A STUDY OF THE EFFECTIVENESS OF DEMONSTRATION METHOD ON GRADE NINE STUDENTS' ACHIEVEMENT IN PHYSICS

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Abstract

The main purpose of the present study is to study the effectiveness of demonstration method on Grade Nine students' achievement in physics. Demonstration method was used as a method of teaching that relies heavily upon showing the learner a model performance. Demonstration method includes five main parts: purposing, planning, demonstration proper, executing and evaluation. The design used in this study was a true experimental design; pretest-posttest control group design. According to the format of that design, (7) sample lesson plans of learning materials were constructed. The target population is Grade Nine students who are learning physics. Two high schools situated in Dagon and Mingalardon Townships were selected by random sampling method. Science combination students were selected. A total of (120) students and (4) physics teachers participated in it. Treatments were conducted separately in two groups. The experimental groups were taught according to the principles of demonstration method. The control groups were taught as usual. Learning materials were selected from "Some Applications of Mirror Formula" in Chapter (9), "Reflection of Light" and "Electric Charges, Matter and Electricity, Conductors and Insulators, Charging by Induction and Materials and Magnets" in Chapter (10), "Electricity and Magnetism" from Grade Nine Physics Textbook. Independent samples *t* test was used to test the hypotheses of this study. The result shows that there was a significant difference in the achievements of physics between the students who were taught by using demonstration method and those who were not. It can be suggested that the demonstration method should be used in the classroom in teaching physics. Therefore, it verifies that demonstration method bring positive contributions to the physics teaching as well as learning at the high school level. Finally, discussion, and suggestions were provided by the researcher based on the data for improving teaching physics and learning at the high school level.

Keywords: Effectiveness, Demonstration method, Physics, Achievement.

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Introduction

In earlier time, education is regarded as the richest and highest treasure of man. In the twenty-first century, science and technology are going to leading the way and moving at an extremely rapid pace. Therefore, teachers need to ensure that all students are keeping up with the national standards. In the study of mankind, the advent of science is the greatest blessing. Science has been defined as a systematic body of wisdom and knowledge which can give rise to greater and greater invention (Arun, 2008).

The National Science Teachers Association (NSTA) endorses the proposition that science, along with its method, explanations and generalizations, must be the sole focus of instruction in science classes to exclusion of all non-scientific methods, explanations, generalizations and products (Herr, 2008). In the present age called age of science. Therefore, knowledge of physics is essential for taken up professional and applied course such as engineering, technology, medicine, space and so on. By learning physics, students have had a lot of fun because of its immerse value in nature. Moreover, it contains the concepts mechanics, heat, light, radiation, sound, electricity, magnetism, and the nature of matter. Learning often takes place best when students have opportunities to express ideas and get feedback from their peers. Students take action and interact with others to construct the contextual knowledge of the classroom. In demonstration, the teacher and the students are involved in teaching learning process. Demonstration method may be judged as the most practicable and useful method of teaching sciences in the available circumstances of our schools.

When the teacher uses demonstration method, the teacher should consider interactive teaching. Interactive teaching is not void of lecture and lecture is used in combination with demonstration method. The only suitable alternative in such a situation lies in the form of demonstration or lecture-cum-demonstration method in which the scientific facts and principles are practically demonstrated as well as explained to all students of the class simultaneously by the science teacher.

Purpose of the Study

1. To study the effectiveness of demonstration method in Grade Nine physics teaching
2. To promote students' achievement in learning physics by using demonstration method
3. To give suggestions concerning with the concepts of demonstration method to teachers

Research Hypotheses

1. There is a significant difference in the physics achievement of Grade Nine students who learn by demonstration method and those who do not.
2. There is a significant difference in the physics achievement of Grade Nine students at the knowledge level, comprehension level, application level who learn by demonstration method and those who do not.

