The development of mathematics learning activities based on constructivist theory in “Probability” for grade-9 students

Miss Chalom Chairiboon and Assistant Professor Dr. Sathaporn Khanto Curriculum and Instruction Program, Faculty of Education, Khon Kaen University, Thailand Email: Chairiboon@hotmail.com

Abstract

This research aims to develop learning activities based on Constructivist Theory for teaching probability in the mathematics, to develop Mathematics learning achievement and to the diagnosis of Mathematics problem solving skills in probability for Grade 9- students.

The target group was consisted of 38 Grade 9- students in Pisanpunnawittaya School, Muang District Khon Kaen Province, Khon Kaen Provincial Administrative Organization, during the second semester of 2009 school year.

There were 3 categories of tools used in the study. 1) The experimental tool with 15 lesson plans based on the Constructivist theory of learning. 2) the reflection tool which consists of a teacher’s teaching behavior observation form, a student’s studying behavior observation form, a learning-outcome recording form, an interview form, end-of-spiral quizzes and 3) an instrument for evaluating efficiency of an instrument for evaluating efficiency of learning management including the learning achievement test and an assessment tool which diagnoses the mathematics problem solving in “Probability” for Grade 9- students.

The action research was performed through the use of lesson plans 1-5 in action cycle I, lesson plans 6-10 in action cycle II, and lesson plans 10-15 in action cycle III. Data collection was made through field records, observation. Action Cycle Tests were administered by the end of each cycle to assess the students’ progress and reflection of the results. The effectiveness of the lesson plans was developed through the data collection from each tool. An assessment test was administered after all these cycles for conclusive results.

The research findings found that: 1) To develop learning activities based on Constructivist Theory for teaching probability in the grade-9 students found that 5 steps ‘Constructivists are 5 steps of Constructivist instruction: (1) Introduction (2) Teaching a step: Defining problems, Group verification and understanding, Whole class reflection on the concepts (3) Conclusion (4) Small group study (5) Application. 2) 73.68 per cent of students’ achievement on probability higher than 70 percent of the score. 3) 71.05 per cent students have skills in solving problems of probability higher than 70 percent of the score.

Keywords: Learning activities, Constructivist Theory, Mathematics learning achievement, Diagnosis of Mathematic problem solving
Background and significance of the problem

According to the National Education Act of B.E. (1999) (revised: column 2. 2002) section 22, education shall be based on the principle that all learners are capable of learning and self-development, and are regarded as being most important. The teaching-learning process shall aim at enabling the learners to develop themselves at their own pace and to the best of their potentiality. Educational management should emphasize the students’ potential to learn and develop themselves and be regarded as Child-centered. The educational management process should encourage the students’ development and learning potential. Mathematics plays a key role in the development of creative, critical, and reflexive thinking, providing the foundation to solve problems in any situation. Mathematics is also the primary tool in science and technology education (Policy and Education. Religion and culture Office of Permanent Secretary Ministry of Education, 2004). Moreover, People with good mathematical skills have more opportunities to study and get better jobs. Therefore, mathematic skills are important for a country’s development. We can observe this from the countries where many people have high level mathematical skill which lead to higher technology and stronger economy. So Thailand’s development relies on stakeholders who realize the importance of Mathematics and the development of these skills.

In Thailand, The Basic Education Program Act 2008 expects the curriculum to develop every student to be balanced in knowledge and virtue, and to have the basic knowledge for further study, job and lifelong learning. It emphasizes on the belief that every person is able to learn and develop his or herself (Ministry of Education, 2008). It provides the opportunities in mathematics learning for every student to learn by themselves. It also makes educational institutions and schools responsible to consider the suitable subject areas for students to develop their mathematics potential and enable them to apply their knowledge and mathematics skill to improve their quality of life.

The nature of Mathematics is abstract and reasonable. Mathematics’ education will be more efficient by instruction that leads the lesson to be concrete, interesting to motivate the students to solve the problem. Mathematics’ classroom activities are important to students. The teachers should have suitable classroom activities related to the curriculum objectives. The objectives should enable the students to have knowledge and mathematics skills that can be applied to their lives.

But the reports from educational quality evaluation by Department of Curriculum and Instruction Development found that Mathematics is the subject in which students got the lowest average score. Educators attribute the cause to be due to the quality of instruction. So
the instruction should have students participate more, and provide real world situations to learn from. In our daily lives, mathematics is constantly used in our decisions. For example, mathematics is used in the decisions on traveling, education, consuming, politics, economy, and so on.

Constructivist theory is a theory that emphasizes on Child-centered. It considers students’ needs and students’ differences. It also encourages the students to have reasonable thinking and develops their knowledge by themselves. The Constructivist instruction is Child-centered instruction. The teachers set the complex problem and due to the students’ lack of prior knowledge of the problem, the students need to search for more information by discussing, sharing and relating the new knowledge and prior knowledge to be new knowledge. Then the students will compare, contrast and check by themselves and others. The new knowledge which was developed will be complete and more complex than prior knowledge. So the new knowledge will be meaningful to them.

