

A STUDY OF SCIENCE PROCESS SKILLS AND ACHIEVEMENT OF STUDENTS IN SCIENCE AT THE MIDDLE SCHOOL LEVEL

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Abstract

The main purpose of this study was to investigate the science achievement of students who are taught with science process skills at the middle school level. This study was conducted with quantitative research method. The experimental design adopted in this study was a true experimental design, namely, posttest only control group design. This study was conducted in Yangon Region. The sample schools for this study were selected by using a random sampling method. Two high schools were selected from two different districts, Yangon Region. The subjects were Grade Seven students selected from No. (1) BEHS Latha and No. (4) BEHS Pazundaung. The reliability of instruments was calculated through a pilot testing with (30) Grade Seven students. The internal consistency (Cronbach's Alpha) of the students' achievement test was (.743). For this study, (120) Grade Seven students were selected from both schools by random sampling method. These students were divided into two groups: control and experimental. The experimental group was treated with science process skills and the control group was taught with formal instruction. After that, a posttest was administered to two groups. Independent samples t-test was used to test whether there was significant difference between these two groups. Examination of the means and t-test at No. (1) BEHS Latha ($t=10.51$, $df = 58$, $MD=9.10$, $p=.000$) and No. (4) BEHS Pazundaung ($t=14.95$, $df=58$, $MD=10.70$, $p=.000$) indicated that students who were taught by science process skills demonstrated significantly better than those who were taught with formal instruction. Research findings proved that science process skills has positive contribution to the science teaching at the middle school level.

Keywords: Science Process Skills, Achievement

Introduction

Science is simultaneously a kind of knowledge and a way of gaining and using that knowledge. Indeed science is both product and process, inseparably joined. Science has made a tremendous impact on the life of the present day society which is a product of science. The thinking, feeling and actions of a modern man are practically guided by the effects of science. There is an involvement of science, direct or indirect, in all works as well as leisure of a modern man. The habits and attitudes have also been affected by science. Science affects the behavior of the learner and enriches his character and personality. It also offers the opportunities for creative thinking and constructive imagination.

Science is the system of knowing about the universe. The impact of science is evident in agriculture, industry, health, modern civilization, democracy etc. Science looks for different kinds of pattern and relationship in our universe. Nowadays children undergo the explosion of information and they need to learn more to adapt the complex changing world. They also need to learn by themselves and the role of teachers and parents is to facilitate in the learning process of the children and to train them to become self-directed learners. To develop such habits, students must possess science process skills. According to Johnston (2009, cited in Maranan, 2017), science process skills are significant in improving students' cognitive development and facilitating students' active participation during the teaching and learning process.

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Statement of the Problem

The science process skills constitute a general definition of the logical and rational thought that are used throughout lifetime (Aydogdu & Kesercioglu, 2005, cited in Feyzioglu, 2009). Studies aiming to equip students with science process skills have concluded that students acquire each science process skills through certain stages (Saat, 2004, cited in Feyzioglu, 2009). These stages have been identified as recognition of scientific process, making habits, and automation.

These skills can be gained by students through certain science education activities (Harlen, 1999). Students equipped with science process skills tend to achieve higher than students with low process skills. This is because such students tend to reason intelligently and tackle problem situations more efficiently leading to higher achievement. Students who are able to make use of formal thought are also able to solve problems beyond the capabilities of those who did not possess modes of reasoning.

Purposes of the Study

The general purpose of this study is to investigate the science achievement of students who are taught with science process skills at the middle school level. The specific objectives are as follows.

- To compare science achievement of the students who are taught with science process skills and those who are not taught with science process skills.
- To provide suggestions for improving science teaching learning situation.

Research Hypotheses

- (1) There is a significant difference in the achievement of science between students who receive science process skills and those who do not receive.
- (2) There is a significant difference between the achievement of students who receive science process skills and those who do not receive in performing the knowledge level questions.
- (3) There is a significant difference between the achievement of students who receive science process skills and those who do not receive in performing the comprehension level questions.
- (4) There is a significant difference between the achievement of students who receive science process skills and those who do not receive in performing the application level questions.

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 are from only two selected schools from Yangon Region. Participants in this study are Grade Seven students from the selected schools within the school year (2018-2019). The second limitation is that this study is only concerned with the science process skills of the Grade Seven students. The third limitation is the content area of chapter (5) from Grade Seven General Science Textbook prescribed by the Basic Education Curriculum, Syllabus and Textbook Committee, 2018-2019.

Definition of Key Terms

Science Process Skills

Science process skills are the tools that students use to investigate the world around them and to construct science concepts (Oxford Encyclopaedia Science Dictionary).

Achievement

Achievement is a thing that somebody has done successfully, especially using their own effort and skill (Oxford Encyclopaedia Science Dictionary).