Definition of Key Terms

1. Effectiveness: Effectiveness (effect) means having power to produce, or producing, a desired result (Cruickshank & Bainer, 1999).
2. Demonstration method: Demonstration method is a method of teaching that relies heavily upon showing the learner a model performance that he should match or pass after he has seen a presentation that is live, filmed, picture, chart and electronically operated (Good, 1973, cited in Garcia, 1989).
3. Physics: The scientific study of natural forces such as light, sound, heat, electrically, pressure (Waters, 2010).
4. Achievement: Achievement is the one's best, to do successful, to accomplish tasks requiring skill and effort and to be recognized by authority (Smith & Hudgins, 1995).

Review of Related Literature

Demonstration Method

Demonstration method is a method of teaching that relies heavily upon showing the learner a model performance that the students should match or pass after a presentation that is live, filmed, picture, chart and electronically operated. (Good, 1973, cited in Garcia, 1989).Demonstration means "to show". In lecture method, the teacher just talks but in demonstration method, the teacher also shows and illustrates certain phenomenon and applications of abstract principles through demonstration of experiments (Tulasi, 2007).A demonstration can also be given inductively by the instructor asking several questions but seldom giving answers. An inductive demonstration has the advantage of stressing inquiry which encourages students to analyze and make hypotheses based on their knowledge (Trowbridge, 1990). There are five ways in which a demonstration can be presented. These are teacher demonstration, teacher-student demonstration, student-group demonstration, individual student demonstration, and guest demonstration (Trowbridge, 1990).

Criteria and Cautions for a Good Demonstration

This method, through very popular and most widely used, may not prove, successful with some teachers. The following are some of the cautions, which if kept in view by the teacher, will assure that the demonstration will be a success.

1. While performing an experiment the teacher must be sure that each and everything is clearly visible to the pupils. There will be no difficulty if a lecture gallery is available but in its absence there are several ways of enabling the pupils to get a better view.
2. A large mirror erected at a suitable angle above the teacher's bench will enable the class to see what is going on if they look at the reflection in the mirror. This is a very useful method of enabling the pupils to have a view of each and everything which otherwise is never possible. It will enable the students to look into the test tubes while the contests are being heated.

3. Demonstration apparatus should be as large as possible such as a big model of electric bell.
4. The apparatus to be used should be placed on the left hand side of the table and arranged in order in which it will be shown.
5. The teacher must be sure that the experiments will succeed and are strikingly clear. This demands and adequate preparation on the part of the teacher and a rehearsal of the experiments under the conditions prevailing in the classroom.
6. The teacher should never complain about inadequate and faulty apparatus.
7. The experiments demonstrated must be connected with the common things seen and handled by the pupils in daily life.
8. The demonstrations must be fit into the sequence of experiments which pupils do in their practical class.
9. The teacher must be call individual members of the class, in turn, to help the teacher in the demonstration work.
10. Attention of the class is very important. The teacher should know various methods of arresting their attention and creating interest.
11. Proper account of time and season, climate conditions sometimes affect the apparatus.
12. Demonstration experiments should be supplemented with teaching aids like charts, pictures, diagrams, models, film strips and so on.
13. A large black-board behind the teacher's demonstration table is most essential. During the lesson, the teacher can use it to a great advantage. The principles arrived at, as a result of demonstration, can be summarized on the black-board. Necessary diagrams can be drawn on it (Singh & Nath, 2010).

Merits of Demonstration Method

This method is psychological because the students have not to imagine anything, instead they are shown concrete thing are living specimens. Consequently, they active interest in teaching-learning process. It, therefore, motivates their interest and enthusiasm for science.