From the study of researches which support the application of Constructivist theory in learning activities are Siriburee (2008), Phunyafu (2008), Kentum (2008), Utra (2007), Yossawong (2006) and Akarum (2006) found that Constructivist theory can develop the learning achievement and the students have the potential to solve the problem, relate their experience to solve the problem and have desired characteristics such as the students are able to create knowledge by themselves, be responsible, be reasonable, be confident, have group process skill and have good attitude to Mathematics.

Researcher used action research by Kemmis & Mctaggart (Cited in Pongboriboon, 1994) to develop the instructional activities with Constructivist theory because the action research is the research that practice in step-by-step, plan to practice, observation and reflection the practice in practice circles. So the research can realize the error to solve and continue to develop in all the research time.

From the study of character of learning mathematics activities for grade-9 students in Pisanpunnawithaya School, Khon Kaen, Thailand found that the learning mathematics activities were not variety, answer the question and the participate of students were not shown, the students were shy to ask the question to the teacher, the teacher only use the textbooks to teach the students, the teacher used the abstract instructional medium to explain the content. For this reason, the mathematics learning achievements in the content of probability were low.

From the above reasons and according to the previous researches, researcher was interested in the development of learning activities, learning achievement and solving
problem skill in Mathematics subject in the content of probability of grade-9 room 3 in Pisanpunnawithaya School, Khon Kaen, Thailand. The researcher also believed that Constructivist theory can develop the learning activities, learning achievement and Mathematics problem solving to be more efficient.

**Objectives**

1) To develop learning activities based on Constructivist Theory for teaching probability in the mathematics learning for Grade 9- students.

2) To develop Mathematics learning achievement in probability for Grade 9- students in order that at least 70% of them make a learning achievement score of 70% or better

3) To the diagnosis of Mathematics problem solving skills in probability for Grade 9-students in order that at least 70% of them make a learning achievement score of 70% or better.

**Technical Terms**

1. Constructivist Theory means a learning theory which believed that the new knowledge will depend on the effect of the prior knowledge and transfer from experiences and prior restructuring to cognitive restructuring. There are 5 steps of instruction as following: 1) Introduction 2) Teaching a step: Defining problems, Group verification and understanding, Whole class reflection on the concepts 3) Conclusion 4) Small group study 5) Application.

2. Learning achievement means the score of students who study in the Mathematics department in the content of probability from Grade-9 Mathematics department learning achievement forms which are created by the researcher.

3. Problem in arithmetic means problem refers to situations that create problems in different ways. Students used Mathematics skills and Mathematical methods to correct the situation and lead to the correct answer.

4. Problem solving abilities skill means of solving problems of students. This is a test of skill solving intelligence which is created by the researcher.

5. Problem solving skills test means that the query was constructed in accordance with the expectations of learning about probability. And characteristics of problem issues as IPST (2005) determined that the step problem solving 4 steps: 1. Understanding the problem 2. Devising a plan 3. Carrying out the plan 4. Looking back.

6. Criteria via means targeted achievement of learning math content and problem solving skills of grade-9 students in Pisanpunnawittaya School. This is the criterion to 70 percent of students score at least 70 percent.
7. A research assistant means a teacher subject of learning mathematics in grade-9 students which together perform research in the classroom. Who observed the action plans and feedback. Plans to improve on each trial completed lesson plans and each cycle.

**Framework of the study**

![Figure 1 Framework of the study](image)

**Research Methodology**

This research is Action research. The purpose are 1) to develop learning activities based on Constructivist Theory, To develop Mathematics learning achievement in probability and To the diagnosis of Mathematics problem solving in probability for Grade 9- students in order that at least 70% of them make a learning achievement score of 70% or better.

**The target group**

Forty Grade-9 students who are studying in the second semester in the class of 2009 in Pisanpunnawittaya School, Khon Kaen, Thailand.

**Research tools**

1) The experimental tool which consists of 15 lesson plans based on the Constructivist theory of learning
2) The reflection tool which consists of a teacher’s teaching behavior observation form, a student’s studying behavior observation form, a learning-outcome recording form, an interview form, and end-of-spiral quizzes, and

3) An instrument for evaluating efficiency of learning management including the learning achievement test and an assessment tool which diagnoses the mathematics problem solving in “Probability” for Grade 9- students

**Data Collection and Analysis**

1) Orientation the sub-researchers and participants to understand the role and importance in learning activities based on Constructivist Theory and action research.

2) Teach the participants by using 15 Constructivist lesson plans about probability. The estimate time is 15 hours in the second semester of 2009.

3) Gather information from the lesson plans by using the practice reflection tools and use the information to solve the problem in the next circles.

4) Test the participants by using the learning achievement tests and Mathematics problem solving tests. Then use the score to analyze.

**Data Analysis**

1) Quantitative Data:

   - Use the data from the learning achievement tests to calculate the percentage and compare the criterion are the number of the students at least 70% and learning achievement score more than 70%.

