

**A COMPARATIVE STUDY OF GRADE 6 SCIENCE STUDENTS’  
ACADEMIC ACHIEVEMENT UNDER TEACHER-CENTERED  
LEARNING METHOD AND INQUIRY-BASED LEARNING METHOD AT  
PANCHASAP SCHOOL, BANGKOK, THAILAND**

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**Abstract:** The purpose of this study was to compare grade 6 science students’ academic achievement under two different teaching methods at Panchasap School, Bangkok, Thailand. The two methods were teacher-centered learning method and inquiry-based learning method. The research included five objectives. Objective one was to determine the students’ academic achievement under teacher-centered learning method in pre-test and post-test. Objective two was to determine if there was a significant difference between pre-test and post-test under teacher-centered method. Objective three was to determine students’ academic achievement under inquiry-based learning method in pre-test and post-test. Objective four was to determine if there was a significant difference between pre-test and post-test under inquiry-based learning method. Objective five was to determine if there was a significant difference in academic achievement in science between teacher-centered learning method and inquiry-based learning method. Two groups of Grade 6 students at Panchasap School, Bangkok, Thailand were used for this research study. The sample size of this study was 83 students where 42 students were under the teacher-centered learning method and 41 students were under the inquiry-based learning method. The data were collected by using a pre-posttest. The pre-post test scores were analyzed by means, standard deviations, paired samples *t*-test and an independent samples *t*-test (two-tailed). The findings of the study indicated a significant difference between teacher-centered learning method and inquiry-based learning method at a significance level of .05. Students achieved higher when exposed to inquiry-based learning method.

**Keywords:** Teacher-centered learning method, Inquiry-based learning method, Comparative study, Pre-test, Post-test, Academic achievement

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## **Introduction**

The Thailand National Education Act 1999 declared that science is one of the core subjects taught in Thai schools. Science and technology are essential in developing effective solutions to the challenges faced by the society today (Gluckman,2011). To succeed in this highly technological society, students need to develop their capabilities in the fields of science, technology, engineering and math (STEM) education to levels much beyond what was considered acceptable in the past (Hunt, 2016). STEM must be the approach brought to the classroom from primary to high school, university and professionals so that Thailand can achieve full economic development (Boonruang, 2015). In order to help Thai student's learn science, it is important to create appealing, motivating, and student-centered teaching materials (Fredrickson, 2017). Panchasap School is a private catholic school located in Bangkok, Thailand. The school includes the Intensive English Program (IEP) for students to learn English in which mathematics and science are taught using English as the medium of instruction for four periods a week.

Otherwise, the medium of instruction is Thai. The learning method in Panchasap School is primarily a traditional way where the teacher is the prime focus and students listen and take notes. In other words, it is a teacher-centered approach. The difficulties involved in teaching in English also arise as students are non-native English speakers.

In this 21st century of Internet and technology, it is very easy to retrieve information with just a few clicks. But if students do not learn how to access and process information as well as filtering what is useful, they will be at an incredible disadvantage. Unfortunately, Thai students lag behind in learning science (Ramsoot, 2016). This was also observed in Grade 6 of Panchasap School by this researcher.

The researcher has worked at the Panchasap School for 3 years as a IEP science teacher and has witnessed the difficulties in students' learning. The researcher has also observed the low achiever students who are promoted every year in spite of their low grades Therefore, it becomes a problem for both the students and teachers.

The researcher believes that a different learning method applied in the school may make a difference to these students' learning. Therefore, the researcher decided to conduct a research study on Grade 6 students to compare the academic achievement level under two learning methods: traditional learning method (teacher-centered approach) and inquiry-based learning method (student-centered approach).

## **Research Objectives**

The following research objectives were used in this study.

1. To determine Grade 6 science students' academic achievement level under teacher-centered learning method in pre-test and post-test at Panchasap School, Bangkok, Thailand.

2. To determine if there is a significant difference in Grade 6 science students' academic achievement level under teacher-centered learning method between pre-test and post-test at Panchasap School, Bangkok, Thailand.
3. To determine Grade 6 science students' academic achievement level under inquiry-based learning method at Panchasap School, Bangkok, Thailand.
4. To determine if there is a significant difference in Grade 6 science students' academic achievement level under inquiry-based learning method between pre-test and post-test at Panchasap School, Bangkok, Thailand.
5. To determine if there is a significant difference in Grade 6 science students' academic achievement level under teacher-centered learning method and inquiry-based learning method at Panchasap School, Bangkok, Thailand.

## **Literature Review**

### *Thailand's Education System*

Thailand's education system is managed by the Ministry of Education under the Thai government. It covers from pre-school to senior high school where twelve years of free basic education is provided by the government, and a minimum of nine years' school attendance is mandatory (Ministry of Education Thailand, 2008). The current education policy is guided by the National Education Act of 1999 and the 15-year National Education Plan (UNESCO, 2011).