Significance of the Study

In line with the development of new science curricula in Myanmar, it is necessary for all science teachers to have a firm understanding of the nature of science and be abreast of the current educational advances affecting the society every day. The purpose of science education is to provide experiences through which young children can acquire the knowledge, skills, and attitudes that lead to patterns of behavior acceptable to the society. Science teachers need to be willing to help their students develop science process skills as well as provide scientific technological knowledge.

Teaching science only through note taking and memorization cannot get students achieve science concepts. Teaching with science process skills is an appropriate approach for elementary and middle school teachers. Science process skills approach not only allows students to be an active participants in the learning process but also forces them to take an active role by engaging them in a meaningful thought provoking way. Science process skills are based on real life situations and such skills lead students develop self-confidence to solve problems that they might face in everyday activities.

Teaching science through science process skills provide students with experiences that help them attain positive attitudes toward science. If teachers are knowledgeable about the science process skills, their students will gain appropriate and effective skill instruction. These science process skills are vital for science learning and concept formation at the primary and middle school levels. The National Science Teacher Association (NSTA, 2002) states that teachers should create learning situations that focus on inquiry and the process skills to enhance students' learning.

Therefore, a research for studying the science process skills and the science achievement of students at the middle school level is necessary.

Theoretical Framework

Importance of Science Process Skills

Skills refer to specific activities or tasks that a student can proficiently do. Skills can be clustered together to form specific competencies. To be competent in the scientific knowledge, learners must use science process skills because they are ways of the acquisition of such knowledge. Ways of thinking in science are also called the process skills. Science process skills include the skills of each individual that are used in daily life which can improve the quality and standard of life by understanding the nature of science. Science process skills are process thinking skills using scientific processes and approaches (Rezba, Sprague & Fiel, 2002).

Learning science from cradle to adulthood begins with the development of science process skills. This is because science process skills serves as instrument that encourages the learner to perform the kinds of tasks that would lead him/her to reflective thinking and discovery knowledge. When science process skills are emphasized in the classroom, students' proficiency on individual skills increases, some skills are transferred to new situations, and the skills are retained over time (Padilla, 1990). Padilla suggests that basic science process skills provide a foundation for more complex science process skills. The development of science process skills in students provides essential components for the development of the general goals of education (Gbamanja, 2002, cited in Joseph, et., al., 2017).

The development of SPSs enables students to acquire the skills necessary to solve everyday problems (Aydogdu et al., 2014, cited in Rauf, et.,al., 2013). If these skills are not well developed, relevant evidence is not collected. According to karamustafaoglu (2011, cited in Maranan, 2017), understanding of science process usually refer to skills or abilities that must be owned by the scientists on the process of scientific discovery. The processes of science are basic components of thinking and are useful in problem solving and critical thinking, not only in science but also in day-to-day life situations.

Advantages of Science Process Skills

1. It develops skills in the learner which he or she could use in solving everyday problem.
2. It is activity-oriented, learner-centered and encourages maximum student participation in the learning activities.
3. It is motivating and increases students' interest in their activities.
4. Students tend to develop the scientific method of thinking in the learning process.
5. It facilitates concept formation emanating from primary experiences which the learner will encounter in the skills acquisition process.
6. It also encourages the development of skills which are the general attributes of scientists which students must emulate.

Disadvantages of Science Process Skills

1. Other non-science disciplines do not seem to benefit much from this approach since it is scientifically oriented.
2. The planning of the activities to facilitate skill developing among students could be time consuming and expensive in terms of material resources required.

Research Methodology

Research Design

The research design used for this study was a true experimental design.

Procedure for the Study

The researcher sought out the literature related to this study through books and Internet sources. After that, lesson plans and an achievement test were constructed for this study. Validation for instruments were determined by the expert judgments. According to their suggestions, test items were modified again and its marking scheme was also presented. After getting the validity of these instruments, pilot study was conducted. The pilot study was

conducted in Basic Education High School, Kawhmu in November, 2018. After the pilot study, the experiment was conducted in No (1), Basic Education High School, Latha and No (4), Basic Education High School, Pazundaung.

The sample students were selected in random. The students were grouped randomly for control and experimental group. And then the experimental group learned through science process skills and the control group received the formal instruction. Finally, the achievements of experimental and control group were compared by using the independent samples 't' test.

Instruments

In this study, lesson plans and an achievement test for Grade Seven students were used as instruments.

(a) Lesson Plan

The format of lesson plan was based on the five basic science process skills described by Padilla, (1990). They are observing, communicating, classifying, inferring and predicting. The learning materials are the lessons from Chapter (5) "The Earth and Space". Extended materials were pictures, models and the things in the school compounds.

(b) Achievement Test

The posttest (achievement test) were developed based on the chapter (5) The Earth and Space in Grade Seven General Science Textbook prescribed by the basic education curriculum, syllabus and textbook committee. A table of specifications was drawn up for the posttest in order to facilitate the crafting of test questions. The items used for the posttest were composed of (5) true/false items, (5) completion items, (5) multiple choice items, (5) matching items and (5) short question items. The allocated time for the test was (45) minutes. The total marks for this test were (30).

