



Using PBL with FILA Chart to Design Learning Activities on Fundamental Principle of Counting to Support Problem-Solving Skills

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Abstract

The key successful in mathematical problem solving is that students could employ problem-solving skills for performing in problem-solving process related to mathematical problems posed by instructors in a mathematics classroom. However, it is found that there are many students frustrated with using problem-solving skills in practice because thinking simultaneously with mathematics problems and procedures in solving them based on problem-solving skills seem to be abstract and very difficult for students. The purposes of this study are to develop learning activities using PBL with FILA chart as a scaffolding tool applied for supporting students to use problem-solving skills in performing with mathematics problems on Fundamental Principle of Counting step by step. To determine the effect of using learning activities using PBL with FILA chart on the levels of students' problem solving skills, three subjective tests about subject matter on Fundamental Principle of Counting are administered as posttest to student. The rubric score is employed to determine the level of students' problem solving skills through their performing in subjective tests. Data from rubric for evaluating student' problem solving skills is analyzed using descriptive statistics to find frequency of students identifying particular student' skill levels in problem solving for each of essential features of problem solving skills and to compute the mean skill levels in problem solving of students for each essential features. The results have verified the significant effects that learning activities using PBL with an effect FILA chart.

Keywords: FILA Chart, Problem Based Learning, Problem Solving, Problem Solving Skills, Fundamental Principle of Counting

Introduction

One crucial activity in mathematics learning is problem solving because it is an integral part of all mathematics learning. Instructional programs should enable all students to build new mathematical knowledge through problem solving, to solve problems that arise in mathematics and in other contexts, to apply and adapt a variety of appropriate strategies to solve problems, and to monitor and reflect on the process of mathematical problem solving (National Council of Teachers of Mathematics, 2000).

The key successful in mathematical problem solving is that students could employ problem-solving skills for performing in problem-solving process related to mathematical problems posed by instructors in a

mathematics classroom. However, it is found that there are many students frustrated with using problem-solving skills in practice because thinking simultaneously with mathematics problems and procedures in solving them based on problem-solving skills seem to be abstract and very difficult for students. By this reason, finding scaffolding tools to move all these abstracts into concrete process that could help students to successfully perform problem-solving skills becomes important learning design in mathematics classroom (Jozwiak, 2004; Mourtos, Okamoto, & Rhee, 2004; Sulong et al., 2007; Cote, et al., 2010). FILA chart as a scaffolding tool is applied for supporting students to use problem-solving skills in performing with mathematics problems step by step. By conforming procedures assigned

by FILA chart including component as follow; Fact (F), Ideas (I), Learning issues (L), and Action (A), students could write down their abstract thinking about problems and procedures on FILA chart that set steps as stage in training problem-solving skills for students in concrete from (Sulong et al., 2007; Manaf, Ishak, Hanafi, & Yassin, 2013; Peen & Arshad, 2013).

This study was designed to investigate the effect of using PBL with FILA chart to create learning activities

on Fundamental Principle of Counting. Each activity was designed to train student to perform procedures based on problem solving skills with mathematics problem related to subject matter about Fundamental Principle of Counting through assigning FILA chart construction. The results were wishful to be observed is that the evidence of problem solving skills from FILA chart and subjective tests.

Learning Design Using PBL with FILA Chart

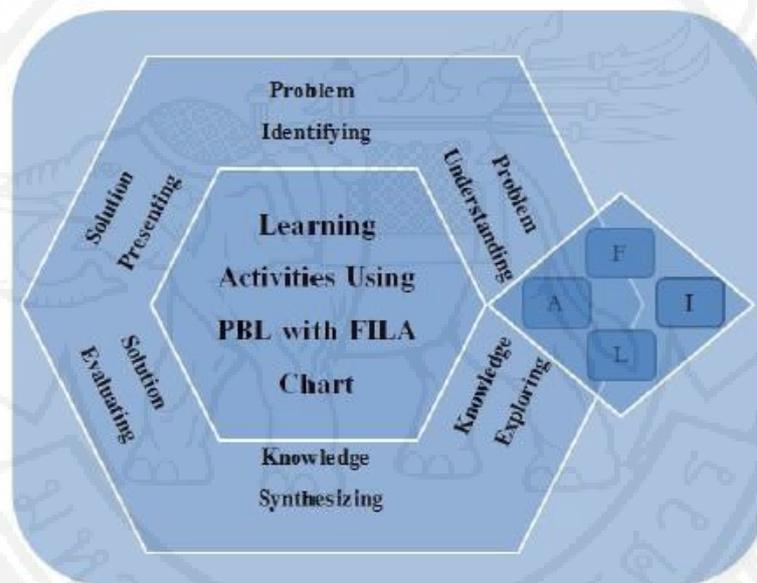


Figure 1 Key components for learning design using PBL with FILA chart

For the development of mathematics learning activities using PBL with FILA chart on Fundamental Principle of Counting, Six stages of Problem-Based Learning were applied from Hmelo-Silver (2004). FILA chart would be played as a scaffolding tool for support students to perform in the stage of Problem Understanding. All of stages could be summarized in Figure1 and could be given their details as follow;

Satge 1: Problem Identifying

When students encountered with problems situations related to subject matter on Fundamental Principle of

Counting, they were encouraged in brainstorming process with their group mate for identifying what the problems would like to know and recorded the specific goal of the problems on their work sheet.

Stage 2: Problem Understanding

When students had known what the problems needed, in this stage each group would work with FILA chart construction that assigned students to employ problem-solving skills to analyze problems situations and write details about problem situations on FILA chart followed by Fact (F), Ideas (I), Learning issues



(L), and Action plan (A) that could give scope of meaning in this four component as follows;

Fact (F): From problem situation, what was important information students received.