The promotion of thinking skills, self-learning strategies and moral development is at the heart of teaching and learning in the Thai National Curriculum. The objectives of the curriculum are to provide: basic education for all; experiences useful for daily living; and education for national unity with common purposes (Ministry Education Thailand, 2008).

### *Science Education*

Science is a universal subject taught in most school in the world (Jaussen, 2008). Science education emphasizes the involvement of students for them to develop scientific knowledge, outlook, approach and skills. Students tend to prefer a practical approach to science which they believe makes the subject more interesting and more understandable. Science requires engaging students with enthusiasm to catch the interest of the many different groups present in a classroom.

### *STEM Education*

STEM education is a learning innovation in which science, technology, engineering and mathematics are integrated. Students develop their knowledge and skills in science, mathematics and technology through activities, which provide them with the opportunity to apply new knowledge via the engineering process to solve

real life problems, and finally achieve solutions or develop technology as a result (Boonruang, 2015). STEM education should be open, flexible, challenging and emphasize problem-solving ideas and methods

#### *Skinner's Operant Conditioning Theory of Learning*

A teacher – centered theory approach known as behaviorism focuses only on the observable and measurable aspects of human behavior (McLeod, 2017). This approach argues that behavior can be learned or unlearned, and that could be the result of stimulus and response actions (O'Donohue & Kitchener, 1998). Teachers instruct the lesson and for the student to master the lesson, the student should go through practice activities. Examples of behaviorist learning theory include drill work, practices, bonus points, participation points.

However, the constant increasing amount of material to memorize becomes quickly overwhelming. Students lose interest as the subject appears stressful, crushing, boring, and no longer enjoyable (Phungphol, 2005). For this method to be efficient, students must demonstrate a high level of individual motivation towards academic activities (Andersen, 2011).

#### *Bruner's Constructivist Theory of Development*

This is one of the constructivist learning theories where a learner must actively construct knowledge and skills. The knowledge constructed will be mainly based on connecting the ideas and concepts. Learners will produce meaningful information by linking the new knowledge with the previous knowledge gained. (Prince & Felder, 2006).

Knowledge is built through experience and individuals must construct their own knowledge. These experiences promote creation of schemas or mental models and thus lead to learning. Schemas and mental models are cognitive structure that connect the concepts and represent relationships amongst them (Piaget, 1972).

The student-centered approach is an approach that focuses on the student rather than the teacher. It is a way of teaching which truly engages a student where they take responsibility for their own learning and teachers are the facilitators to help the student achieve it.

The student-centered approach includes active learning, cooperative learning, inquiry-based learning, project-based learning, problem-based learning and discovery learning. The four main principles of the student-centered approach are that learning activities be creative, mobile, dynamic and cognitively agitating.

The Schwab's Inquiry-based instructional approach is a set of a processes where learners ask questions and explore for the answers by themselves under the guidance of the teachers. The main concept of this approach is to let the students to find meaningful information that they can apply (Inquiry Based Learning, 2017).

The BSCS 5E Instructional Model (Bybee & Landes, 1990), also known as the Biological Science Curriculum Study 5E instructional model, can be used to design a science lesson, and is based upon cognitive psychology, constructivist-learning theory, and best practices in science teaching.

Learners interpret objects and phenomena and internalize those interpretations in terms of their current conceptual understanding. It includes engage, explore, explain, elaborate and evaluate (Bybee & Landes, 1990).

### Conceptual Framework

The purpose of this study was to determine the students' achievement under teacher-centered learning method and inquiry-based method. Scores from a pretest and posttest were used to determine whether there was any significant difference between the two teaching methods.

The study was conducted on two classes of Grade 6 where Grade 6/5 was through teacher-centered learning method and Grade 6/4 was through inquiry-based learning method.

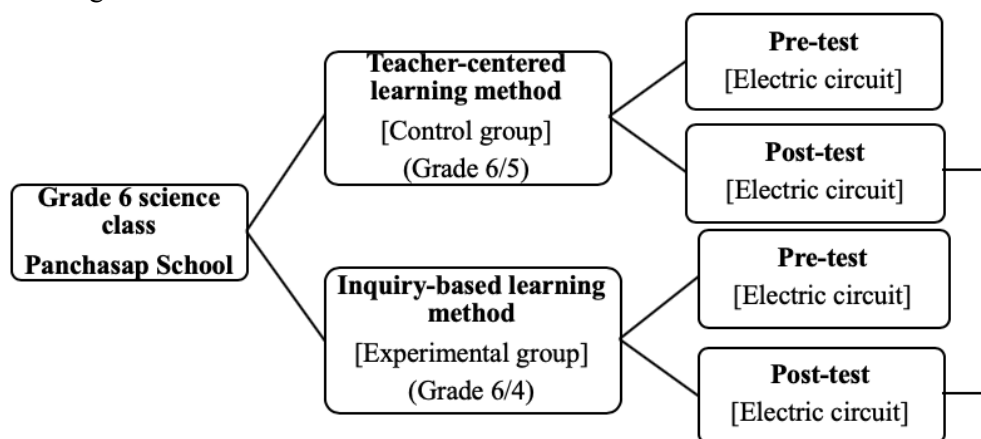


Figure 1: Conceptual Framework for this study.

