

CLASSROOM ACTION RESEARCH FOR TEACHING MATHEMATICS IN SECONDARY SCHOOLS

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ABSTRACT

The purpose of this study was to investigate compatibility among class levels, mathematics contents, and teaching and learning strategies of classroom action research conducting in secondary schools. The participants were 22 graduate students who were in the Practicum course of Mathematics Education Program, International College, Suan Sunandha Rajabhat University. This course took two semesters (one academic year) of secondary school. The researcher collected data from 22 theses conducted by classroom action research method, and then analyzed the data by explaining compatibility among class levels, mathematics contents, and teaching and learning strategies. The results showed that students applied different teaching strategies to conduct classroom action research in secondary schools in order to increase students' mathematics achievement. They were responsible for teaching grade nine to twelve students in different mathematics contents. Some teaching strategies could be integrated in different mathematics contents and class levels such as The Geometer's Sketchpad (GSP), Polya's four steps and Know-Want-Learn strategy. Some were applied in the same class level but different mathematics contents such as flipped classroom model and journal writing. In addition, some mathematics contents, complex number system, vectors in three dimensions, and analytical geometry could be taught with various teaching strategies. Finally, some teaching strategies were used in specific class level and mathematics contents including open-ended problems, van Hiele's phases of learning, remedial lessons, 5Es instructional model, programed instruction, one-to-one tutoring as a small group, Teams Games Tournaments (TGT), think-pair-share learning strategies based on constructivism paradigm, student Teams Achievement (STAD) technique, contextual teaching and learning method, discovery learning method.

Keywords: Classroom action research, Mathematics, Teaching strategies

INTRODUCTION

Mathematics is one of the most important fields because it is a foundation in studying other subjects such as science, physics, chemistry which still rely on mathematical calculations and thinking process. As stated in the Basic Education Core Curriculum [1] that mathematics is highly significant for the development of the human mind. It enables a person to think logically and systematically, to analyze various problems or situations, to anticipate, to plan, to make decisions, to solve problems and to apply mathematics to daily life. Indeed, mathematics is not only a tool that helps with the accuracy of obtained results in any kind of problem solving but also an imperative instrument in workplaces, regardless of which line of work that requires careful thinking and reliable problem solving process.

International College, Suan Sunandha Rajabhat University provides Master Degree of Arts in the program of Mathematics Education as one of more than ten networking centers serving for the Project for the Promotion of Science and Mathematics Talented Teachers (PSMT). Students in this project were awarded scholarships from the Thai government to study in a two-year Master. This project is under the Institute for the Promotion of Teaching Science and Technology (IPST), an independent authority under the Ministry of Education, responsible for the development of national curriculum, educational media and tools, standard and quality assessment on science, mathematics and technology education from elementary to upper secondary schools. IPST is also tasked with re-training teachers and students, promoting science talents and advising science education policy. The main objective of this project is to produce highly qualified science teachers for teaching gifted students in Enrichment Science Classrooms within Thai secondary schools. PSMT requires students to conduct classroom action research during the period of their Practicum course, 2

academic semesters in secondary schools. They took Practicum course in several secondary schools in Bangkok.

Classroom action research conducted by students in this project is a very beneficial tool for students to learn most effectively and for teachers to teach most effectively. Action research is an ongoing process of reflection and action to produce the most effective learning environment possible. [2] defined action research as an enquiry, undertaken with rigor and understanding so as to constantly refine practice; the emerging evidence-based outcomes will then contribute to the researching practitioner's continuing professional development. Those involved in action research generally want to solve some kind of day-to-day immediate problem such as figuring out ways to improve the teaching of mathematics, or to increase funding [3]. Moreover, [4] stated that action research is a type of applied research that aimed to solve an immediate problem, and the results of the research are restricted to the context in which the research is conducted and may not be suitable for applying in other situations.

