Myanmar students' number sense and problem solving skills.

Therefore, this study was conducted for investigating middle school students' number sense and problem solving skills. Thus, this study can give evidence that number sense and problem solving skills are closely related with each other. In order to become a good problem solver, the essential requirement is to make sense of numbers. Both number sense and problem solving skills are basic skills needed by today's learners. So, this study highlighted that these skills were important in teaching and learning mathematics. Thus, it is expected that this study can support, to a certain extent, the development of number sense and problem solving skills, which are crucial to get higher achievement in mathematics.

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Appendix A
(Number Sense Test)

owårwef; ausmif;om;/olrsm;
udef;*Pef;qdkif&mem;vnfodjrifEdkifrIppfaq
;vTm

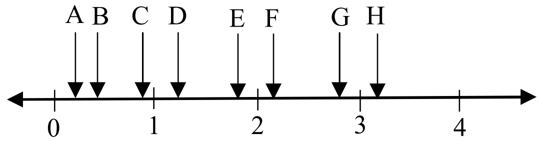
nTefMum;csuf/ /
atmufygar;cGef;rsm;udkajzqdkyg/
cGifhjyKcsdef (1) em&D
tydkif; (u)
udef;rsm;\ t"dyÜÜg,fESifh
t½G,ftpm;wdkYudk em;vnfjcif;

Understanding of the meaning and size of numbers (Number concepts)

1. 16, *, 4, 2, 1
 ay;xm;aomuddef;tpDtpOfwGif(*)jyxm;aomae&müjznfh&rnfhudef;rSm-
 (A) 12 (B) 10 (C) 8 (D) 6 jzpfonf/
2. atmufygudef;rsm;teufrS20000ESifhfteD;qHk;udef;rSm-
 (A) 21536 (B) 21356(C) 21365 (D) 23165 jzpfonf/
3. atmufygwdkYrStMuD;qHk;tydkif;udef;rSm-
 (A) $\frac{5}{6}$ (B) $\frac{5}{7}$ (C) $\frac{5}{8}$ (D) $\frac{5}{9}$ jzpfonf/
4. 0.4 ESifh0.6 tMum;ü 'orudef;ta&twGufrSm-
 (A) wpfckrsSr&Sdyg/
 (B) wpfck&Sdygonf/
 (C) tenf;i,f&Sdygonf/
 (D) ajrmufjrm;pGm&Sdygonf/
5. $0 \times 3, 1 \times 4, 2 \times 5, 3 \times 6, \square$
 txufygudef;tpDtpOft&uGufvyfwGifjznfh&rnfhtajzrSm -------jzpfonf/
6. 2 \qefYusifbufudef;rSm-------- jzpfonf/
7. 2ESifh3Mum; &Sdudef;wpfckudk udk,fpm;jyKrnfh tydkif;udef;wpfck&&Sd&ef atmufyg uGufvyf wGif jznfh&rnfhudef;rSm --------jzpfonf/

$\frac{\square}{8}$

8.



txufygudef;rsOf;t&B +
F\wefzdk;ESifhwlnDaomtu©&mrSm -------- jzpfonf/

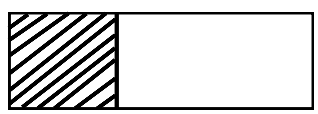
tydkif; (c)
udef;rsm;\wlnDaom yHkpHrsm;ESifhudk,fpm;jyKazmfjyrIrsm;udk em;vnfjcif;/ toHk;jyKEdkifjcif;

Understanding and use of equivalent forms and representations of numbers (Multiple representations)

1. ‘okn’udk-
(A)obm0udef;
(B)tajr§mufxyfwl&udef;
(C)ok'¨udef;
(D) taygif;xyfwl&udef; [kac:onf/

2. atmufygwdkYteufrStBuJD;qHk;yuwdwefzdk;rSm-
(A) -19 (B) -17 (C) 15 (D) 13 jzpfonf/

3.