1. It is very suitable when the apparatus is very costly or very sensitive and is likely to be damaged if handled by the students e.g., Fortin's barometer, electric dynamo, etc.
2. It is helpful in case of dangerous experiments like preparation of chlorine, burning of hydrogen etc.
3. The method is considered most economical. When apparatus is not sufficient for the students to do practical individually, the teacher may perform the experiment before the whole class. Also it saves times when a number of experiments can be performed in a short time.
4. It is a time-saving method. If compared to Heuristic, Project or Experimental methods, it saves mush time. On this score it cannot be compared to lecture method, which is too speedy.
5. Although it is not child-centered method, yet the students are kept engaged in various activities like observing, taking notes, answering questions, drawing diagrams, and sometimes involving in the actual performance of experiments.
6. It is suitable method for all types of students i.e. average, below average and above-average. There is uniformity of teaching and all learn at a common pace (Kumar, 1995).

Teaching Steps of Demonstration Method

Demonstration method can be used to provide examples that enhance lectures and to offer effective hands-on, inquiry-based learning opportunities in the classroom. Sometimes called as the initiative method, the demonstration method aims at learning skills faster and more effective when the students are shown how the job is done by using the actual tools, machines, and materials (Belen, 1962, cited in Garica, 1989). It contains five steps as follows:

1. **Purposing:** The class decides on an activity which involves the process of demonstration. The teacher may suggest it but the teacher should not impose it on them, the teacher may encourage them to go through with it but the teacher should not dictate it on them.
2. **Planning:** This phase consists of the object of the demonstration, the person or persons to conduct it, the materials to be needed, and the date, time, and place activity. If outside an outside resource speaker will be invited, necessary arrangements like a letter of invitation should be made.
3. **Demonstration proper:** the teacher needs to teach the theory of concepts to the class before demonstration. Before the demonstration is done, all the preliminaries should have been prepared-material wise, procedure–wise and the classroom physical arrangement.
4. **Executing:** Students are expected to carry out or repeat the same performance shown during the activity. During this phase, the teacher should keep close watch of the students' performance for they may likely need his assistance and further explanation.
5. **Evaluation:** this is done to access how successful the students are involving in the activities. Another aspect of evaluation is concerned with their assessment of the demonstration proper.

These steps of demonstration procedure based lessons were constructed to conduct the experimental research that is concerned with the effectiveness of demonstration method on students' achievement in physics.

Research Method

In order to explore the effectiveness of demonstration method, a quantitative research method was used to compare students' physics achievement among the two groups, namely experimental group and control group. These two groups were randomly assigned in each school. This chapter is essentially concerned with the research design, research instruments, population and sample size and data analysis.

Research Design and Procedure

The research design for this study was a true experimental design, pretest-posttest control group design: ROXO (Randomization, Test, Treatment, and Test). The pretest- posttest control group design involves at least two groups. The sample students were selected in random. The students were grouped such as experimental and control group. Both groups are administered a pretest of the dependent variable. Pretest was used to measure the initial ability of the sample students. One group receives a demonstration method treatment, and both groups are tested with posttest questions. The combination of random assignment and the presence of a pretest and a control group serve to control for all sources of internal invalidity (Gay, 2003).Finally, the achievements of experimental and control groups were compared by using the independent samples '*t*' test. Pretest question was based on the Chapters (1,2,3,4,5,6,7 & 8) and posttest questions were developed on the concepts from Chapter (9) and Chapter (10) in Grade Nine physics textbook. The pilot study was conducted in November, 2016. After the pilot study, the experiment was conducted in December, 2016.

Instruments

Pretest

The pretest was used to see whether the students were essentially the same or not on the dependent variable at the start of the study (Gay, 2003).Test items were constructed from chapter one to eight in Grade Nine physics textbook that contains physics and measurement, vectors, describing motion, forces, work and energy, heat and temperature, measurement of heat, wave concept and sound wave. The pretest contains (5) true-false items, (5) completion items, (5) short questions, and (4) long questions that cover the concepts from chapter (1) to (8).