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. Two districts were selected in random. After that, one high school from each township was selected as sample schools. The participants in this study were selected by random sampling and they were assigned to experimental and control group. The total number of students participated in this study were (120).

Data Analysis

The data were analyzed by using descriptive statistics (mean score and standard deviation). The independent samples 't' test was used to compare the achievement of students who learned by science process skills and that of students who learned by formal instruction at knowledge, comprehension, and application level. In order to determine the significant differences, the independent samples 't' test was used with SPSS 22.

Research Findings

Finding of Students’ Achievement at Knowledge Level on the Posttest Question

Table 1 *t*-Values for Experimental and Control Group on the Posttest Question at Knowledge Level

School	Group	N	M	SD	MD	<i>t</i>	<i>df</i>	Sig (2-tailed)
BEHS (1)	Experimental	30	5.03	0.72	1.06	4.98	58	.000***
	Control	30	3.97	0.93				
BEHS (4)	Experimental	30	5.60	0.67	1.50	6.53	58	.000***
	Control	30	4.10	1.06				

Note: ****p* < .001

BEHS (1) – No. (1) Basic High School Education, Latha

BEHS (4) – No. (4) Basic High School Education, Pazundaung

The mean scores of experimental and control groups were (5.03) and (3.97) in BEHS (1). They showed that there was a significant difference between the achievement of control and experimental group at the knowledge level in BEHS (1). This means that the students’ achievement of experimental group at knowledge level is higher than that of control group. And the mean scores of experimental and control groups were (5.60) and (4.10) in BEHS (4). This also means that the students’ achievement of experimental group at knowledge level is higher than that of control group in BEHS (4). This result is also illustrated by the Figure 1.

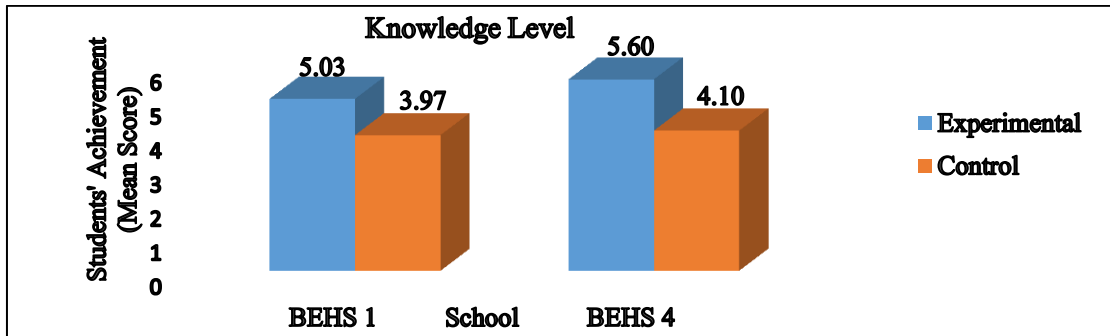


Figure 1 Mean Comparison of Students’ Achievement on the Posttest Question at Knowledge Level by Schools

Finding of Students’ Achievement at Comprehension Level on the Posttest Question

Table 2 *t*-Values for Experimental and Control Group on the Posttest Question at Comprehension Level

School	Group	N	M	SD	MD	<i>t</i>	<i>df</i>	Sig (2-tailed)
BEHS (1)	Experimental	30	10.30	0.79	4.07	12.26	58	.000***
	Control	30	6.23	1.63				
BEHS (4)	Experimental	30	10.77	0.77	2.54	6.69	58	.000***
	Control	30	8.23	1.92				

Note: ****p* < .001

BEHS (1) – No. (1) Basic High School Education, Latha

BEHS (4) – No. (4) Basic High School Education, Pazundaung

The mean scores of experimental and control groups were (10.30) and (6.23) in BEHS (1). It was found that the mean scores of experimental group was significantly different from the mean scores of control group in BEHS (1). In BEHS (4), the mean score (10.77) of experimental group is significantly different from the mean score (8.23) of control group. It can be interpreted that the achievement of experimental group is higher than that of control group at comprehension level. This result is also illustrated by the Figure 2.