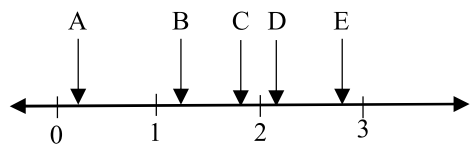
yHkwGifjc,frIef;xm;aomtpdwftydkif;udktydkif;udef;jzifhazmfjyvsSif-
(A) $\frac{1}{2}$ (B) $\frac{1}{3}$ (C) $\frac{1}{4}$ (D) $\frac{1}{5}$ jzpfonf/

4. $\frac{3}{8}$ udk&mcdkifEIef;jzifhazmfjyrnfqdkvsSif-
(A) 30% (B) 35% (C) 37.5% (D) 35.7% jzpfonf/

5. $(7 \times 10000) + (2 \times 1000) + (4 \times 10) + (8 \times 1)$\tajzrSm-------- jzpfonf/

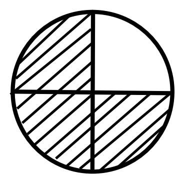
6. $|-x| = 3$jzpfvsSif$x$ \wefzdk;rSm--------jzpfonf/

7.



ay;xm;aomudef;rsOf;ay:wGif 2.19 udkudk,fpm;jyKonfhtu©&mrSm -------- jzpfonf/

8.



yHkwGifjc,frIef;xm;aomtydkif;onf -------- %ESifhnDrsSonf/

tydkif; (*)
udef;qdkif&mtajccHvkyfxHk;vkyfenf;rsm;udk em;vnfjcif;

Understanding the meaning and effect of operations (Effect of operations)

1. *Pef;ESpfvHk;ygaomudef;ESpfckwdkY\ ajr§mufv'frSm-
   (A)*Pef;oHk;vHk; (odkY) av;vHk;ygaomudef; &\/
   (B)tpOftNrJ *Pef;av;vHk;ygaomudef; &\/
   (C)wpfcgwpf&H *Pef;ig;vHk;ygaomudef; &\/
   (D) *Pef;oHk;vHk; (odkY) av;vHk; (odkY) ig;vHk;ygaomudef; &\/
2. atmufygudef;rsm;teuf45×105\tajzESifhteD;qHk;udef;rSm-
   (A) 4000 (B) 4600 (C) 5200 (D) 5800jzpfonf/

3. $29 \div 0.8$\tajzonfcefYrSef;ajctm;jzifh-
   (A) 29atmufi,fonf/
   (B) 29ESifhnDonf/
   (C) 29 xufBuD;onf/
   (D) 29 xufBuD;vnf;BuD;onf/ (odkY) nDvnf;nDonf/
4. a&avSmifuefwpfuefwGifig;aumifa&1000&Sd\/ 15%xyfwdk;vmaomfxdka&avSmifuefü&Sdaomig;aumifa&-
   (A)150
   (B)1015
   (C)1050
   (D)1150 aumif&Sdonf/
5. $(-3)+8+(-12)$\ tajzrSm------- jzpfonf/
6. $(9)\times(-2)\times(-6)$\tajzrSm -------- jzpfonf/
7. $\left(\frac{-3}{4}\right)\div\frac{9}{10}$udk&Sif;vsSiftajzrSm -------- jzpfonf/
8. jrjrüaiG 4000 usyf&Sd\/ olronf&Sdaom ydkufqH\ 90%udk tuÐs0,fvdkufaomf usefaiGrSm ------ jzpfonf/

tydkif; (C)
wlnDaomazmfjycsufrsm;udkem;vnfjcif;/toHk;jyKEdkifjcif;

Understanding and use of equivalent expressions
(Equivalent expressions)

1. $5\times \boldsymbol{w}=(5\times 20)+(5\times 3)$
   ay;xm;aomnDrsSjcif;t&'$\boldsymbol{w}$'\wefzdk;rSm-
   (A) 23 (B) 32 (C) 60 (D) 203jzpfonf/

2. $38 + (-27) = \text{-----} + [\ \text{-----} + (-27)]$

taygif;ajymif;jyef*kPfowådudktoHk;jyKítxufygu GufvyfESpfckwGifjznfh&rnfhudef;pHkwGJrSm-