Based on [3], action research involves four basic stages: 1) identifying the research problem or question; 2) gathering the necessary information; 3) analyzing and interpreting the information; and 4) developing and action plan. [2] referred to [5] who mentioned that action research is participatory research which involves a spiral of self-reflective spirals of planning a change, acting and observing the process and consequences of the change, reflecting on these processes and consequences and then re-planning, acting and observing, reflecting, and so on. There are five advantages of action research offered by [3], which include: 1) It can be done by almost any professional, in any type of school, at any grade level, to investigate just about any kind of problem; 2) It can improve educational practice; 3) It can develop more effective ways to practice their craft; 4) It can help teachers identify problems and issues systematically; 5) It can build up a small community of research-oriented individuals within the school itself.

According to most classroom action research, researchers apply active learning especially cooperative learning and other teaching strategies promoting active learning. These strategies can be defined as instructional activities involving students in doing things and thinking about what they are doing [6]. [6] also stated that students must do more than just listen. They must read, write, discuss, or be engaged in solving problems. Significantly, to be actively involved, students must engage in such higher-order thinking tasks as analysis, synthesis, and evaluation. Students learn more when they participate in the process of learning, whether it is through discussion, practice, review, or application [7].

To offer guidelines for teaching and learning mathematics and conducting more effectively classroom action research especially in mathematics, this paper aimed to investigate compatibility among class levels, mathematics contents, and teaching and learning strategies of classroom action research conducting in secondary schools.

METHODOLOGY

This research demonstrated classroom action research conducted by graduate students in the program of Mathematics Education while they took Practicum course in secondary schools

Participants

The participants in this study were 22 graduate students in the program of Mathematics Education, International College, Suan Sunandha Rajabhat University who conducted classroom action research in secondary schools in Bangkok by applying a variety of teaching strategies in various mathematics contents and class levels. Secondary Schools where the students collected data for classroom action research consisted of Debsirin School, Horwang School, Mahaprutaram Girls' School under the Royal Patronage of Her Majesty the Queen, Samsenwittayalai School, Satrinonthaburi School, Satriwithaya School, and Suankularb Witthayalai School.

Instruments

The instruments in this study were 22 theses of graduate students in program of Mathematics Education, International College, Suan Sunandha Rajabhat University that were revealed the results after implementing classroom action research in seven secondary schools in Bangkok.

Data Collection and data analysis

The researcher reviewed literature and related studies about classroom action research and Mathematics teaching strategies as well as 22 theses of the graduate students according to teaching strategies, Mathematics contents and class levels. Moreover, the researcher observed the class which graduate students taught as in the course of Practicum. The researcher analyzed compatibility among teaching strategies, Mathematics contents and class levels.

RESULTS

This study aimed to investigate compatibility among class levels, mathematics contents, and teaching and learning strategies of classroom action research conducting in secondary schools. The findings revealed that graduate students conducted classroom action research to increase students' mathematics achievement by applying a variety of teaching strategies in different mathematics contents and class levels. They were assigned to teach students in grade nine to twelve.

Some teaching strategies could be integrated in different mathematics contents and class levels such as The Geometer's Sketchpad (GSP), Polya's four steps and Know-Want-Learn strategy. Some were used in the same class level but different mathematics contents such as flipped classroom model and journal writing. In addition, some mathematics contents, complex number system, vectors in three dimensions, and analytical geometry could be taught with various teaching strategies.

Lastly, some teaching strategies were applied in specific class level and mathematics contents including open-ended problems, van Hiele's phases of learning, remedial lessons, 5Es instructional model, programed instruction, one-to-one tutoring as a small group, Teams Games Tournaments (TGT), think-pair-share learning strategies based on constructivism paradigm, student Teams Achievement (STAD) technique, contextual teaching and learning method, discovery learning method. The results were shown in Table 1.

