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Students' problem solving strategies in problem solving - mathematics classroom

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Abstract

Teaching approaches in mathematics classrooms have been changed to a more insight-based problem oriented process during the last decade (van Oers, 2002). In addition, problem solving requires a variety of skills including interpreting information, planning and methodical working, checking results and trying alternative strategies (Muir, Beswick, & Williamson, 2008). The purpose of this research was to investigate students' problem solving strategies (Posamentier & Krulik, 1998) in a problem solving-mathematics classroom, using an open approach as a teaching approach and composed of four phases: 1) posing open-ended problems, 2) students' self learning, 3) whole class discussion, and 4) comparison, and summarization through connecting students' mathematical ideas that emerged in the classroom (Inprasitha, 2010). Case study was employed in this study. Video and audio tape recording, and field note taking were used as methods for collecting data of a targeted group including six of grade 1 students in 2010 academic year of a school participating the Project for Professional Development of Mathematics Teachers through Lesson Study and Open Approach. Data were analyzed by using descriptive statistic and analytic description. The results revealed that the students used the problem solving strategies in all phases and mostly in the 2nd phase of the problem solving-mathematics classroom. Moreover, when the students solved the problems, they cooperated to create their problem solving strategies. Thus it could be considered that the problem solving-mathematics classroom, which starting with open-ended problems and having sessions for students to solve the problems by themselves, encourages students to create their own problems and problem solving strategies.

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1. Introduction

Teaching approaches in mathematics classrooms have been currently changed to a more insight-based problem oriented process (van Oers, 2002). A critical point is then not whether the teachers should use problem solving as a teaching approach to mathematics, but rather what kinds of authentic experiences concerning mathematics that students can get through problem solving (Cai, Mamona-Downs, & Weber, 2005). A problem solving-mathematics classroom or a mathematics classroom using an open approach as a teaching approach emphasizes on students'

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problem solving and encourages students to use different strategies to solve the problems composed of four phases (Inprasitha, 2010) as shown in Figure 1. The teachers mostly encourage students' problem solving, in addition, by starting the classes with an open-ended problems which is designed in according with students' experience or what the students have learned. In other words, the approach in this classroom necessarily nurtures the students to learn mathematics in meaningful ways. As a result, it could be recognized that the approach used in the problem solving classroom is a mathematical practice that shapes concepts, meanings, processes, and values, whereby promoting a transformation from techniques (ways of doing) to meanings (ways of knowing) (Bishop, 1988). In addition, the problem solving requires a variety of skills including interpreting information, planning and methodical working, checking results, and trying alternative strategies (Muir, Beswick, & Williamson, 2008). A teachers' understanding and recognition of students' problem solving strategies used in the problem solving-mathematics classroom, therefore, should be promoted.

2. Purpose of the study

This study was aimed to investigate students' problem solving strategies in the problem solving - mathematics classroom using the open approach as the teaching approach.

3. Target Group of the study

The target group included six of grade 1 students, who were studying at Ban Bueng-neum-bueng-krai-noon School, and attending 5 classes of Length Comparison in the second semester of 2010 academic year. The school has been participating in the Project for Professional Development of Mathematics Teachers through Lesson Study and Open Approach supervised by Center for Research in Mathematics Education (CRME), Khon Kaen University since 2007 academic year.

4. Research Methodology

4.1. Theoretical Frameworks

This research was conducted by employing principles of 2 theoretical frameworks, as follows.

1) Open Approach as a Teaching Approach (Inprasitha, 2010) is composed of four phases: 1) *Posing open-ended problem*, the open-ended problems are posed in the classroom and the students are often asked about a meaning of the problems and challenged to solve the problems, 2) *students' self learning*, this phase consists of a combination of two parts: individual work and discussion by the whole class, 3) *whole class discussion and comparison*, the students' activities are crucial to further development of a lesson that the teacher should try to identify those students who do not understand the problems and provide more suggestions to stimulate the students in a whole class to think in according to the problems, and 4) *summarization through connecting students' mathematical ideas emerged in the classroom*, the teacher should include all students' prepositions and concentrate on one point view and lead to a conclusion by integrating and arranging them in according to particular point of view, in which used to identify phases of the case studied classroom.

2) Problem Solving Strategies (Posamentier & Krulik, 1998) includes 1) Working backwards, 2) Finding a pattern, 3) Adopting a different point of view, 4) Solving a simpler or analogous problem, 5) Considering extreme cases, 6) Making a drawing (visual representation), 7) Intelligent guessing and testing (approximation), 8) Accounting for all possibilities, 9) Organizing data, and 10) Logical reasoning, in which used to investigate them in each phase of the case studied classroom.

These two theoretical frameworks would support an empirical data for the problem solving-mathematics classroom or mathematics classroom using an open approach as the teaching approach in which encourages the students to learn by themselves via solving the problems along in each phase of the classroom.

