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

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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

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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.

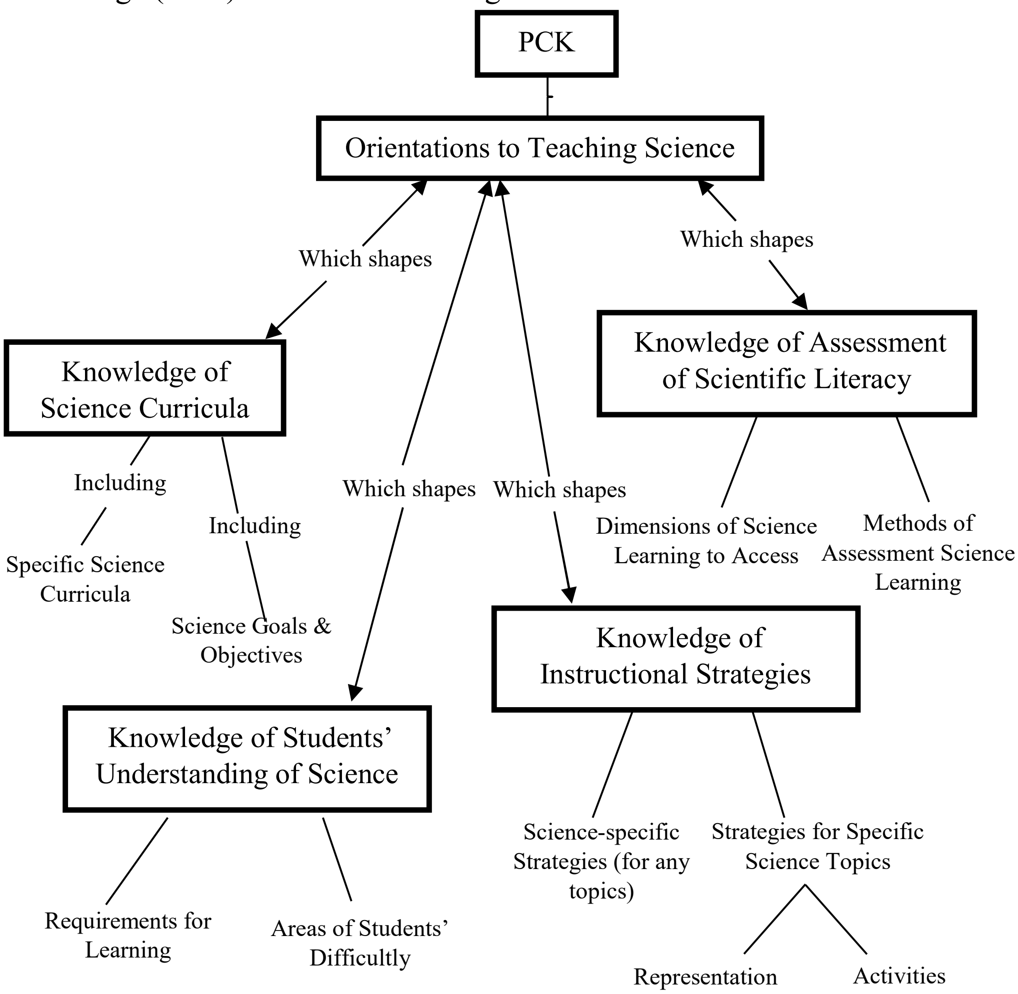

Figure 1: Components of Pedagogical Content Knowledge for Science Teaching
Source: From Magnusson, Krajcik & Borko, 1999.

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).