Table 1 Table of Specifications for Pretest Items

Lesson	Mechanics			Heat			Waves & Sound			Total Marks
Section / Level	K	C	A	K	C	A	K	C	A	
Section (A)	10	7	2	5	-	-	1	3	2	30
Section (B)	3	8	4	1	2	2	-	-	-	20
Total Marks	13	15	6	6	2	2	1	3	2	50

Note: K=Knowledge Level Items
C = Comprehension Level Items
A=Application Level Items

Posttest

The treatment duration lasted only about one month. At the end of the treatment, both groups were administered a posttest. These test items include true-false items, completions items, definitions, drawings and calculations. These items were constructed on the basis of the first three levels of Bloom's Taxonomy i.e, knowledge, comprehension, and application. Therefore, the posttest questions contain (15) items for knowledge level, (15) items for comprehension level and (20) items for applications level (see Table 3.3). In other words, test items can be divided into direct or seen questions (from textbook) and indirect or unseen questions (from other source). The value of Cronbach alpha α for the posttest was above (0.7).

Table 2 Table of Specifications for Posttest Items

Section	Optic												Electricity and Magnetism												Total Marks
	K				C_1				A				K				C_1				A				
	C_2	T	S	L	C_2	T	S	L	C_2	T	S	L	C_2	T	S	L	C_2	T	S	L	C_2	T	S	L	
Section A													4	3	5	-	2	3	-	-			12		30
Section B								4				1				3				5				7	20
Total Marks								4				1	4	3	5	3	2	3		5			12	7	50

Note: K = Knowledge Level Items
C_1 = Comprehension Level Items
A = Application Level Items
C_2 = Completion Items
T = True or False Items
S = Short Answer Items
L = Long or Calculation Items

Population and Sample Size

All the participants in this study were Grade Nine students. This study was conducted in Yangon Region. There are four districts in Yangon Region. Two districts were selected in random. One township from each selected district was also selected in random. After that, one high school from each township was selected and there were two sample schools. The participants in this study were also selected by random sampling and they were randomly assigned to control group and experimental group.Total of (120) Grade Nine students participate in it. The following table shows the population and sample size.

Table 3 : Population and Sample Size

No	Township	School	Population	Sample Size		
				Experimental Group	Control Group	Total
1.	Dagon	School (1)	785	30	30	60
2.	Mingalardon	School (2)	361	30	30	60

School (1) = A High School from Dagon Township
School (2) = A High School from Mingalardon Township

Data Analysis

The data were analyzed by using a descriptive statistics (mean, standard deviation, percentage) and independent samples '*t'* test. The independent samples *'t'* test was used to compare the achievement of students who learned through the use of demonstration method and that of students who learned without using demonstration method at knowledge, comprehension, and application levels.

Research Findings

Findings of Students' Achievement in the Pretest

In order to find out the background knowledge of the selected sample students in the experimental and control groups, pretest was administered in two schools.

Table 4: '*t'* Values for the Pretest Means of Experimental and Control Groups

Sample	Group	N	M	SD	MD	*t*	*df*	Sig. (2- tailed)
School 1	Experimental	30	37. 96	4.55	0.23	0.18	58	.857 (ns)
	Control	30	37. 73	5.39				
School 2	Experimental	30	39.03	5.13	0.70	0.52	58	.608 (ns)
	Control	30	38.33	5.37				

Note: ns= no significance
School (1)= A School from Dagon Township
School (2)= A School from Mingalardon Township

Table (4) shows '*t*' values for the experimental and control groups on the pretest items. As shown in table, the means of the experimental and control groups were (37.96) and (37.73) for the sample high school from Dagon Township. And also the means of the experimental and control groups were (39.03) and (38.33) for the sample high school from Mingalardon Township. These data showed that there was no significant difference between the experimental and control groups on the background of physics in both schools. So, initial group equivalency was seen at the start of study.