   - Use the data from the Mathematics problem solving on the probability tests to calculate the percentage and compare with the criterion are the number of the students at least 70% and the problem solving skills score more than 70%.

2) Qualitative Data:

   Use the gathered data from the observation teaching behavior form, the observation students’ learning behaviors forms, lesson plan using record forms, students’ interview forms and post circles tests to analyze the content for evaluation the characteristics and solve them for effective learning activities.

**Conclusions**

In the action research in teaching Mathematics development by using the developed lesson plan in the content of probability in Grade-9 students, the findings are consisting of 3
forms: Constructivist Instruction, learning achievement and Mathematics Problem Solving skills are shown as following:

5 steps 'Constructivists was

1.1 Introduction is a step for students’ preparation and the teacher tells the learning objectives to the students by the teacher reads by him or herself or has the students read. The teacher also reviews their prior knowledge by games/ stories/ role plays/ conversations/ answering the questions.

1.2 Teaching a step is a step for the students to develop their concept. The teacher sets the activity for the students which based on the principle of construction, interaction and participation by…

1) Defining problems; the teacher presents problem which related to the lesson and diary lives and appropriate with age and ability of the students. The students discover knowledge which be used to solve problem by themselves from prepared concrete materials by the teacher.

2) Group verification and understanding; the teacher divides the students into a group of 4-5 people and the students discuss on the means to solve problem individually then the students choose an appropriate means to solve problem.

3) Whole class reflection on the concepts; each group presents the means to solve problem to the class, discuss on the means from each group and check the correctness and reasonableness. The teacher presents the means which the students did not present and collects the appropriate means which the class accepted. The teacher also explains the advantages and disadvantages and concludes the means to solve problem together.

1.3 Conclusion is a step for the students to conclude their concept from the lesson. The teacher helps the students to conclude for the students to check their concept to be correct.

1.4 Small group study is a step for the students to apply their knowledge to any situation professionally. The students do the exercise which created by the teacher or the students.

1.5 Application is the step for the teacher to evaluate the students’ knowledge by observing the students’ behaviors on doing the exercise and the test.

Table 1 Learning achievement scores and problem solving skills at the end of cycle 1-3

<table>
<thead>
<tr>
<th>Type of score</th>
<th>Cycle</th>
<th>Total</th>
<th>All of</th>
<th>S.D.</th>
<th>% of</th>
<th>The passing of</th>
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Table 1 found that Learning achievement: According to the result of learning activities based on Constructivist theory, the researcher can observe from the quiz average score in each circle are increased. Learning achievement score in Cycles 1-3 are 59.21%, 61.32% and 62.63%, the number of students passing in the cycles1, 2 and 3 as 23.68%, 28.95% and 36.84% and Problem solving skills score in cycles 1-3 are 55.79%, 58.16% and 60.79%, the number of students passing in the cycles1, 2 and 3 as 31.58%, 31.58% and 44.74%.

2) To develop Mathematics learning achievement in probability for Grade 9- students in order that at least 70% of them make a learning achievement score of 70% or better

3) To the diagnosis of Mathematics problem solving in probability for Grade 9-students in order that at least 70% of them make a learning achievement score of 70% or better.

<table>
<thead>
<tr>
<th>Type of score</th>
<th>Total number of students</th>
<th>All of score</th>
<th>S.D.</th>
<th>% of score</th>
<th>The passing of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Achievement</td>
<td>38</td>
<td>40</td>
<td>2.852</td>
<td>70.59</td>
<td>28</td>
</tr>
<tr>
<td>Problem Solving Skills</td>
<td>38</td>
<td>10</td>
<td>1.026</td>
<td>70.26</td>
<td>27</td>
</tr>
</tbody>
</table>

The table 1 found that from the learning achievement test after taught all 3 circles found that the students get 73.68% and 71.05% of all students passed the tests. Moreover, the students who were taught in the content of probability based on Constructivist theory have the problem solving skill 70.25% and there are 71.70% of all students passed the test.

Discussion
To develop learning activities based on Constructivist Theory for teaching probability in the grade-9 students found that 5 steps 'Constructivists are 1. Introduction 2. Teaching a step 3. Conclusion 4) Small group study 5) Application, 73.68 per cent of students’ achievement on probability higher than 70 percent of the score and 71.05 per cent students have skills in solving problems of probability higher than 70 percent of the score. This is discussed that the Constructivist Theory can Resulting in academic achievement and problem solving skills to develop the better because Constructivist Theory is a model for learning activities by
- Students to focus on problems situations similar to real life.
- Solve through direct experience. Create self-knowledge and exchange ideas with others.
- Solving through teamwork and the interaction between friends and teachers.
- Learning an activity that encourages students to solve problems through their own thinking.
- Conduct various activities to promote problem solving skills.
- Encourage students to express comments or questions.


**Recommendations**

1) Teachers should use this instruction with other mathematics lesson such as solving decimal or percentage problem.

2) Teachers should use the learning activities based on Constructivist theory to study the comparison of high, medium and low ability students.

3) Teachers should study about the attitude of students to Constructivist instruction.

**References**