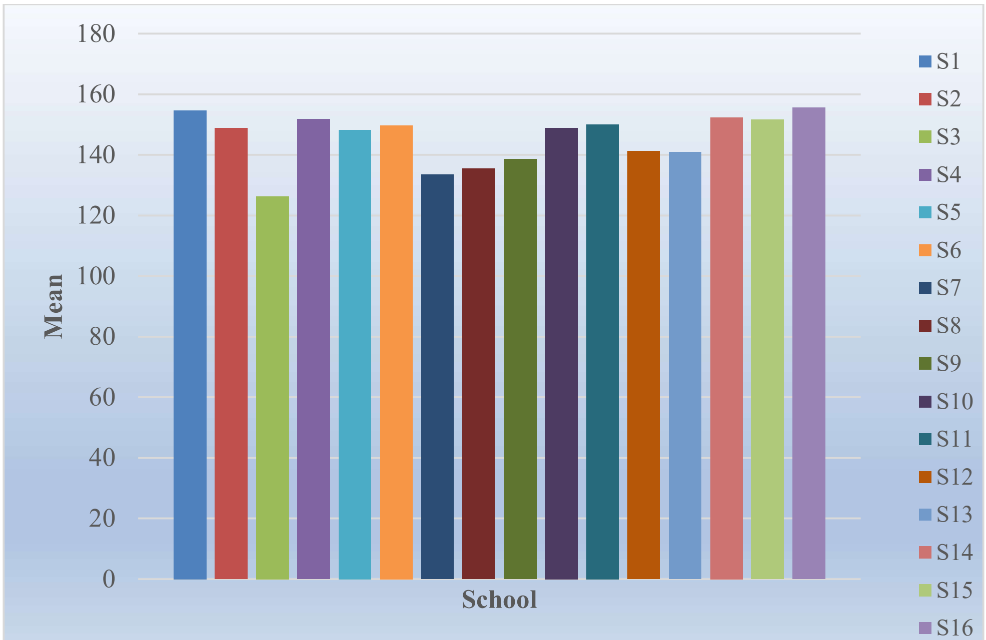

Figure 2: Comparison of Means for Science Teachers' Pedagogical Content Knowledge by Schools

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).

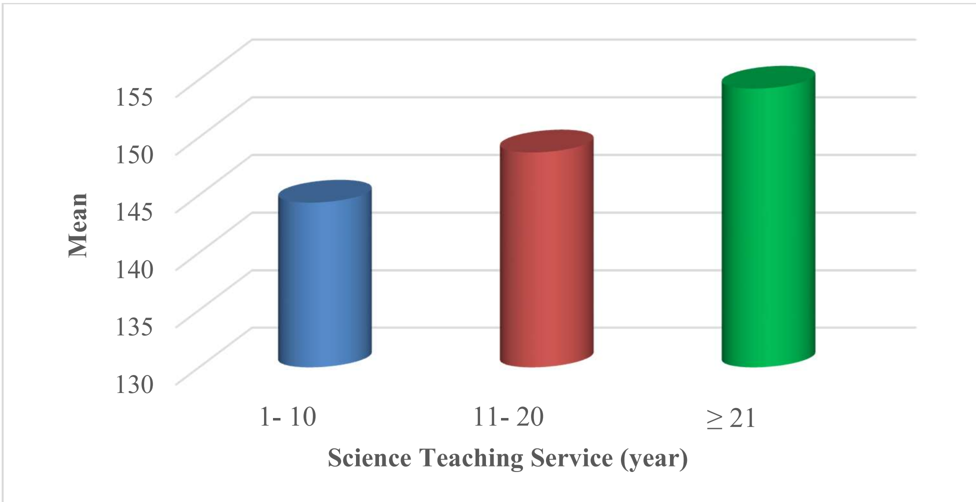

Figure 3: Comparison of Means for Science Teachers' Pedagogical Content Knowledge in terms of Science Teaching Service

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).