### Method

#### *Participants*

The researcher investigated the Grade 6 students' academic achievement under the two teaching methods; teacher-centered learning method and inquiry-based learning method at Panchasap School, Bangkok, Thailand. The populations of this study were 83 Grade 6 science students.

#### *Instrumentation*

The researcher used a pre-posttest which included the same set of questions. The test was based on *Chapter 5: The Electric Circuit* from IEP Science Grade 6 .

The test was divided into three sections; Multiple choice, Fill in the blanks and Short answer questions. The total score of the test was 100%.

The pre-posttest used for this research study was reviewed and validated by three senior science teachers with more than 5 years of teaching experience. The reliability of the test was tested with five students of another Grade 6 section.

The result indicated that the test was reliable (see Table 1).

**Table 1: Reliability Statistic of Pre-Test and Post-Test**

<b>Cronbach's alpha</b>	<b>Cronbach's alpha based on standardized items</b>	<b>Number of items</b>
.72	.68	25

## Findings

### *Research Objective One*

Research Objective 1 was to determine Grade 6 science students' academic achievement level under teacher-centered learning method in pre-test and post-test at Panchasap School, Bangkok, Thailand.

**Table 2: Means and Standard Deviations of Pre-Test and Post-Test under Teacher-Centered Learning Method (n=42)**

<b>Research instrument</b>	<b><i>M</i></b>	<b><i>SD</i></b>
Pre-test	68.00	11.92
Post-test	78.48	15.02

Table 2 shows the pre-test ( $M= 68.00$ ) was lower than the post-test ( $M= 78.48$ ). There was an increase of 15.41 % in their academic achievement. This indicated that the students achieved higher after the instruction.

### *Research Objective Two*

Research Objective 2 was to determine Grade 6 science students' academic achievement level under inquiry-based learning method in pre-test and post-test at Panchasap School, Bangkok, Thailand.

**Table 3: Paired Samples t-Test of Pre-Test and Post-Test under Teacher-Centered Learning Method (n= 42)**

Research instrument	<i>N</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>p</i>
Pre-test	42	68.00	11.92	41	-5.95	< .001
Post-test	42	78.48	15.02			

Table 3 indicates that there was a significant difference in Grade 6 science students' academic achievement level between pre-test and post-test under teacher-centered method in Panchasap School, Bangkok, Thailand at the level of .05.

#### *Research Objective Three*

Research Objective 3 was to determine Grade 6 science students' academic achievement level under inquiry-based learning method in pre-test and post-test at Panchasap School, Bangkok, Thailand.

**Table 4: Means and Standard Deviations of Pre-Test and Post-Test under the Inquiry-Based Learning Method (n= 41)**

Research instrument	<i>M</i>	<i>SD</i>
Pre-test	67.80	11.45
Post-test	85.66	11.00

Table 4 shows the pre-test ( $M= 67.80$ ) was lower than the post-test ( $M= 85.66$ ). There was an increase of 26.34 % in their academic achievement. This indicated that the students achieved higher after the instruction.

#### *Research Objective Four*

Research Objective 4 was to determine if there was a significant difference in Grade 6 students' academic achievement level under inquiry-based learning method between pre-test and post-test at Panchasap School, Bangkok, Thailand.

**Table 5: Paired Samples t-Test of Pre-Test and Post-Test under Inquiry-Based Learning Method (n= 41)**

Research instrument	<i>N</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>p</i>
Pre-test	41	67.80	11.45	40	-14.65	< .001
Post-test	41	85.66	11.00			

Table 5 findings show that the pre-posttest under inquiry-based learning method ( $n=41$ ,  $M=17.85$ ,  $SD=7.80$ ). The analysis recorded that  $t(40) = 14.65$  and  $p = <.001$ . This concludes that there was a significant difference in Grade 6 science students' academic achievement level between pre-test and post-test under inquiry-based learning method in Panchasap School, Bangkok, Thailand at the level of .05.

#### *Research Objective Five*

Research Objective 5 was to determine if there was a significant difference in Grade 6 science students' academic achievement level under teacher-centered learning method and inquiry-based learning method at Panchasap School, Bangkok, Thailand.

