Using Simple Experiments incorporated with Science Inquiry to Develop Conceptual Understanding of Static Electricity

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Abstract

The objectives of this research were to develop the simple experiment incorporated withscientific inquiry approach to qualify the criteria 80/80, and to study the learning progress of static electricity. The sample group composed of 34 students in Mathayomsuksa 6/1 at SrikoonWitthayabaunlung School, Amnat Charoen Province during Semester 2 of Academic Year 2014. One group pretest-posttest was applied.The instruments used for data collection were simple experiments of static electricity and an achievement evaluation form. An efficiency, average, standard deviation, t-test, and normalized gain were employed. The results were that the experiments had the efficiency at 77.35/77.06. The students gained more conceptual understanding of static electricity with statistical significance at the level of 0.5 and had the conceptual development in the medium gain level at 0.62

***Keywords*:** simple experiments, scientific inquiry**,** static electricity

Introduction

SrikoonWitthayabaunlung School, under the authority of The Secondary Educational Service Area Office 29, has been operating Mathayomsuksa 1-6 with 619 students in total. It is the medium size school which is in need of the operating rooms and instruction media. The budget more than ten thousands has been spending on the students' welfare such as lunch and transportation because of the students' poverty and the long distance residence. Besides, the budget has been shared to the new buildings construction to support an increasing number of students. All these reasons results in the lake of budget for supporting in instruction media. As a result, teaching method mainly focuses on the lecture of content, theories, and principles. Lecturing allows students to memorize rather than to participate in the lesson. They have lost their enthusiasm and lack of class engagement and are bored with the lessons. The result is the low achievement in Physics.

Physics is one branch of Science studying on the principles and rules of nature, the structure of the matter, and the rules of universe. Thus, Physics is the science which focuses on the experiments, the observation of the natural phenomenon and its causes, and the experiments to find out the conclusion based on the experiment results. Therefore, the major important thing of studying Physics is to conduct the learning environment for students to practice and discover by themselves such as 5E scientific inquiry approach which is classified in many levels; teachers define the problems, activities, materials, equipment, and methods for students or the students define the problems, activities, and select the equipment and the methods themselves. Table 1 summarizes the phase of 5E scientific inquiry approach consisted of Engagement, Exploration, Explanation, Elaboration, and Evaluation.

Table 1 summary of the 5E scientific inquiry approach.

Engagement
The teacher or a curriculum task accesses the learners' prior knowledge and helps them become engaged in a new concept through the use of short activities that promote curiosity and elicit prior knowledge. The activity should make connections between past and present learning experiences, expose prior conceptions, and organize students' thinking toward the learning outcomes of current activities.
Exploration
Exploration experiences provide students with a common base of activities within which current concepts (i.e., misconceptions), processes, and skills are identified and conceptual change is facilitated. Learners may complete lab activities that help them use prior knowledge to generate new ideas, explore questions and possibilities, and design and conduct a preliminary investigation.
Explanation
The explanation phase focuses students' attention on a particular aspect of their engagement and exploration experiences and provides opportunities to demonstrate their conceptual understanding, process skills, or behaviors. This phase also provides opportunities for

teachers to directly introduce a concept, process, or skill. Learners explain their understanding of the concept. An explanation from the teacher or the curriculum may guide them toward a deeper understanding, which is a critical part of this phase.

Elaboration

Teachers challenge and extend students' conceptual understanding and skills. Through new experiences, the students develop deeper and broader understanding, more information, and adequate skills. Students apply their understanding of the concept by conducting additional activities.

Evaluation

The evaluation phase encourages students to assess their understanding and abilities and provides opportunities for teachers to evaluate student progress toward achieving the educational objectives.

Therefore, from all the reasons mentioned, the researcher selected the simple experiments and5E Scientific Inquiry approach to develop conceptual understanding of static electricity of Mathayomsuksa 6. The sample group was 34 students of SrikoonWitthayabaunlung School. One group pretest-posttest was applied.

Materials and Methods

Step 1 Design the experiments. The researcher studied the relevant researches. For example, the study on"Using Laboratory Group Investigation Technique toEnhance Grade 12 Students' Concept about Electricity and Magnetism" by S. Cheur-on[1] and the research on "Using Inquiry teaching Method with Simple Harmonic Motion Apparatus for Improving Achievement" by W. Rattanaporn[2]. The simple experiment consisted of two parts. The first part was the experiment equipment, which were the cheap and available equipment but efficiently used in the experiment, such as simple electroscope, which was made of copper wire, glass bottle, and aluminum sheet, see Figure 1.

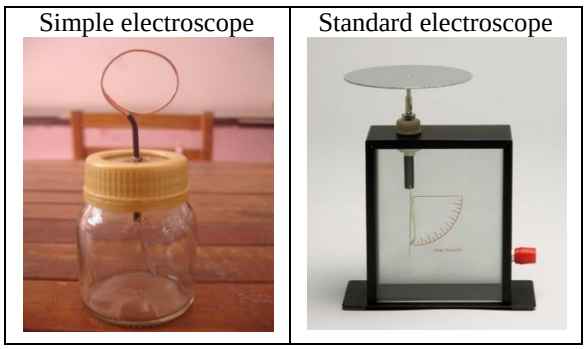

Figure 1 comparison of simple electroscope invented by the researcher and standard electroscope.

The second part was the scope of content. The content was about the concept of static electricity, starting from the electrification, properties of electric charge, and its application, which consisted of 5 experiments (13 activities) as show in Table 2.