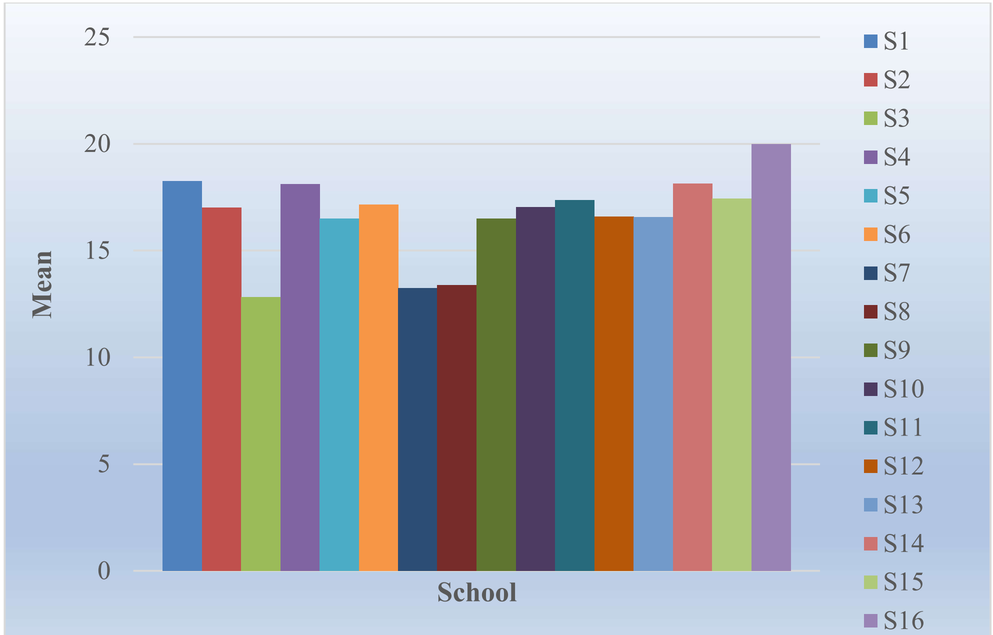

Figure 4: Means of Students' Science Achievement in Selected Schools

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 -------------------

-------&mxl; --------------------

----

vuf&Sdwm0efxrf;aqmifaeaomausmif; ----- -------------------- jrdKUe,ftrnf - -------------------------

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

-------ynmt&nftcsif;--------------------

----

vkyfief;cGifqdkif&m vufrSwf& oifwef;rsm;^'Dyvdkrm^bGJU

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

(*) ---

vkkyfoufpkpkaygif; --

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

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

odyÜHbmom&yftay:wGifxm;&Sddaom oabmxm;tjrif --

tydkif; (c)

atmufygtaMumif;t&mwpfckcsif;pDudkzwfí q&m? q&mrwdkY\ oabmxm; tjrifESihf udkufnDrI&Sdaom **tuGufwpfuGu**f wGifom trSefjcpf (Â) jyyg/

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/					
3/	odyÜHpmoifcef;onf pnf;pepfusei ausmif;om;rsm;onf rdrdvkyfudkif&rnfh vkyfief;rsm;udk wdwfqdwfpGm vkyfudkifae oifhonf/					
4/	odyÜHbmom&yfoifMum;csdefwGif bmom&yfqdkif&mtaMumif; t&mrsm;udk ausmif;om;^olrsm; tcsif;csif; wdkifyifaqG; aEG;rI jyKoifhonf/					
5/	odyÜHqdkif&m vufawGUvkyfief;rsm;udk q&mrSOD;pGm o&kyfjy vkyfaqmifjyD;rS wynfhrsm;tm; aqmif&Gufaprnf/					
6/	tcsdKUaom odyÜHbmom&yfqdkif&m taMumif;t&mrsm;udk ausmif;om;					

pOf	ppfaq;rnfhtaMumif;t&m	vHk;0oabmr	oabmrwlyq	rqHk;jzwfw	oabmwlonf	vHk;0oabmw
	rsm;udk,fwdkif &SmazGavhvmoifhonf/					
7/	q&monf ausmif;om;rsm; odyÜHbmom&yfqdkif&muRrf;usifrI &&Sdvmap&ef txyfxyftcgcg avhusifhoifMum;ay; oifh onf/					
8/	odyÜHbmom&yf oifMum;jcif;\ &nf&G,fcsufrSm odyÜHqdkif &m A[kokwrsm;udkvufawGUb0wGiftoHk;cs wwfap&ef jzpfonf/					
9/	q&monf ausmif;om;rsm;\ oif,lavhvmjcif; vkyfief; xuf atmifcsufjrifhrm;a&;udk OD;pm;ay;aqmif&Gufoifh onf/					
10/	odyÜHbmom&yfqdkif&m vufawGUvkyfief;rsm;udk ausmif;om; rsm;udk OD;pGmvkyfaqmifapjyD;rS &&Sdvmaom &v'frsm;udk aqG;aEG;oifjyoifhonf/					