Finding of Students' Achievement in the Posttest

Table 5: Independent Samples *t* test Result of Posttest Means

Posttest Scores	Group	Samples	Mean	Standard Deviation	Mean Difference	*t*	*df*	Sig. (2-tailed)
S	G	N	$\bar{X}$	SD	MD	*t*	*df*	Sig. (2-tailed)
Total Scores	Experimental	60	29.69	4.39	6.47	8.16	118	.000***
	Control	60	23.22	4.30				
Knowledge level Scores	Experimental	60	9.89	2.01	1.37	3.47	118	.001**
	Control	60	8.52	1.97				
Comprehension level Scores	Experimental	60	9.48	1.93	2.00	4.76	118	.000***
	Control	60	7.48	2.30				
Application level Scores	Experimental	60	10.32	2.56	3.10	5.97	118	.000***
	Control	60	7.22	3.35				

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

Table (5) shows the results of the independent samples *t* test. The *t* test for independent samples was used to compare the means of the experimental

and control groups to test whether the students in one group did better or worse than the students in other group. This table shows the sample size, the means and standard deviation for each group. The means on the overall posttest were (29.69) and (23.22). Then, the means on knowledge level, comprehension level, and application level of posttest in those two comparison groups were (9.89) and (8.52) , (9.48) and (7.48), as well as (10.32) and (7.22). As shown in table (4.6), the variable, posttest means and its respective level means were separately compared for two sample groups. Moreover, mean difference, *t* value, degree of freedom, Sig. (2-tailed) and the *p* value (probability value) that describes a statistically significant difference level were described. This table shows that the groups of the experimental students who received a new treatment were found to have more effective achievement in physics learning than the groups of control students who do not.

Results

From the experimental findings, the following results were found.

1. There were significant differences in physics achievement of Grade Nine students who learnt by demonstration method and those who did not.
2. There were significant differences in physics achievement at the knowledge level, comprehension level, and application level of Grade Nine students who learnt by demonstration method and those who did not.

Finally, meta-analysis developed by Glass (1981) was used on the result of this experimental study. The effect size of this study was 1.49. A numerical value of 1.49 indicates that the treatment had a strong treatment effect. A positive effect size means that the students who received demonstration method performed better than the students who received formal learning or without demonstration method. It can be interpreted that there was a strong positive effect of treatment used as a new instructional design.

Discussion and Conclusion

The main purpose of the present study was to study the effectiveness of demonstration method on Grade Nine students' achievement in physics, to promote students achievement in learning physics by using demonstration

method, and to give some suggestions concerning with the aspects of demonstration method to teachers. In this study, demonstration method was used for learning "Some Application of Mirror Formula" in Chapter (9), "Reflection of Light" and "Electric Charges, Matter and Electricity, Conductors and Insulators, Charging by Induction and Materials and Magnets" in Chapter (10), "Electricity and Magnetism". The nature of the selected materials that are taken from two chapters is relatively difficult and they include very new physics concepts. In learning those physics concepts, the teacher need to emphasize on some essential points such as its meanings, related symbols, mathematical equations, units for different systems, illustration diagrams, sign convections of mirror formula, direction of light, conceptual questions and so on. At the basic education level, Grade Nine is one of the most important one because of the nature of curriculum and subject matter contents.

Findings from this study show that the students in the experimental group who received new treatment has higher achievement in learning physics than the control students who received formal treatment. Statistical results verified that demonstration method was superior in improving students' physics achievement. This may be because the exposure to this method allows students to use concrete experiences. Another result was observed that the students in the experimental group can perform better in answering knowledge level, comprehension level, and application level items than those in the control group. Therefore, it can be interpreted that there is significant difference in achievement between Grade Nine physics students who learnt by demonstration method and those who learnt by formal learning. Similarly, the teachers who were assigned for the experimental groups were interested in the new design of teaching. Most of the students in both groups made errors in the concepts on sign convections of mirror formula because there were two chapters concerned with sign convections in physics content. All of the students have no background knowledge in applying these concepts in previous Grades. Moreover, most students in both groups made errors in the concepts on another type of magnet. Some students who received formal treatment made errors in illustrating neutral beryllium atom and illustrating the poles of a bar magnet because they do not have enough concrete experiences in studying those concepts. But, students who received new

treatment had performed well in those physics concepts because they had to learn these concepts in hand-on experiences. According to Trowbridge and Bybee (1990), a good demonstration is the process of showing something to another person or students. Demonstration method can serve as simple observations of materials and verification of a process and may also be experimental in nature. Instead of talking about a concept, procedure or set of facts, laws, the teacher may be able to walk through demonstration of the information in action. Therefore, the students who received demonstration method obtained a sound experience to actively participate in demonstration activities in the classroom.