(A) 18, 20 (B) 16, 22

(C) 11, 27 (D) 9, 29 jzpfonf/

3. atmufygwdkYteuf $\frac{-3}{2}$ ESifhwlnDaomudef;rSm-

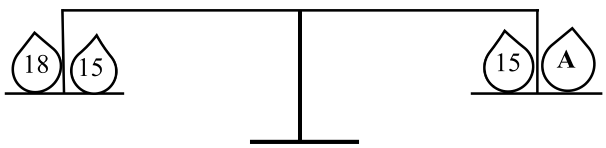
(A) $\frac{2}{3}$ (B) $\frac{3}{2}$ (C) $\frac{-3}{-2}$ (D) $-\frac{3}{2}$ jzpfonf/

4. $243 \times \text{-----} = \text{-----} \times 24.3$

uGufvyfESpfckvHk;wGifjznfh&rnfhudef;rSm-

(A) 1 (B) 0 (C) 0.1 (D) 0.01jzpfonf/

5.



yHkwGifjyxm;onfhtwdkif; oauFw**‘A’**\wefzdk;rSm -------- jzpfonf/

6. $[3 \times \text{-----}] \times (-4) = 3 \times [\text{-----} \times (-4)] = 24$
ajr§mufjcif;qdkif&m zufpyf&*kPfowåd t& uGufvyfESpfckvHk;wGif jznfh&rnfhudef;rSm -------- jzpfonf/

7. oknr[kwfaomudef;wpfckESifh 4if;\vSefudef;wdkYajr§mufv'frSm -------- jzpfonf/

8. $(-0.03)\,[\,\boldsymbol{p} + (-0.05)] = [(-0.03)(-0.04)] + [(-0.03)(-0.05)]$
txufygnDrsSjcif;rS***p***\wefzdk;rSm -------- jzpfonf/

tydkif; (i)

wGufcsufjcif; ESifha&wGufjcif; qdkif&menf;vrf;rsm;

Computing and counting strategies

aMumifwpfaumifonf4&ufwGifig; 600gudkpm;\/

· 6&ufwGifxdkaMumifonfig;-

(A) 800 g
(B) 900 g
(C) 1000 g
(D) 1100 g udkpm;onf/

· c&D;wpfckudkwpfem&DvsSif 80 kmjzifhoGm;&m 6em&D Mum\/ tjyefc&D;wGif 4 em&D Mumonf/ toGm;tjyefc&D;ESpf&yfaygif;twGufwpfem&DvsSifysrf;rsSoGm;EIef;rSm-

(A)96 km (B) 72 km (C) 48 km (D) 24 kmjzpfonf/

· z&JoD;wpfvHk;udkav;pdwfpdwf\/xdkYaemufwpfpdwfpDudkESpfydkif;pDjyefydkif;onf/ wpfzefxyfrHí wpfydkif;pDudk xuf0ufydkif;jzwfjyefaomf aemufqHk;&&Sdvmaom z&JoD;pdwf ta&twGufrSm-(A) 4 (B)8 (C)12 (D) 16pdwfjzpfonf/

250\40%onfatmufygwdkYteuf-(A)200 (B)150 (C)100 (D) 50

· ESifhwlnDonf/

0ESifh20Mum;&Sd ok'¨udef;ta&twGufrSm-------- vHk;

· &Sdonf/

· reDwGifaiG750usyf&Sd\/ olr\ aiGonfrvSwGif&Sdaom aiGatmuf150usyf avsmhenf;vsSif rvSü&SdaomaiGrSm----- jzpfonf/

ausmfausmfonf

· wpfrdepfvsSifpmvHk;a&28vHk;&dkufEdkif\/ xdkEIef;jzifh 5.5 rdepfMumvsSif pmvHk;a& ----- jyD;atmif&dkufEdkifonf/

vGefcJhaomwpfywfu pmtkyfwpftkyfvsSif 350usyf

· ay;&\/ ,ck 10%avsSmha&mif;vsSif pmtkyf\wefzdk;rSm -------- jzpfonf/

Appendix B
(Test for Students' Problem Solving Skills)

owårwef; ausmif;om;/olrsm;

jyóem/ykpämrsm;ajz&Sif;jcif;qdkif&muRrf;us ifrIppfaq;vTm

nTefMum;csuf / /

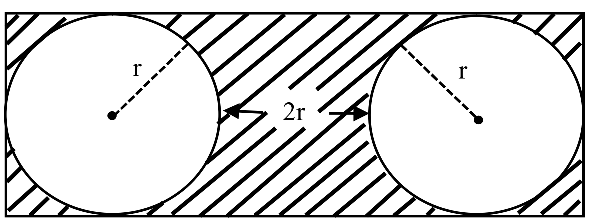
atmufygar;cGef;rsm;udkajzqdkyg/

cGifhjyKcsdef (45) rdepf

1. $2\times(\sqrt{2})^5\times(\sqrt{2})^{\frac{-2}{3}}=(\sqrt{2})^{a+1}$ jzpfvsSifaudk&Smyg/