2/ oif&dk;nTef;wrf;qdkif&mtodynmA[kokwrsm;udkppfaq;jcif;

vHk;0oabmr oabmrwlyq rqHk;jzwfw oabmwlonf vHk;0oabmw

pOf	**ppfaq;rnfhtaMumif;t&m**	vHk;0oabmr	oabmrwlyg	rqHk;jzwfw	oabmwlonf	vHk;0oabmw
1/	tv,fwef;tqifhodyÜHoif&dk;onf oif,lrIqdkif&mvkyfief; rsm;udk OD;pm;ay;a&;qGJxm;onf/					
2/	tv,fwef;tqifhodyÜHoif&dk;onf uav;rsm;odyÜHynmudk pdwf0ifpm;í pl;prf;avhvmvdkpdwf wdk;yGm;vmap&ef &nfoefí a&;qGJxm;jcif;jzpfonf/					
3/	vuf&SdtoHk;jyKoifMum;aeaom odyÜHoif&dk;onf acwfum vtajctaeESifh rudkufnDonfhtjyif ausmif;om;rsm;udk oifMum;&eftwGuf oifhavsmfrIr&Sdyg/					
4/	tv,fwef;tqifh odyÜHoif&dk;wGifyg0ifaom bmom;yn qdkif&m taMumif;t&mrsm;onf vufawGUb0ESifh uGm[rI&Sdonf/					
5/	odyÜHoif&dk;rS csrSwfxm;aom vufawGUvkyfief;rsm;onf vkyfaqmif&efrvG,fulyg/					
6/	tv,fwef;tqifh odyÜHoif&dk;onf ausmif;om;rsm; pOf;pm;awG;ac:rI &ifhoefvmap&ef?					

pOf	**ppfaq;rnfhtaMumif;t&m**					
	wDxGifOmPfjrifhrm; vmap&efESifh pepfwus vkyfudkifaqmif &Gufwwfap&ef OD;wnfa&;qGJxm;onf/					
7/	odyÜHq&mwpfOD;taejzifh tv,fwef;tqifh odyÜHoif&dk; udktajccHxm;í ,if;ESifhqufpyfaeonfh taMumif;t&m rsm;udk csJUxGifoifMum;oifhonf/					
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/					
9/	odyÜHoif&dk;wGifyg0ifaom taMumif;t&mrsm;tjyif odyÜH bmom&yfqdkif&m*sme,f? r*¾Zif;ESifhAD'D,dkrsm;udkMunfh& SK avhvmoifhonf/					
10/	odyÜHoif&dk;wGifyg0ifaom taMumif;t&mrsm;ESifh qufpyf aeaom					

pO f	**ppfaq;rnfhtaMumif;t&m**					
	odyÜHjyyGJ?jydKifyGJrsm;odkUoGm; a&muf avhvmjcif; onf oifMum;rIvkyfief;pGrf;aqmif&nfud k wdk;jrSifhapEdkif onf/					

3/ tuJjzwfppfaq;rIqdkif&mtodynmA[kokwrsm;udkppfaq;jcif;

pO f	**ppfaq;rnfhtaMumif;t&m**	vHk;0oabm	oabmrwlyg	rqHk;jzwf	oabmwlonf	vHk;0oabmwl
1/	ppfaq;tuJjzwfrIjyKvkyf&mwGif roifMum;rD csrSwfcJh aom oifcef;pm\ &nfrSef;csufrsm;ESifh udkufnDrI&Sd atmif jyKvkyfoifhonf/					

pO f	**ppfaq;rnfhtaMumif;t&m**					
2/	odyÜHbmom&yf ppfaq;tuJjzwfrI jyKvkyf&mwGif odyÜHbm om&yfqdkif&m tcsuftvufrsm;udk OD;pm;ay; ppfaq;rI jyKvkyfoifhonf/					
3/	oifMum;xm;aom odyÜHbmom&yfqdkif&m A[kokwrsm; udk ausmif;om;rsm; vufawGUb0wGif rnfodkYtoHk;cs onfudk od&Sd&eftwGuf vufawGYb0wGif MuHKEdkifaom tajct aersm;udk zefwD;í ppfaq;rIjyKvkyfoifhonf/					
4/	bmom&yf oifMum;aepOfwGif ausmif;om;rsm;udk ppfaq;rI jyKvkyfjcif;onf tcsdefukefí xda&mufrI r&Sdyg/					
5/	odyÜHbmom&yfonf pl;prf;avhvmrIudk tajccHonfh bmom&yfjzpfonfhtwGuf ausmif;om;rsm;\vufawGU vkyfaqmifrIudk t"duxm;í ppfaq;rIjyKoifhonf/					
6/	bmom&yfoifMum;jyD;csdefwGif ausmif;om;rsm; oif,l jyD;onfh					