Generally, students mismatch in the usage of subject terms concerning electric charges, permanent magnet, and properties of magnet. Some students were weak in clarifying conductors and insulators and northern end of the earth and southern end of the earth. They also made errors in the abstract concepts concerning the nature of electric charges, the nature of atom, and principle of conservation of electric charge because they had learnt the early physics concepts in rote learning. Based on the posttest answers, the students who received new treatment can respond more precisely than the other students concerning description of subject terms, relevant concepts, laws and drawing illustration diagram. The results show that the treatment equally effects in overall posttest means and application level means. It also supported the research hypothesis; there is a significant difference in the physics achievement of Grade Nine students who learnt by demonstration method and those who did not. So, this finding pointed out that demonstration method has positive contribution to the achievement of the students in physics learning. The study of demonstration method on physics teaching brought positive and productive effects. Demonstration method is rooted in good teaching practice for all levels of students. Moreover, it is the most economical and time-saving method for all teachers. The students are interested in demonstration lessons and hence they participated in the teaching of physics. It motivates students' interest and enthusiasm for science.

Based on the research findings and interpretations, demonstration method should be used in classroom teaching but this study in not perfect because there were some limitations in this study such as time duration and

content area. With respect to the research findings, the researcher wants to suggest the following facts.

(1) The teacher should tell the students the basic concept and allow the students to participate in teaching learning process and the teacher should guide the students and help them when they need.

(2) The teacher should provide help, encouragement and attention for their students to learn effectively and to participate actively in learning activities.

(3) The teacher should provide opportunities for the students to apply their knowledge in science activities which is involved in teaching learning process.

(4) The teacher needs to relate the science content with the real life situations so that the students will be interested in their learning.

(5) By teaching physics concepts through demonstration method, the teacher should study other science books such as science stories, science magazines, newspapers and internet sources which can improve teaching learning process.

(6) By using demonstration method, the teacher should allow the students to study by themselves to think critically, to solve the problems by themselves. Instead of memorizing the physics concepts, laws, and formula, the teacher needs to create the instructional procedure in which students explore those concepts in hand-on activities.

(7) The teacher who uses demonstration method should create an intellectual learning community that is continuously creating opportunities for teaching and learning.

(8) The teacher who uses demonstration method has valuable opportunities to provide students with a clear understanding of a particular idea or physics concepts including illustration diagrams and calculations.

(9) The teachers have to teach the relationships between theories and laws.

(10) By using demonstration method, the classroom teacher can create a valuable opportunity for the students to study about the empirical nature and subjective nature of physics concepts.

(11) Besides, in physics teaching, the teachers have to teach students to be able to draw illustration diagrams, and to label the diagrams precisely.

(12) The teacher has to teach new terms of physics concepts, their related samples, different kinds of unit systems, fundamental dimensions of basic units and derived unit systems precisely.

(13) In physics, the teacher has to teach new terms of physics concepts, their related samples, different kinds of unit systems, fundamental dimensions of basic uints and derived unit systems precisely.

(14) Moreover, in physics teaching , sign convections such as plus sign (+) for distance of real object, real image and real focus, minus sign (-) for distances of virtual object, virtual image and virtual focus must be noted clearly to be able to calculate physics problems correctly.

(15) This study is specially contributed to physics teaching at the high school level. Although this research was concerned with physics teaching, it also can be applied into the other subject matter contexts and the various school levels including primary school level and middle school level.