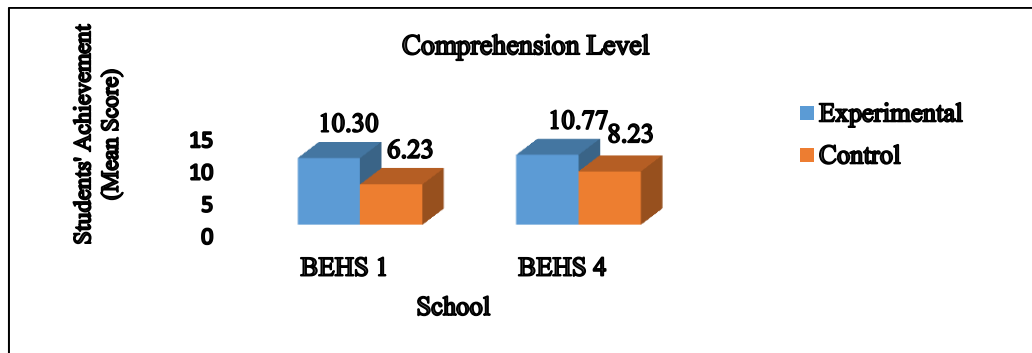


Figure 2 Mean Comparison of Students' Achievement on the Posttest Question at Comprehension Level by Schools

Finding of Students' Achievement at Application Level on the Posttest Question

Table 3 *t*-Values for Experimental and Control Group on the Posttest Question at Application Level

School	Group	N	M	SD	MD	<i>t</i>	<i>df</i>	Sig (2-tailed)
BEHS (1)	Experimental	30	9.93	2.12	3.63	6.34	58	.000***
	Control	30	6.30	2.32				
BEHS (4)	Experimental	30	10.60	2.81	6.33	10.09	58	.000***
	Control	30	4.27	1.98				

Note. ****p* < .001

BEHS (1) – No. (1) Basic High School Education, Latha

BEHS (4) – No. (4) Basic High School Education, Pazundaung

In comparison of the two groups' means of BEHS (1) indicated that the mean score of experimental group (9.93) was significantly higher than the mean score of control group (6.30) at application level. And also in BEHS (4), the mean score (10.60) of experimental group is significantly higher than the mean score (4.27) of control group. It can be interpreted the achievement of experimental group is significantly higher than that of the control group at application level in the posttest. This result is also illustrated by the Figure 3.

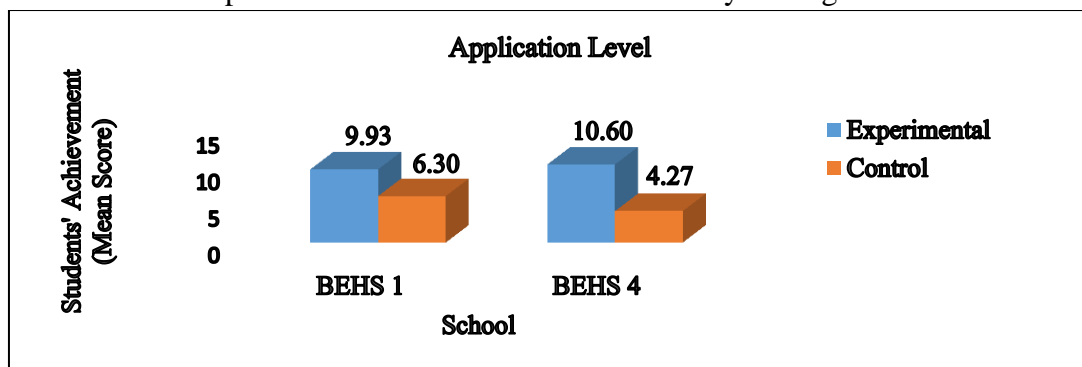


Figure 3 Mean Comparison of Students' Achievement on the Posttest Question at Application Level by Schools

Summary of Findings

The results of findings were as follows.

- At knowledge level, there was a significant difference between the achievement of students who learned by science process skills and those who learned by formal instruction. This means that the achievement of experimental group is higher than that of control group at knowledge level.
- At comprehension level, there was a significant difference between the achievement of students who learned by science process skills and those who learned by formal instruction. This means that the thinking skills of experimental group is higher than that of control group at comprehension level.
- At application level, there was a significant difference between the achievement of students who learned by science process skills and those who learned by formal instruction. This means that the problem solving skills of experimental group is higher than that of control group at application level.

Discussion, Suggestions, Conclusion

Discussion

According to the research findings of students' achievement in science, it was found that the mean scores of experimental and control groups were significantly different in each school. The mean scores for the total achievement at knowledge, comprehension and application levels of experimental and control groups were (25.27) and (16.17) in No. (1) Basic Education High School, Latha and (27.30) and (16.60) in No. (4) Basic Education High School, Pazundaung. This results showed that the achievement of the experimental groups who learned by science process skills was significantly higher than that of the control groups who did not.

By teaching with science process skills, active participation can be achieved. The construction of reality by verbal processes is frequently impossible because of the differences between the images which students visualize and the images which the writer or the speaker is attempting to convey. The more opportunities the students have for observing, the more they will improve observing skill and the more they will comprehend what they learn. According to the findings, the students from the experimental groups improved the level of comprehension and application. They were also able to construct their knowledge personally based on their experiences and develop a better understanding of scientific concepts.

Most students are not able to apply knowledge acquired in the class environment to other situations including other class environments. This is due to not having an appropriate cognitive level of comprehension and application. Students who acquired science process skills tend to think analytically and are more successful with new problems than those who do not possess science process skills (Oloyede, 2012).