pO f	**ppfaq;rnfhtaMumif;t&m**	vHk;0oabmnf	oabmrwlyg	rqHk;jzwfw	oabmwlonf	vHk;0oabmw
	taMumif;t&mrsm;udk em;vnfoabmaygufrI &Sdr&Sdodap&eftwGuf ppfaq;rIjyKvkyfoifhonf/					
7/	ppfaq;rIrS&&Sdaom&v'frsm;udk tajccHí ausmif;om; rsm;tcwftcJ&Sdaom tMumif;t&mrsm;udk jyefvnf oifMum;rI jyKvkyfoifhonf/					
8/	jyefvnfoifMum;rIjyK&aom taMumif;t&mrsm;udkxyfrH ppfaq;&ef rvdkyg/					
9/	oif,ljyD;aom oifcef;pmrsm;udk qufvufavhvmrI aqmif&GufEdkif&ef oifcef;pmudk tajccHonfh vufawGU b0ESifh qufpyfaeonfh ar;cGef;rsm; ar;jref;oifhonf/					
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/					

atmufygwdkYrS q&m^q&mrwdkY\ oabmxm;ESifhudkufnDrI&Sdaom tajz**wpfck** udk a&G;cs,fay;yg/

4/ odyÜHbmom&yfoifMum;jcif;enf;AsL[mqdkif&m todynmA[kokwrsm;udk ppfaq;jcif;

pO f	**ar;cGef;rsm;**	**tajzjznfh&ef**
1/	odyÜHbmom&yfoifMum;&mwGif oifcef;pmwpfckcsif;pDtvdkuf	

	tajct aetcsdeftcg ESifhoifhavsmfonfh oifenf;udk (u) owfrSwfxm;jcif;r&Sdyg/ (c) owfrSwfxm;ygonf/ (*) tqifajyovdkoifMum;ygonf/ (C) owfrSwf&efrvdktyfyg/	
2/	odyÜHbmom&yfoifMum;&mwGif oifaxmufulypönf;rsm; (&kyfyHk um;csyf? AD'D,dk? ypönf;ppfponfjzifh) toHk;jyKí oifMum;&ef (u) rvdktyfyg/ (c) wpfcgwpf&Homvdktyfonf/ (*) tjrJwrf;toHk;jyKoifhonf/ (C) oifcef;pmtcsdKUtwGufrvdktyfy g/	
3/	oifMum;aom taMumif;t&mrsm;udk ausmif;ol^om;rsm; em;rvnfyg u (u) Oyrm? om"ursm;toHk;jyKí em;vnfatmifoifMum; ygrnf/ (c) qifwlaomjzpf&yfrsm;udk zefwD;toHk;jyKíoifMum; yg rnf/ (*) oifMum;jcif;udk acwÅ&yfem;jyD;rS	

	jyefvnfoifMum;yg rnf/ (C) erlemyHkrsm;jyí oifMum;ygrnf/	
4/	oifonf odyÜHoifMum;&mwGif oifcef;pmacgif;pOfESifh qufpyfaeonfh vkyfief;rsm;udk em;vnfoabmaygufí vufawGU vkyfaqmifEdkifap&ef (u) pl;prf;avhvmrIaqmif&Gufaprnf/ (c) vufawGUvkyfief;ay;í aqmif&Gufaprnf/ (*) o&kyfjyoifMum;enf;jzifh oifMum;ygrnf/ (C) oifcef;pmESifhqufpyfaeonf hjyóemudk zefwD;í vufawGUajz &Sif;apygrnf/	
5/	odyÜHbmom&yfoifMum;&mwGif (u) oifcef;pmtaMumif;t&mrsm;udk aqG;aEG;azmfxkwfjyD; odyÜH qdkif&ma0g[m&rsm;udk rdwfqufay;í &&Sdaom todonmudk vufawGUtoHk;jyK oifMum;avh&Sd ygonf/	