2. pwk&ef;yHkoP²mef&SdaomMurf;jyifwpfck\{&dd,monf 53 pwk&ef;udkuf 7 pwk&ef;ay&Sdaomf 4if;\ tem;wpfzufudk&Smyg/

3. atmufygyHk&SdrIef;jc,fxm;aom{&d,mudkqcGJudef;yH kpHjzifhjyyg/



4. ypönf;wpfck\ wefzdk;udk 6% wdk;vdkufaomtcg xdkypönf;\ wefzdk;onf80usyfjzpfvm\/ rlvwefzdk; udk&Smyg/

5. rlvwef; ausmif;wpfausmif;ü ausmif;om; 400a,muf&Sd&m a,mufsm;av; OD;a&rSm rdef;uav;OD;a&xuf 80 a,muf ydkaomfa,mufsm;av;OD;a&ESifh rdef;uav;OD;a& toD;oD; rnfrsSpD&Sd oenf;/

6. ℓ =a + (n − 1) d yHkaoenf;rSd y"meudef;&SdaomyHkaoenf; odkYajymif;yg/ ℓ =200, a = 50 ESifh n = 26 jzpfvsSif d udk&Smyg/

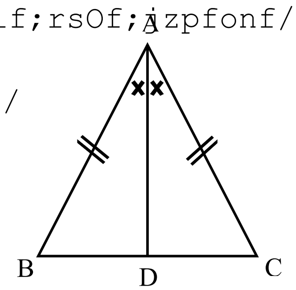
7. yHkwGif Δ ABConfESpfem;nDBwd*Hjzpfí AB =AC jzpfonf/ AD onf $\angle$BAC \ xuf0ufydkif;rsOf;jzpfonf/

(i) $\Delta ABD \cong \Delta ACD$jzpfygovm;/

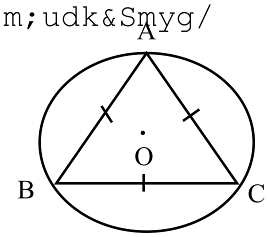
(ii) DonfBC\ tv,frSwfjzpfygovm;/

(iii) $\angle ADC = 90°$jzpfygovm;/

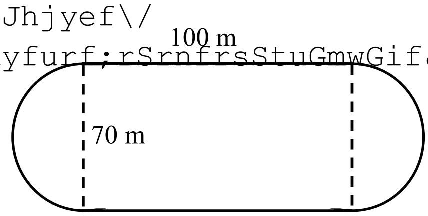
taMumif;jycsufjzifhajzqdkyg/



8. oHk;em;nDBwd*H\ axmifhywfpuf0dkif;ay:&Sd t0ef;ydkif;BuD; BCESifh t0ef;ydkif;i,f BCwdkY\ 'D*&Dtwdkif;twmrsm;udk&Smyg/



9. oabFmwpfpif;onfqdyfurf;rStaemufpl;pl; 8 km tuGmodkYxGufcJhjyD; wpfzefajrmufpl;pl; 15 km tuGmodkYxGufcJhjyef\/ oabFmonfrlvqdyfurf;rSrnfrsStuGmwGif&Sdaeoenf;/

10. 

yHkonf abmvHk;uGif;wpfuGif;\ yHkjzpfonf/ *dk;aemufydkif;onf puf0dkif;jcrf;yHk jzpfonf/ tu,fí axmifhrSefpwk*HyHkabmvHk;uGif;onf tvsm; 100 m? teH 70m jzpfvsSif puf0dkif;jcrf;rsm; tygt0if uGif;\ywfvnftem;onfrnfrsSjzpfrnfenf;/