It can be said that students in the experimental groups were active in the learning process because the students in the experimental groups applied their own process skills in learning the science lessons rather than listening to the teacher's lecture and reading the passage.

Suggestions

Rote learning and memorization do not support the creativity and critical thinking skills. These skills are essential elements in the 21st century that generates rapid development in information and technology and a constant explosion of knowledge. Science process skills are the foundation of such skills. They can be achieved by emphasizing student-centered approach that stresses the background situation of the students on which effective learning is made with the help of the teachers. Therefore, in order to meet the needs of nowadays, educators have to move from the teacher-centered approach to learner-centered approach. In today's classroom in Myanmar, students are asked to listen to the teacher's lecture, take down notes, memorize facts and information that they do not understand or the materials that was unknown. It is the responsibility for all educators to create better learning situation and provide students with the skills and confidence to go forth to solve the world's problem. By developing science process skills, students can become competent problem solvers and face the challenges head on according to this study.

Students who are taught with process skill approach are able to apply their skills and realize the importance of these skills in everyday activities. Learning with science process skills places students in realistic, contextualized environments. Both teachers and students should use materials or equipment during teaching and learning process. This will help students understand science concepts, in the event where the materials are not available, teachers or students must improvise. In school where large classes exist, teachers should endeavor to sub-divide the students into smaller groups and teach each group using extended materials at different times. This will help students in full participation during the lesson. Developing science process skills in learning science, students will recognize and accept the ways in which each individual is unique, understand that their lives influence their environment and are influenced by it, use information and values to make rational decisions and evaluate the personal consequences. They can also be aware of the constant changes in themselves. Applying science process skills, students become more autonomous, self-directed and responsible for their own learning.

One of the objectives of teaching Middle School General Science in Myanmar is to help pupils learn to think scientifically and creatively. Science education is crucial to enhance the ability of the leaders and citizens of tomorrow to create solutions and find new paths to a better, more sustainable future. It is through education that the next generation of citizens, workers, professions and leaders will be prepared for life-long learning about sustainability (UNESCO, 2012). Students should be given the responsibility to search for their own meaning through hands-on activities. It helps students to get them to think for themselves.

Therefore, educators should emphasize and be aware of the importance of teaching methods and styles of teaching on their teaching learning situation. And also, teachers should know the importance of selecting the most appropriate teaching methods. According to the results of this study, the mean scores of experimental group are higher than that of control group at all levels (knowledge, comprehension and application). The emphasis on student's self-study is important. The students should construct their own knowledge. Teachers should think from the angle of a learner, not to think how to give all the knowledge to students or to give all the content of the textbook to students in detail. The teacher should take more time in planning the lessons and engage students maximally with activities that should help them develop the spirit of enquiry through their exploration of nature from their local environment.

To equip students with science process skills in classroom environment, teachers themselves should possess these skills. A teacher who is not properly equipped with these skills may experience difficulties to deliver these skills to the students. Teachers should select the appropriate teaching aids that can stimulate students' interest to use their science process skills in the learning process. Science process skills are essential for encouraging critical thinking, cooperative learning and enhancing problem solving skills by solving real world problems. And, the teacher should design several good problems covering the knowledge of the course.

Teachers should manage a class where student teams are working independently and at a different pace and choose a problem that allows students to successfully reach the assigned outcomes. Teachers should provide a good learning community in the classroom with positive teacher-student and student-student relationships and give opportunities for students to do the activities. Teachers should encourage students to think more deeply and critically, to participate in problem solving activities and discussions, and to stimulate students to seek information on their own. Most of the students are not capable of thinking on their own. Therefore, teachers should help students become self-directed learners and create a classroom environment in which students study with freedom and think critically. Teachers as facilitators should help to keep the students focused on the essential problem, through the problem might change over time, and even become more complex.

In this research, there were some limitations such as content area (only Chapter-5, "the Earth and Space" from Grade Seven Science Textbook) and the sample is only Yangon Region. Therefore, the results were not representative for the whole content area of Grade Seven General Science. Science process skills should be used at various school levels: primary, middle and high school level. As the size of the sample is small, this result may not be generalized to a larger population. Thus, carrying out a larger research in a nationally representative area in a longer duration is highly recommended to validate results of the present research.

Conclusion

Scientific knowledge includes theory, principles and laws forming content part of sciences. To be competent in the scientific knowledge, learners must use science process skills because they are ways of the acquisition of such knowledge. Ways of thinking in science are also called the process skills. Science process skills include the skills of each individual that are used in daily life which can improve the quality and standard of life by understanding the nature of science. Science process skills are process thinking skills using scientific processes and approaches (Rezba, Sprague & Fiel, 2002). These skills help the learner build up competence in searching for knowledge and information in the field of sciences through scientific method and arousal of interest in future science-based pursuits.