**Table 6: Independent Samples t-Test of Post-Tests under Teacher-Centered Learning Method and Inquiry-Based Learning Method (n= 83)**

Post-test group	<i>N</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>F</i>	<i>p</i>
Control Group	42	78.48	15.02	81	2.48	.02
Experimental Group	41	85.66	11.00			

Table 6 findings show that the control group which was the teacher-centered learning method ( $n=42$ ,  $M=78.48$ ,  $SD=15.02$ ) and the experimental group which was the inquiry-based learning method ( $n=41$ ,  $M=85.66$ ,  $SD=11.00$ ) were compared. The analysis recorded that  $t(81) = 2.48$  and  $p = .02$ . According to the findings there is a significant difference of Grade 6 Students' achievement level under teacher-centered learning method and inquiry-based learning method in Science class at Panchasap School, Bangkok at the level of .05.

#### **Discussion**

This study determined that there was a significant difference in students' achievement under teacher-centered learning method and inquiry-based learning method. Grade 6/5, which was the control group, went through the teacher-centered learning method. The 15.41% increase in their means of the pre-post test and a significant difference



between the pre-post test indicated their improved academic achievement level. There was an improvement in their learning indicating that the students did gain knowledge in their science class when treated with teacher-centered learning method.

Students in Panchasap School have always been treated with this traditional approach. The increase in the academic achievement level can be due to the incorporated learning method which was used throughout their school life. Students were more accustomed and familiar with this learning method. The drill practice or the rote learning have always been their way to gain new knowledge. For this method to be efficient, students must demonstrate a high level of individual motivation towards academic activities (Andersen, 2011).

On the other side, Grade 6/4 students which was the experimental group went through the inquiry-based learning method during this period. There was an increase of 26.34% in the means between the pre-post test. Students in this group achieved higher than the control group. The science teacher noted a real difference in learning and understanding looking at the difference in the students' mean scores. Students prefer a practical approach to science as it makes the subject more interesting (NEFR,2011). Moreover, it also engages the students, which is important when a class size like in Panchasap School is more than 40 students with a multitude of different interests.

The researcher adopted the inquiry-based learning method for Grade 6/4 as according to previous researchers, it is believed that this approach can increase the students' engagement in science class as well as develop their higher order thinking skills which ultimately leads to higher achievement scores. Therefore, all the lessons for this class were planned to use the BSCS 5E instructional model. This model consists of five phases that learners goes through. It includes Engage, Explore, Explain, Elaborate and Evaluate (5Es Teaching and Learning Model, 2017). It was a new learning method for these students as they were always treated with a teacher-centered approach. Students were very cooperative and excited to learn a science lesson in a different way. The lessons were started with an open-ended question which allowed students to engage in brainstorming by asking more questions to seek for answers, collect the information and filter out what is needed, reasonable answers with provided evidence, solving problem creatively and reflect on their own answers. However, for the teacher-centered learning method, there were direct instructions in class using books, whiteboard and PowerPoint slides, take notes in their notebook, complete the worksheets as well as a homework was followed.

According to Johnson, Johnson and Smith (1991), learning does not only occur between the teachers and students, but between students and their environment, and the students themselves. The teacher noticed more engagement in the class where students were actively participating. The researcher also spoke to the experimental group about the learning experience using the inquiry-based learning. The responses

were positive indicating the excitement they had doing the experiments, they enjoyed the class, were more engaged with the learning as well as get to work as a group and not an individual project. Students loved sharing ideas with each other.

Panchasap School has a strong EP program where students' language skills are at an intermediate level, made it easier to implement the teaching method. There can be difficulty in applying it to other regular schools in Thailand as Thai students seem to be more comfortable with the traditional instruction which has been implementing for years. However, according to Chang and Mao (1998), inquiry-based science instruction for middle and high school students had positive effects on students' science achievement, cognitive development, laboratory skills, science process skills, and understanding of science knowledge when compared to students taught using a traditional approach.

### **Recommendations**

#### *Recommendations for School Administrators*

The researcher would recommend the school administrators to motivate and encourage the involvement of teachers, parents and students for an effective implementation of the inquiry-based learning method which can lead to a better achievement result. This can be done by providing professional development programs for the teachers or even having meet up sessions with the parents.

#### *Recommendations for Teachers*

The researcher would recommend the teachers at Panchasap School should be more aware and prepared for STEM Education, using student-centered approaches generally and for the inquiry-based learning method specifically. With professional development programs and support from the school, parents and students as well as the willingness to make a change may equip the students with the 7C's required in the 21<sup>st</sup> century world.

#### *Recommendations for Future Researchers*

The researcher would recommend future researchers to consider the factors which can affect the research; English knowledge deficiency, the length of the study, student 'passivity as well as the support from the school and the teachers. Moreover, future researcher can explore in other fields other than Science as well as for different grade levels could be implemented as well.

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