	(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
1/	oifcef;pm roifMum;rDwGif ausmif;om;rsm; xdktaMumif;t&mESifh qufpyfí rnfrQod&SdcJhonfudk ppfaq;avh&Sdygovm;/		
2/	oifcef;pm roifMum;rDwGif ausmif;om;rsm; &&SdoGm;apcsifonfh taMumif;t&mrsm; (oif,lrIqdkif&m OD;wnfcsuf)rsm;udk csrSwf avh&Sd ygovm;/		
3/	oifcef;pmESifhywfoufonfh vufawGUvkyfief;rsm;udk vkyfaqmif avh&Sdygovm;/		
4/	odyÜHbmom&yfyg oifcef;pmtaMumif;t&mrsm;wGif oifcef;pm wpfckcsif;pDtvdkuf ausmif;om;trsm;pk rSm;avh&Sdaom trSm;rsm;		

	&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

odyÜHbmom&yfwwfajrmufrIppfaq;vTm

qXrwef; cGifhjyKcsdef – (45) rdepf

1/ atmufygwdkYrStajzrSefa&G;yg/ (10) rSwf

tajza&;&e
f

(u) zvifrif (Fleming) onf --------
udkwDxGifcJhonf/ (u) ----------
(1) umvom;a&m*gukxHk; (2) rD;oD; (3)
yifeDqvifaq; (4) uifr&m

(c)

vl\cE¨mudk
,fwGif vrf;aMumif;wpfzufwnf;odkY
vIyf&Sm;Edkifaom tqpfrSm ---------
jzpfonf/ (1) 'l;qpf (2)
atmufar;&dk;qpf
(3) vufaumuf0wf (4) vnfyif;t&dk;qpf
(c) ------

(*) cE¨mudk,fESifhajcvufwGif
tqpftydkif;rsm;ygaomowÅ0grSm ------
jzpfonf/
(1) c&k (2) a&b0J (3) a>r (4)
uif;jrD;aumuf (*) -----------

(C) t&dk;wGifwG,fuyfaeaom<uufom;udk -----
[kac:onf/
(1) tpif;&Sd<uufom; (2)
acsmarGUaom<uufom; (3)
ESvHk;om;&Sd<uufom;
(4) tpif;rJh<uufom;
(C) -----------

(i) yifv,fa&xJrS qm;udk aevSef;jyD;xkwf,laomenf;onf ----- enf;jzpfonf/
(1) aygif;cHjcif; (2) t&nfppfjcif; (3) taiGUysHjcif; (4) azmufxHk;xnfhjcif; (i) ------------

(p) eef;MudK;qGJEdkifaomowÅKrSm ------- jzpfonf/ (1) qmvzm (2) rD;aoG;
(3) aMu;eD (4) ausmufcsOf (p) ------------

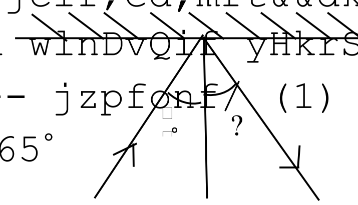
(q) jyifnDaMu;rHkwGifay:aomyHk&dyfonf ------- jzpfonf/ (1) yHk&dyfppf
(2) yHk&dyfa,mif (3) yHkzrf;um;csyfwGifay:aomyHk&dyf (4) rlvyHkxufMuD;rm; aomyHk&dyf (q) -----------

(Z) nDnmaomjyifnDaMu;rHkay:odkY tvif;usa&mufvQif ------- jzpfonf/
(1) tvif;,dkifjcif; (2) tvif;auGUjcif;
(3) ysHUa&mtvif;jyefjcif;
(4) yHkrSeftvif;jyefjcif; (Z) -----------

(ps) em;udktEÅ&m,fjzpfaponfh toHjzpfvQif em;pnf\tajrS;yg;udk xHkxdkif; oGm;ap&ef -------- uxdef;ay;onf/
(1) em;pnf (2) <uufom; (3) em;wGif;>yefvdrf (4) tMum;tm&Hk (ps) -----------

(n)

tvif;jyefjcif;ed,mrt&&dkufaxmifhESifhj yefaxmifh wlnDvQif yHkrS jyefaxmifhrSm ---------- jzpfonf/ (1) 60˚ (2) 30˚ (3) 45˚ (4) 65˚