When science process skills are emphasized in the classroom, students' proficiency on individual skills increases, some skills are transferred to new situations, and the skills are retained over time (Padilla, 1990). Padilla suggests that basic science process skills provide a foundation for more complex science process skills. He also affirms that teachers cannot expect students to develop the more complex skills and higher order thinking skills if students are not provided the opportunity to practice the basic skills.

The main purpose of this study is to study science process skills and achievement of students in science at the middle school level. Quantitative research methodology was used to

study science process skills and achievement of students in science at the middle school level. The design adopted in this study was true experimental design (posttest only control group design).

There are four districts in Yangon Region: East, West, South and North. Two districts were selected in random and then one township was chosen in random from each selected district.

According to this study, the achievement of students in experimental group was significantly higher than that of control group in the combination of all levels in the posttest (knowledge, comprehension and application level).

Finally, the teacher should use suitable teaching methods or the styles of teaching for the students to have a sound understanding of the material. And the teacher cannot expect to teach all the material in a textbook to students. The teacher should tell the students that they are responsible for their study and emphasize on their self-study. Therefore, the teacher should focus on new teaching strategies and methods. Science process skills will encourage the students to become active participants in their learning. So, the teachers should consider to use science process skills in their instruction in science according to the time and circumstance of a classroom situation.

In addition more research is needed to find the ways how to improve students' problem solving skills, teamwork skills and critical thinking in their learning process. This research is only concerned with the quantitative measure of students' achievement by using science process skills and formal instruction in teaching general science. It is better to find the solutions for the students' problems facing in their learning process both in quantitative and qualitative research. And then, this research is concerned with the quantitative measure of students' achievement at knowledge level, comprehension level and application level. And also, a study should be made about the effects of science process skills on students' achievement at all levels (six levels of Bloom's Taxonomy). As a result of this study, it is recommended that in this study, the sample schools were randomly selected from Yangon Division. Further research should be carried out for the other states and divisions.

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Appendix A

Achievement Test

အခန်း (၅)၊ ကမ္ဘာမြေကြီးနှင့် အာကာသ

တတ်မြောက်မှုစစ်ဆေးရန်မေးခွန်း

Posttest (30 marks)

အထွေထွေသိပ္ပံ

ဆဋ္ဌမတန်း

ခွင့်ပြုချိန် (၄၅) မိနစ်

၁။ အောက်ပါဖော်ပြချက်များကို မှန်လျှင်(မှန်)၊ မှားလျှင် (မှား)ဟုရေးပါ။ (၅ မှတ်)

- (က) မိုးလေဝသအခြေအနေများသည် စိုက်ပျိုးရေးအတွက် များစွာအရေးပါသည်။
- (ခ) လေသည် ဖိအားနည်းသောဒေသမှဖိအားများသောဒေသများသို့ ရွေ့လျားလေ့ရှိသည်။
- (ဂ) သတ္တဝါများအတွက် စိမ်းစိုသာယာသောပတ်ဝန်းကျင်သည် အရေးကြီးသည်။
- (ဃ) ရေကြီး၊ ရေလျှံခြင်းသည် သီးနှံများကို ကောင်းစွာဖြစ်ထွန်းစေသည်။
- (င) မြေဆီ၊ မြေဩဇာပျက်စီးမှုသည် စိုက်ပျိုးရေးကို ထိခိုက်စေသည်။

၂။ အောက်ပါဖော်ပြချက်များကို ပြည့်စုံမှန်ကန်စေရန် လိုအပ်သောစကားလုံးများကို ဖြည့်စွက်ပါ။ (၅ မှတ်)

- (က) လေထုအတွင်းရေငွေ့ပါဝင်မှုသည် ----- ဖြစ်စဉ်များအတွက် အလွန်အရေးပါသည်။
- (ခ) ရေသည် အငွေ့အရည်၊ -----အသွင်ဖြင့်တည်ရှိနိုင်သည်။
- (ဂ) အပင်များစိုက်ပျိုးခြင်းဖြင့်-----ပျက်စီးမှုကို ကာကွယ်နိုင်သည်။
- (ဃ) ကျွန်ုပ်တို့ပတ်ဝန်းကျင်ရှိ အနံ့အသက်နှင့် စူးရှမှုများကို -----မှုဖြင့် အဝေသို့ လွင့်သွား စေနိုင်ပါသည်။
- (င) အိုဇုန်းလွှာသည်----- များကို တားဆီးပေးနိုင်သည်။

၃။ အောက်ပါကွင်းထဲရှိ အဖြေများအနက်မှ အဖြေမှန်ကို ရွေးပါ။ (၅ မှတ်)