In conclusion, demonstration describes valuable advantages for the classroom teacher. In terms of the statistical results, students' performance between the experimental and control groups has significant difference on overall physics achievement, knowledge, comprehension, and application levels. So, it can promote students' achievement in teaching physics. During demonstration, students can perform by asking and answering questions and discussing their opinions that can enhance the student to develop concentration, self-reliance and interpersonal skills. Finally, this study shows that demonstration can be used to ask students to identify a problem, suggest of hypotheses, and modify the design of the experiments and to interpret the observation that lead to the solution of the problems. So, demonstration

method has sound positive contribution to the improvement in physics teaching at the basic education high school level.

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Sample Lesson Planfor Grade Nine Physics through Demonstration Method

(45 minutes)

1. Topic/ Lesson **Chapter (10) Electricity and Magnetism: Conductors and Insulators**

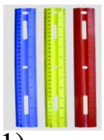
2. Learning Objectives:

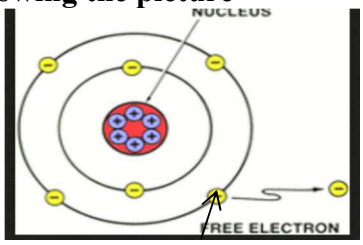
To acquire necessary foundation for further study in science
To define bound electron and free electron
To define conductors, insulators, and semiconductors
To distinguish the conductors, insulators and semiconductors
To draw the circuit symbol for conductor and insulator

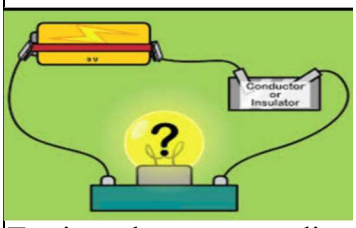
3. Background Knowledge The students have already learnt about the structure of an atom.

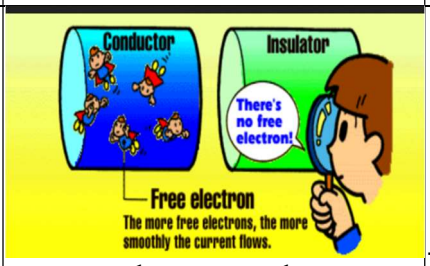
4. Instructional materials **Printed media**- Textbook, Whiteboard, Marker
Real objects- conductive materials, insulation materials, charts, bulb, filaments

5. Instructional Procedures Through the Use of Demonstration Method

Demonstration Procedure	Teacher's Activities	Learner's Activities
1.Purposing	Introducing about conductors and insulators Choosing the learning activity Guiding the students to participate in learning activity - bound electrons - free electrons - conductors and insulators	Discussing about the learning activities
2. Planning	Showing the instructional materials  (1)  (2)  (3)	Observing instructional materials **Students' findings:** 1. Plastic ruler 2. Glass rod 3. Gold 4. Silk

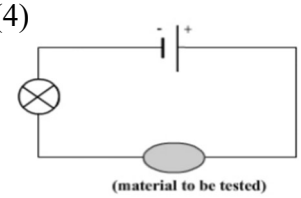
Demonstration Procedure	Teacher's Activities	Learner's Activities
	    (4) (5) (6) (7)	5. Eraser 6. Spring 7. Needle
3. Demonstrating proper	Teaching about the concepts of electricity Assessing the students' background knowledge **Teacher's Questions**; (1) What is the nature of atom? (2) State the name of two kinds of electric charges. (3) What is the nature of electron? **Showing the picture**  bound electron	**Students' Answers**; (1) An atom consists of a core called the nucleus around which the particles called electrons are moving. (2) Positive charge and negative charge (3) Electron is also a **negatively** charge particle.
	Teacher's Questions: (4)What is the direction of electron which is far from the nucleus? (5) What is direction of electron which is near to the nucleus **Teacher's Explanation** - attractive force is greater for the electrons closer to the nucleus the inner electron cannot move freely	**Students' Answers:** (4)away from the nucleus (5) towards the nucleus **Students' note taking** - the inner electron cannot move freely - inner electron are tightly bound by nucleus