(n) ------ -----

2/ atmufygwdkUudk,SOfwGJajzqdkyg/

(5) rSwf

aumfvH A aumfvH B

(u) azmufxHk; (1) qmvzm

(c) t0wfavQmfqdk'g (2) u,fvqD,rfumAGefedwf

(*) uefY (3) umAGef

(C) tdrfoHk;qm; (4) u,fvqD,rf[dkufaj'mufqdk'f

(i) rD;aoG; (5) qdk'D,rfumAGefedwf

(6) qdk'D,rfuvdk&dk'f

aumfvH A aumfvH B

(u) azmufxHk; ---------------------- ----------------

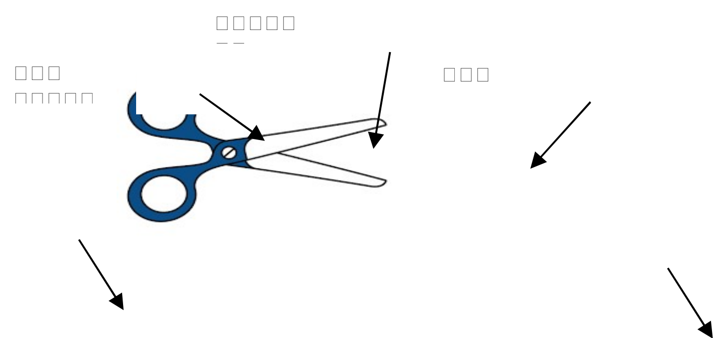
(c) t0wfavQmfqdk'g-------------------- ------------------

(*) uefY ---------------------------------------

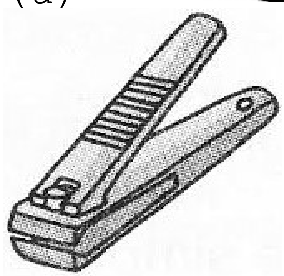
(C) tdrfoHk;qm; ---------------------------------------

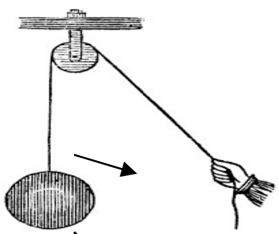
(i) rD;aoG;---------------------------------------

3/ atmufazmfjyygyHkrsm;rS pdkuftm;? vnfcsufESifh0efwdkUudk cGJjcm;í tnTef;wyfay;yg/ (4) rSwf Oyrm



(u) (c)





(*) (C)

4/ atmufygar;cGef;wdkUudk wdkwdkESifhvdk&if;omajzqdkyg/ (6) rSwf

(u) ay;xm;aomyHkrsm;wGif oHvdkufqGJiifEdkifaom ypönf;udk a&G;cs,fay;yg/

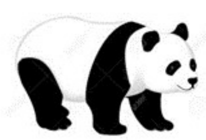
tajzjznfh&ef

(c) ESif;avQmpD;aeaomolESifh jrufcif;ukef;qif;wGif ajy;aeaomolwdkYwGif rnfolu ydkí yGwfrI tm; ydkrsm;oenf;/

tajzjznfh&ef

(*) yHkrS ausm&dk;&SdowÅ0gESifh ausm&dk;rJhowÅ0gwdkYudk a&G;cs,fí trsdK;tpm; cGJjcm;azmfjyyg/

(1)  ----------------------------
----

(2)  -----------------------
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(3)  -----------------------------
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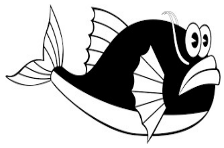
(4)  -----------------------------
----

****

odyÜHbmom&yfwwfajrmufrIppfaq;vTm

trSwfay;pnf;rsnf;

qXrwef; cGifhjyKcsdef – (45) rdepf

1/ (u) (3) yifeDqvifaq; (1) rSwf

(c) (1) 'l;qpf (1) rSwf

(*) (4) uif;jrD;aumuf (1) rSwf

(C) (1) tpif;&Sd<uufom; (1) rSwf

(i) (3) taiGUysHjcif; (1) rSwf

(p) (3) aMu;eD (1) rSwf

(q) (2) yHk&dyfa,mif (1) rSwf

(Z) (4) yHkrSeftvif;jyefjcif; (1) rSwf

(ps) (2) <uufom; (1) rSwf

(n) (3) 45° (1) rSwf

pkpkaygif;