- (က) လေဖိအားသည် (အောက်မှ၊ အထက်မှ၊ အဘက်ဘက်မှ) သက်ရောက်နိုင်သည်။
- (ခ) ငွေ့ရည်ဖွဲ့ခြင်းဆိုသည်မှာ (ရေခိုးရေငွေ့များအရည်အဖြစ်၊ အရည်များ ရေခိုးရေငွေ့အဖြစ်၊ ရေခိုးရေငွေ့များ ရေခဲအဖြစ်) သို့ပြောင်းလဲသွားခြင်းကို ခေါ်ပါသည်။
- (ဂ) မြန်မာနိုင်ငံ အလယ်ပိုင်းရှိ မိုးနည်းရပ်ဝန်းဒေသသည် (ရေငွေ့များသော၊ ရေငွေ့နည်းသော၊ စိုစွတ်သော)ဒေသဖြစ်သည်။
- (ဃ) မိုးနည်းရေရှားရပ်ဝန်း ဒေသများတွင် သစ်တောများအကုန်အစင်ခုတ်လှဲမှုသည် (အက်စစ်မိုးများ၊ ကမ္ဘာ့ရေများ၊ မြေဆီလွှာ ပျက်စီးမှုများ) ကိုဖြစ်စေသည်။
- (င) လေထုညစ်ညမ်းမှုကို (မီးသွေး၊ ဖွဲ၊ လျှပ်စစ်မီးဖို)များ သုံးစွဲခြင်းဖြင့် လျော့ချနိုင်သည်။

၄။ အောက်ပါပေးထားသော ကော်လံနှစ်ခုမှ သင့်လျော်ရာ ယှဉ်တွဲပါ။ (၅ မှတ်)

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|--|---|
| ကော်လံ (၁) | ကော်လံ (၂) |
| (၁) စက်မှုလုပ်ငန်းများနှင့် မော်တော်ယာဉ်တို့ မှထွက်သော ဓာတ်ငွေ့များကြောင့် | (က) ရေချိုသယံဇာတများ ညစ်ညမ်း သွားရသည်။ |
| (၂) တောပြုန်းမှုနှင့်ရွှေ့ပြောင်းတောင်ယာ လုပ်ကိုင်မှုကြောင့် | (ခ) အိုဇုန်းလွှာ ပျက်စီးရသည်။ |
| (၃) ပိုးသတ်ဆေးများအသုံးများလာမှုကြောင့် | (ဂ) မြေသား၊မြေဆီလွှာ တိုက်စားခံရသည်။ |
| (၄) အိမ်သုံးပစ္စည်းများတွင် ထည့်သုံးထား သောအအေးပြု ဓာတ်ငွေ့များကြောင့် | (ဃ) မြေဆီလွှာ ပျက်စီးရသည်။ |
| (၅) ရေဆိုးနှင့် အိမ်သာများလာမှုကြောင့် | (င) လေထုညစ်ညမ်းမှုနှင့် ကမ္ဘာကြီးပူနွေး လာမှုများဖြစ် လာရသည်။ |

၅။ အောက်ပါမေးခွန်းများကို ရှင်းလင်းဖြေဆိုပါ။ (၁၀ မှတ်)

- (က) လူသားများကြောင့်ဖြစ်ပေါ်လာသော ပင်လယ်သမုဒ္ဒရာများကို ညစ်ညမ်းစေသည့်အကြောင်း အရင်းများကို ရှင်းပြပါ။
- (ခ) မိုးရေမလုံလောက်သော အရပ်ဒေသများတွင် မည်သို့စိုက်ပျိုးသင့်သည်ကို တင်ပြဆွေးနွေးပါ။
- (ဂ) စိုက်ပျိုးရေးသည် မိုးလေဝသနှင့် ဆက်နွှယ်မှုရှိပါသလား။ အဘယ်ကြောင့်နည်း။
- (ဃ) လေထုဖိအား၏ သဘောသဘာဝကို မည်သည့်ကိရိယာများတွင် အသုံးပြုထားသနည်း။
- (င) ရေငွေ့များအထက်သို့တက်ပြီး ငွေ့ရည်ဖွဲ့ခြင်းကြောင့် မည်သည့် သဘာဝဖြစ်စဉ်များဖြစ်စေ နိုင်သည်ကို ရှင်းပြပါ။

Appendix D

Marking Scheme for Posttest

- ၁။ (က) မှန် (၁ မှတ်)
- (ခ) မှား (၁ မှတ်)
- (ဂ) မှန် (၁ မှတ်)
- (ဃ) မှား (၁ မှတ်)
- (င) မှန် (၁ မှတ်)

- ၂။ (က) မိုးလေဝသ (၁ မှတ်)
- (ခ) အစိုဓာတ် (၁ မှတ်)
- (ဂ) အိုဇုန်းလွှာ (၁ မှတ်)
- (ဃ) လေတိုက်ခတ်မှု (၁ မှတ်)
- (င) ခရမ်းလွန်ရောင်ခြည် (၁ မှတ်)