Demonstration Procedure	Teacher's Activities	Learner's Activities
	- inner electron are tightly bound by nucleus - it is called bound electron - the electron far away from the nucleus less attractive force of the nucleus electrons are loosely bound by nucleus - it is called free electron Demonstrating the nature of conductors, insulators, and semiconductors Showing the apparatus to the student  Testing the eraser, clip, iron, wool, pen, gold, needle, silk, lead, pencil, with apparatus. - some substances have plenty of electron - electricity conduct through them - the bulb is lighting (6) Are these substances called conductors or insulators? some substances have no free electron - electricity cannot conduct them - the light switch off (7) Are these substances called conductors or insulators?	- the electron far away from the nucleus less attractive force of the nucleus - electrons are loosely bound by nucleus - it is called free electron (6) conductors (7) insulators

<table>
<tr><th>Demonstration Procedure</th><th>Teacher's Activities</th><th>Learner's Activities</th></tr>
<tr><td></td><td> 

- some substance such as wool, silicon, and germanium have moderate amount of electrons
- these substances are neither conductors nor insulators
- it is called semiconductors.
- transistor is also made semiconductor
(8) Are wool, silicon and germanium conductors or semiconductors?</td><td>-wool, silicon, and germanium are called semiconductors

8.semiconductors</td></tr>
<tr><td>4. Executing</td><td>Assigning the students to make experiment
Guiding and supporting to students Concluding the students' findings
The substance which has plenty of free electrons is called an insulator.
e.g. copper, brass, aluminium, silver
- The substance which has very few or no free electrons is called an insulator. e.g. glass, wax, quartz, plastic</td><td>The students conduct experiment and write down their findings
<table>
<tr><th>Conductor</th><th>Insulator</th></tr>
<tr><td>Iron</td><td>Paper</td></tr>
<tr><td>Silver</td><td>Pen</td></tr>
<tr><td>Gold</td><td>Pencil</td></tr>
<tr><td>Needle</td><td>ruler</td></tr>
</table></td></tr>
</table>

Demonstration Procedure	Teacher's Activities	Learner's Activities
5. Evaluating / Performance Assessment and sharing the quiz paper	The teacher makes evaluation with the following questions. (1) What do you understand by a bound electron and a free electron	**(1) Bound electron** The electrons closer to the nucleus or the inner electrons are tightly bound by the nucleus and cannot move freely. **Free electron** The electrons far away from the nucleus or the outer electrons are loosely bound by the nucleus and can move freely.
	(2) Is your body is an insulator or a conductor?	(2) a conductor
	(3) Mention five insulators and five conductors	(3) Five conductors- iron, lead, gold, needle, spring Five insulators-plastic ruler, plastic pen, wood, paper, eraser, pencil
	(4) Draw a circuit diagram of a battery and charging a conductor or an insulator.	(4) 
	(5) State the major difference between the conductors and insulators	**(5) Conductor** -The substances through which electric charges flows are called conductors.

Demonstration Procedure	Teacher's Activities	Learner's Activities
		The substances have number of free electrons to allow the flow of electricity - Example: Copper and Aluminum - Electric charges are free to move from place to place **Insulator** - The substances through which electric charges cannot flow are called insulators. The substance do not have free electrons to allow the flow of electricity Example: Paper and wood Electric charges are fixed in one place
6. Giving Feedback	Checking each student and discussing about the students' answers. Correcting the student's quiz paper.	Students correct their mistakes. Five conductors-iron, lead, gold, needle, spring - Five insulators-plastic ruler, plastic pen, wood, paper, eraser, pencil - are loosely bound by the nucleus and can move freely can move freely. - are tightly bound by the nucleus and cannot move freely.