Step 2 Set the study plans by applying simple experiments and the scientific inquiry activities. There were three plans, which needed two hours for each one.

Step 3 Conduct ten achievement of static electricity evaluation forms (4 multiple choices type).

Table 2 list of experiments.

Exp.1 – Electrostatics: Charging Objects by Friction
Act 1 – Charging Objects by Friction
Act 2 – Electrical Forces between Charged Objects
Act 3 – Forces between a Charged Object and an Uncharged Object
Act 4 – Sneaky Static
Exp.2 – Electrostatics: Detection of Charge
Act 5 – Using the UVa Electroscope to Detect the Presence of Charge
Act 6 – Conductor or Insulator?
Exp.3 – Charging by Induction
Act 7 – Charging the Electroscope by Induction
Act 8 – The Spring Ball
Exp.4 – Van de Graaff Generator
Act 9 – Simply Van de Graaff Generator
Act 10 – Flying Saucer (UFO)
Act 11 – Faraday Cage
Exp. 5 – Coulomb's Inverse Square Law
Act 12 – Measurement of Charge on Two Suspended Pith Balls
Act 13 – Verifying Coulomb's Inverse Square Law

Results and Discussion

Conceptual understanding of static electricity of the students.

The results analyzed from the evaluation form of *experiment* 1 achievement, **Electrostatics: Charging Objects by Friction** showed that the average score after studying (1.62 or 81%) was higher than the score before studying (1.00 or 50%) which was different with the statistical significance at .05 (t = 4.62). In *experiment* 2, **Electrostatics: Detection of Charge**, the result was that the average score after studying (1.44 or 72%) was higher than the score before studying (0.68 or 34%) which was different with the statistical significance at .05 (t = 5.22). Experiment 3, **Charging by Induction**, the results was that the average score after studying (1.56 or 78%) was higher than the score before studying (0.74 or 37%) which was different with the statistical significance at .05 (t = 4.11). Experiment 4, **Van de GraaffGenerator**, the results was that the average score after studying (1.56 or 78%) was higher than the score before studying (0.79 or 39.5%) which was

Table 3 average normalized gain by experiment.

Exp.	Pre-test	Post-test	Actual gain	Maximum possible gain	Normalized gain <g>
1	50.00	80.88	30.88	50.00	0.62
2	33.82	72.06	38.24	66.18	0.58
3	36.76	77.94	41.18	63.24	0.65
4	39.71	77.94	38.24	60.29	0.63
5	39.71	76.47	36.76	60.29	0.61
Total	**40.00**	**77.06**	**37.06**	**60.00**	**0.62**

different with the statistical significance at .05 (t=5.71). Experiment 5, **Coulomb's Inverse Square Law**, the results was that the average score after studying (1.53 or 76.5%) was higher than the score before studying (0.79 or 39.5%) which was different with the statistical significance at .05 (t = 6.04). Moreover, the result analyzed from the evaluation form of the achievement in studying 5 experiments of static electricity which aimed to compare the average score of before and after the study of the sample group, showed that the average score after studying (7.71 or 77.10%) was higher than the average score before studying (4.00 or 40.00%) which was different with the statistical significance at .05 (t=12.47). It indicated that students who were engaged in scientific inquiry approach had obtained more conceptual understanding of static electricity which corresponded with the assumption. The scientific inquiry approach developed the learning progress of the students because it allowed them to understand the content by practicing, learning to work in group, supporting each other, interacting with friends and teachers, and having more enthusiasm in creativity. Moreover, scientific inquiry approach allowed the students to learn how to collect the data from the experiment results and to compare with the scientific principle and to be able to answer the questions, which showed that they gained more conceptual understanding in the content [3].The result of learning progress evaluation, by applying average normalized gain <g> from the actual gain learning result divided by the maximum possible gain at 0.68, as shown in Table 3 (<g> was 0 - 1) was in the medium gain level (From Hake's research, the learning progress was defined by 3 levels of average normalized gain; low gain, medium gain, and high gain with <g> value were 0.3 or less, 0.3 or more but less than 0.7, and 0.7 or more, respectively) [4]. Considering the students' learning process by the experiments from Table 3, if was found that the average normalized gain of all experiments was in medium gain at 0.62. Considering by the experiment, it was found that experiment 2, **Electrostatics: Detection of Charge** had the lowest progress at 0.58. This possibly because the activity applied the simple electroscope which the students were confused with the instruction since they first used it and the situation must be explained to correspond to the experiment at the same time so they gained fewer scores. In experiment 3, **Charging by Induction** had the highest progress at 0.65 because students were well engaged and interested in conducting the activities. The student had done the experiment by using electroscope in experiment 2 so they had enough skill. In addition, the questions in the evaluation form were corresponding to the principle of experiment activities so the score in this experiment was higher than the other.

Conclusions

The research on using the simple experiment incorporated with scientific inquiry approach aimed to studies the learning process in static electricity by applying the simple experiment incorporated with scientific inquiry approach. The results compared the students' learning achievement before and after studying with the simple experiment was that the average score after studying (7.71 or 77.10%) was higher than the score before studying (4.00 or 40.00%) which was different with the statistical significance at .05 (t=12.47) and the class average normalizes gain was 0.62, which was in medium gain level. It implied that the students who were studied by applying scientific inquiry approach obtained more conceptual understanding of static electricity and most of them had a great learning progress.

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