- ၃။ (က) အဘက်ဘက်မှ (၁ မှတ်)
- (ခ) ရေခိုးရေငွေ့များ အရည်အဖြစ် (၁ မှတ်)
- (ဂ) ရေငွေ့နည်းသော (၁ မှတ်)
- (ဃ) ကန္တာရများ (၁ မှတ်)
- (င) လျှပ်စစ်မီးဖို (၁ မှတ်)

- ၄။ ကော်လံ (၁) ကော်လံ (၂)
- (၁) စက်မှုလုပ်ငန်းများနှင့် မော်တော်ယာဉ် တို့မှထွက်သော ဓာတ်ငွေ့များကြောင့် (၁) လေထုညစ်ညမ်းမှုနှင့် ကမ္ဘာကြီးပူနွေး လာမှုများ ဖြစ်လာရသည်။ (၁ မှတ်)
- (၂) တောပြုန်းမှုနှင့် ရွှေ့ပြောင်း တောင်ယာ လုပ်ကိုင်မှုကြောင့် (ဂ) မြေသား၊မြေဆီလွှာ တိုက်စားခံရသည်။ (၁ မှတ်)
- (၃) ပိုးသတ်ဆေးများအသုံးများ လာမှုကြောင့် (ဃ) မြေဆီလွှာ ပျက်စီးရသည်။ (၁ မှတ်)
- (၄) အိမ်သုံးပစ္စည်းများတွင်ထည့် သုံးထား သော အအေးပြုဓာတ်ငွေ့ များကြောင့် (ခ) အိုဇုန်းလွှာ ပျက်စီးရသည်။ (၁ မှတ်)
- (၅) ရေဆိုးနှင့် အိမ်သာများ လာမှုကြောင့် (က) ရေချိုသယံဇာတများ ညစ်ညမ်းသွားရသည်။ (၁ မှတ်)

- ၅။ (က) ကုန်းပေါ်မှ အမှိုက်သရိုက်၊ အညစ်အကြေးနှင့် စွန့်ပစ်ပစ္စည်းများကို ပင်လယ်သမုဒ္ဒရာ များထဲသို့ အစုလိုက် အပုံလိုက် သွန်ချ ရွန့်ပစ်မှု၊ ရေနံတင်သင်္ဘောကြီးများ ပျက်စီးနှစ်မြုပ် ရာမှ ရေနံဂါလံသန်းနှင့်ချီကာ ယိုဖိတ်မှုများကြောင့် ပင်လယ်သမုဒ္ဒရာများ ညစ်ညမ်း ရသည်။ (၂ မှတ်)
- (ခ) မိုးရေမလုံလောက်သောဒေသများတွင် အနီးမှစီးဆင်းသည့် မြစ်ရေ၊ ချောင်းရေတို့မှရေကို နည်းအမျိုးမျိုးဖြင့် သွယ်ယူပြီး စိုက်ခင်းများအတွင်းသို့ပို့ခြင်း၊ ခြောက်သွေ့သောရာသီ တွင်လုံလောက်သောရေရရှိရန်အတွက် မိုးရာသီအတွင်း ရရှိသမျှ ရေကိုဆည်များ၊ ကန်များ ဖြင့်ခံယူစုဆောင်းကာ လိုအပ်သောစိုက်ခင်းများအတွင်းသို့ပို့ပေးရသည်။ (၂ မှတ်)
- (ဂ) စိုက်ပျိုးရေးနှင့် မိုးလေဝသသည် ဆက်နွယ်မှုရှိပါသည်။ သီးနှံများဖြစ်ထွန်းတတ်သည့် မြေ၊ ရာသီဥတုနှင့် အချိန်အခါကို မှတ်သား လေ့လာပြီး လိုအပ်သောသီးနှံတို့ကို စိုက်ပျိုးရ သောကြောင့်၊ မိုးများသောဒေသများတွင် ရေကြိုက်သော သီးနှံတို့ကို ရွေးချယ် စိုက်ပျိုးရပြီး၊ အနည်းငယ်ခြောက်သွေ့သောဒေသများတွင် မိုးမကြိုက်သောအပင်များကို ရွေးချယ်စိုက်ပျိုးရသည်။ (၂ မှတ်)
- (ဃ) သကြွန်အခါ ကလေးများကစားသည့်ပြုတ်၊ ဆရာဝန်သုံးဆေးထိုးပြုတ် (၂ မှတ်)
- (င) ရေငွေ့များအထက်သို့ တက်ပြီး ငွေ့ရည်ဖွဲ့ခြင်းကြောင့် တိမ်ဖြစ်ထွန်းခြင်း၊ မုန်တိုင်း ဖြစ်ပေါ်ခြင်း၊ မိုးရွာခြင်း၊ မိုးသီးကြွေကျခြင်း၊ ဆီးနှင်းကျခြင်း၊ မြူထူဆိုင်းခြင်းများဖြစ်ပေါ် စေနိုင်ပါသည်။ (၂ မှတ်)