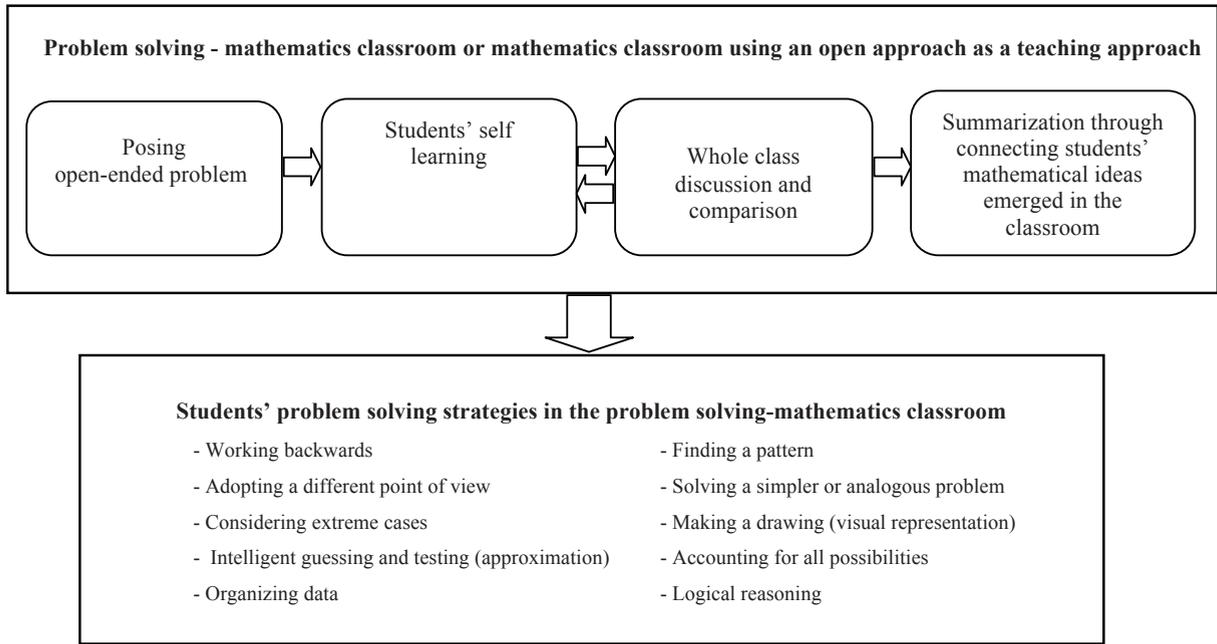


Figure 1. Theoretical frameworks used in the study

4.2. Data Collection and Analysis

Case study was employed in this study. Several methods were used to collect and analyze data: video and audio tape recording, and field note taking were used as methods for collecting data, the collected data were then analyzed by using the case studied classrooms’ transcriptions, descriptive statistic, and analytic description.

5. Results and Discussions

In the problem solving-mathematics classroom using the open approach as the teaching approach, all kinds of problem solving strategies occurred in the classroom and the students use them variously in each phase of the classroom as shown in the following tables.

Table 1. Percentage of the students’ problem solving strategies occurred in each phase of 5 problem solving-mathematics classrooms

Phases of open approach as a teaching approach	Percentage of students’ problem solving strategies
1 Posing open-ended problem	23.59
2 Students’ self learning	44.37
3 Whole class discussion and comparison	25.35

Phases of open approach as a teaching approach	Percentage of students' problem solving strategies
4 Summarization through connecting students' mathematical ideas emerged in the classroom	6.69
Total	100

From Table 1, it reveals that the students used the problem solving strategies in all phases of the problem solving-mathematics classroom and mostly in the 2nd phase, Students' self learning. Therefore, it could be considered that the open-ended problems used in the beginning of the classroom promote the students to create their own problems, and the phases of the classroom which stimulate students to create their own problem solving strategies to solve the problems themselves.

Table 2. Percentage of each kind of students' problem solving strategies occurred in 5 problem solving-mathematics classrooms

Kinds of Problem solving strategies	Percentage of students' problem solving strategies
1 Working backwards	4.58
2 Finding a pattern	9.15
3 Adopting a different point of view	7.39
4 Solving a simpler or analogous problem	5.99
5 Considering extreme cases	2.82
6 Making a drawing (visual representation)	19.02
7 Intelligent guessing and testing (approximation)	8.80
8 Accounting for all possibilities	16.90
9 Organizing data	10.21
10 Logical reasoning	15.14
Total	100

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used all kinds of problem solving strategies to solve the problems. In addition, when the students solved the problems, they cooperated to create their problem solving strategies. Thus, it could be considered that different students' ways of thinking support the students to use the problem solving strategies variously.

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6. Concluding Remarks and Recommendations

Such results could be considered in the new approach used in the problem solving-mathematics classroom that drives the problem solving activities. The students can selves regulate to do problem solving activities. The open approach can shift the mathematics classroom to change differently from the traditional classroom in which the teachers are the center and students only practice and drill, whereby the new students create the problems and problem solving strategies by themselves. Interestingly, therefore, cultural and social context in the problem solving-mathematics classroom influencing students' authentic experiences through the problem solving should be searched for further studies.

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