- (10) rSwf

2/ aumfvH A aumfvH B

(u) azmufxHk; (4) u,fvqD,rf[dkufaj'mufqdk'f (1) rSwf

(c) t0wfavQmfqdk'g (5) qdk'D,rfumAGefedwf (1) rSwf

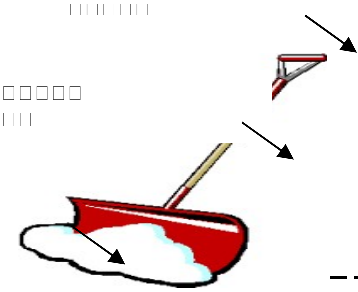
(*) uefY (1) qmvzm (1) rSwf

(C) tdrfoHk;qm; (6) qdk'D,rfuvdk&dk'f (1) rSwf

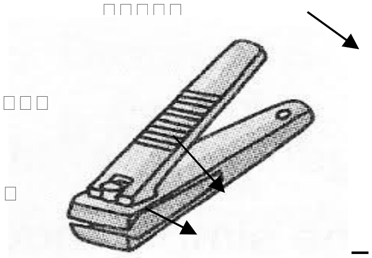
(i) rD;aoG; (3) umAGef (1) rSwf

pkpkaygif;

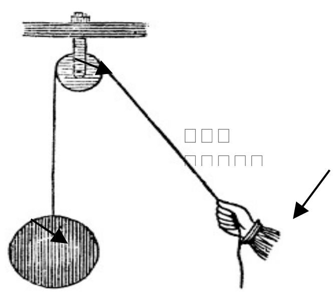
- (5) rSwf

3/ (u)  ---------------------

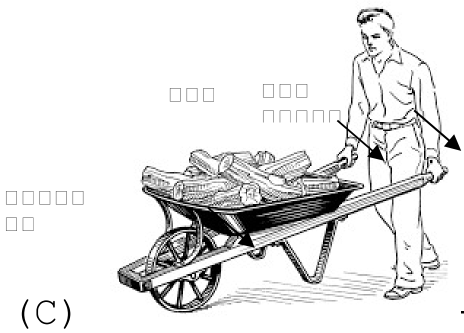
--- (1) rSwf

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

-- (1) rSwf



(*) ----



(C) ------------------------

- (1) rSwf

pkpkaygif;

- (4) rSwf

4/ (u) wG,fcsdwf --------

-------- (1) rSwf

(c) (B)

jrufcif;ukef;qif;wGifajy;aeaomol ------

(*) (1) vdyfjym – ausm&dk;rJhowÅ0g ------

(2) 0uf0H – ausm&dk;&SdowÅ0g ------

(3) iSuf – ausm&dk;&SdowÅ0g ------

(4) ig; - ausm&dk;&SdowÅ0g ------

pkpkaygif; -

(6) rSwf

1/ Multiple Choice (10)

rSwf

2/ Matching (5)
rSwf

3/ Label (4)
rSwf

4/ Short Questions (6)
rSwf

pkpkaygif; - (25)
rSwf

Appendix C

Interview Form

awGUqHkar;jref;onfhtcsdef --------------
aeY&uf -------------------

ae&m ---------------------------usm;^r --
------------------vkyfoufpkpkaygif; -----
----------odyÜHoifMum;onfhvkyfouf -------

1/ odyÜHbmom&yfoifMum;&mwGif uav;A[dkjyKcsOf;uyfoifMum;enf;udk toHk;jyK jcif;ESifh q&mA[dkjyKoifMum;jcif;wdkYwGif rnfonfuydkrdkxda&mufrI&Sdoenf;/

2/

tv,fwef;tqifho dyÜHoif&dk;onf ausmif;om;rsm;udk oifMum;&eftwGuf oifhavsmfrI&Sdygovm;/ oifhawmfrI r&SdvQif tb,fhaMumifh oifhawmfrI r&SdaMumif;udkazmfjyyg/ ausmif;wGif; odyÜHjyyGJ? jydKifyGJrsm; udkvkyfaqmifrI &Sdyg ovm;/

3/

odyÜHvufawGUvk yfief;rsm;udk vkyfaqmifrI&Sdygovm;/ vkyfaqmifrI&SdvQif rnfonfwdkUudk vkyfaqmifonfudk azmfjyyg/

4/ ausmif;om;rsm;
em;vnfrI&&Sd&ef cufcJaom
oifcef;pmrsm;udk oifrnfodkU
oifMum;oenf;/

5/
oifcef;pmrsm;u
dk ppfaq;tuJjzwfrI jyKvkyf&mwGif
rnfonfhtcsufrsm;tay: rlwnfí ppf
aq;avh&Sdoenf;/