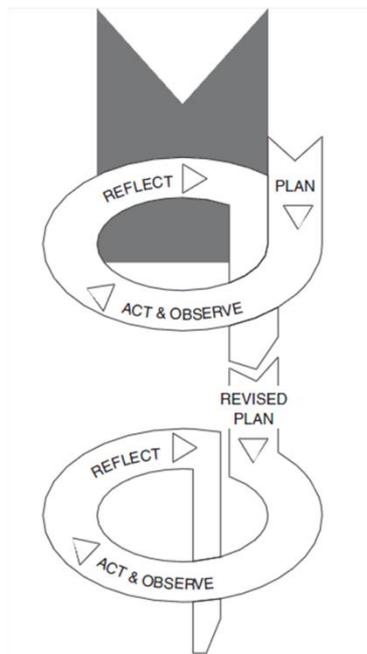
Table 1
Compatibility among class levels, mathematics contents, and teaching and learning strategies

Class Levels	Mathematics Contents	Teaching Strategies
Grade 9	Inequalities	Teaching strategies based on Polya's four steps and Schoenfeld's behavior categories
	Relations	Open-ended problems
Grade 10	Conic Sections	Know-Want-Learn strategy
		The Geometer's Sketchpad (GSP)
	Analytical Geometry	The Geometer's Sketchpad (GSP)
		Van Hiele's phases of learning
	Linear equation system and matrix	Journal writing and remedial lessons
	Matrices	One-to-one tutoring as a small group
	Trigonometric Ratios and Applications	Programed instruction and journal writing
	Trigonometric functions	5Es instructional model and The Geometer's Sketchpad (GSP)
	Functions	Know-Want-Learn strategy
Mathematical word problems in linear function, quadratic function, and mathematical reasoning	Polya's problem-solving approach	
Grade 11	Limits and continuity of functions in pre-calculus	The Geometer's Sketchpad (GSP)
	Vectors in three dimensions	Teams Games Tournaments (TGT)

		Flipped classroom model
	Complex number system	Think-Pair-Share
		Learning strategies based on constructivism paradigm
		Student Teams Achievement (STAD) technique
		Flipped classroom model
	Statistics	Flipped classroom model
	Basic statistics	Contextual teaching and learning method
	Probability	Discovery learning method
Grade 12	Frequency distributions of data, graph of frequency distributions of data, measures of central value and measures of dispersion	Know-Want-Learn strategy

Classroom action research conducted by graduate students in Mathematics Education, International College, Suan Sunandha Rajabhat University followed the cycles according to [5]'s model; plan, act and observe, and reflect, shown in Figure 1.

Figure 1
Action research model



CONCLUSION AND FUTURE WORK

The objective of this study was to investigate compatibility among class levels, mathematics contents, and teaching and learning strategies of classroom action research conducting in secondary schools. The participants in this study were 22 graduate students who were in Practicum course of Mathematics Education Program, International College, Suan Sunandha Rajabhat University. This course lasted for two semesters (one academic year) of secondary school. The researcher collected data from 22 theses conducted as classroom action research, and then analyzed the data by describing compatibility among class levels, mathematics contents, and teaching and learning strategies.

The results demonstrated that students applied a variety of teaching strategies to conduct classroom action research in secondary schools in order to increase students' mathematics achievement. They taught grade nine to twelve students in different mathematics contents.

Some teaching strategies could be integrated in different mathematics contents and class levels such as The Geometer's Sketchpad (GSP), Polya's four steps and Know-Want-Learn strategy. Some were used in the same class level but different mathematics contents such as flipped classroom model and journal writing. In addition, some mathematics contents, complex number system, vectors in three dimensions, and analytical geometry could be taught with various teaching strategies.

Lastly, some teaching strategies were applied in specific class level and mathematics contents including open-ended problems, van Hiele's phases of learning, remedial lessons, 5Es instructional model, programed instruction, one-to-one tutoring as a small group, Teams Games Tournaments (TGT), think-pair-share learning strategies based on constructivism paradigm, student Teams Achievement (STAD) technique, contextual teaching and learning method, discovery learning method.

Likewise, the results of [8]'s research found that flipped classroom and cooperative learning methods could make students' engagement higher than traditional classroom. Students revealed on the interview that using flipped classroom and cooperative learning methods were able to make learning statistics fun and challenging. Furthermore, according to the findings of this study, there were various teaching strategies helped students improve their mathematics learning achievement in secondary schools. Teachers should consider and have a plan to integrate teaching strategies, especially cooperative learning or other active learning strategies in their classroom in order to promote students' achievement.

The future researcher should conduct classroom action research for teaching other subjects and other levels of education such as primary schools and university. Also, they should make an in-depth observation in classroom for obtaining more details

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