Ideas (I): From important information, what were important ideas emerged by students to be guidelines for finding answers to the problems.

Learning issues (L): From important ideas, students needed to explore more details of knowledge about all ideas.

Action plan (A): students employed what their knowledge plan to draft possible plan to solve problems.

Stage 3: Knowledge Exploring

When students had constructed FILA chart, they would use their FILA chart as a navigator to search for knowledge and procedure in their problem solving process.

Stage 4: Knowledge Synthesizing

Students were in problem solving process and formulated answers to the problems

Stage 5: Solution Evaluating

Students concluded and evaluated their solution.

Stage 6: Solution Presenting

Students presented their solution from solving problems

Methodology

Participants

This study was designed to investigate the effect of using PBL with FILA chart to create learning activities on Fundamental Principle of Counting. The subjects were 35 eleventh grade students from Phutthaisong school, Buriram Province, Thailand, in the academic year 2015.

Instruments

There were 3 lesson plans in content knowledge about Fundamental Principle of Counting. Each activity

was designed to support student not only to access contents knowledge about Fundamental Principle of Counting but also to perform problem solving skills through constructing FILA chart in process of problem solving. To investigate the effect of using learning activities based on PBL with FILA chart on the levels of students' problem solving skills, three subjective tests about subject matter on Fundamental Principle of Counting were created. The rubrics for scoring subjective tests based on essential features of problem solving skills related with Mourtos et al., 2004; Polya, 2014 were developed. In the rubric, each of the four essential features (understanding the problem, devising a plan, carrying out the plan, and looking back) was represented by four levels (emergent, developing, proficient and exemplary), each indicating a different level of achievement of that feature.

Procedures

A total of 35 eleventh grade students involved in this study were engaged in learning activities using PBL with FILA chart on Fundamental Principle of Counting. Three subjective tests about Fundamental Principle of Counting were administered as posttest to students. The rubric score was employed to determine the level of students' problem solving skills through their performing in subjective tests.

Data Analysis

Data from rubric for evaluating student' problem solving skills was analyzed using descriptive statistics to find frequency of students identifying particular student' skill levels in problem solving for each of essential features of problem solving skills and to compute the mean skill levels in problem solving of students for each essential features.

An Example of Learning Activity Using PBL with Fila Chart

Students were separated in 4 or 5 people per group by using equal ability criterion for each group. There

were eight groups to perform learning activities of each learning stage hereinafter.

Stage 1: Problem Identifying

Problem situation in the figure 2 would be posed for students to investigate.



Figure 2 Problem situation about the way that the boy dress up

Stage 2: Problem Understanding

By using group process, students in each group complete FILA chart given in the figure 3. Followed by this FILA chart, students would be assigned to employ

problem solving skills with problem situation in the following component of FILA chart including Fact (F), Ideas (I), Learning issues (L), and Action plan (A).

แผนจัดการแก้ปัญหา FILA Model	
 Fact (สถานการณ์ที่นักเรียนเจออยู่ อะไรบ้าง)	 Ideas (ความคิดเน้นเกี่ยวกับ สถานการณ์ปัญหา)
 Learning issues (ข้อมูลที่นักเรียนยังไม่ เข้าใจ)	 Action plans (แผนการรับมือกับ วิธีการแก้ปัญหา)

Figure 3 An example of mind mapping from student’s construction.

Figure 4 showed that students could identify important information and condition from problem situation and

write it on component F of FILA chart including number of shirts, pants, shoes.

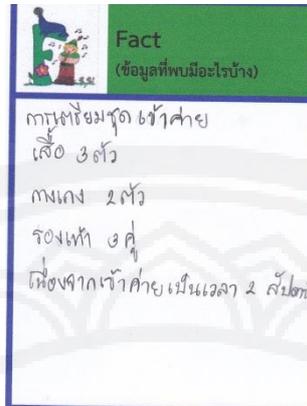


Figure 4 Students' FILA chart related with performing problem solving skill in problem identifying.

Figure 5 showed that students could formulate their possible ideas for finding solutions of the problems and gather them in component I of FILA chart.

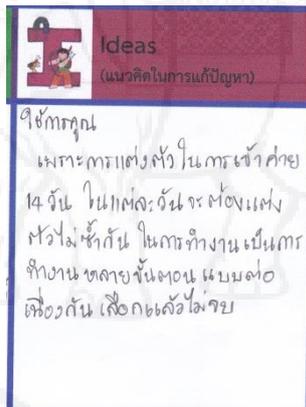


Figure 5 FILA chart of student' problem solving skill with formulating possible ideas for solving problems

Figure 6 showed that students could point out additional information needed to search for finding problem solution and students write this topic in the component L of FILA chart to investigate more details in Stage 3 (Knowledge Exploring).

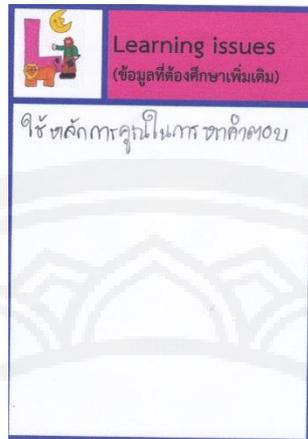


Figure 6 FILA of students' problem solving skill related with investigation of additional information for solving problems

Figure 7 showed that students could draft their possible plan in the component A of FILA chart for running continuously in problem solving process. They would use this information and additional knowledge

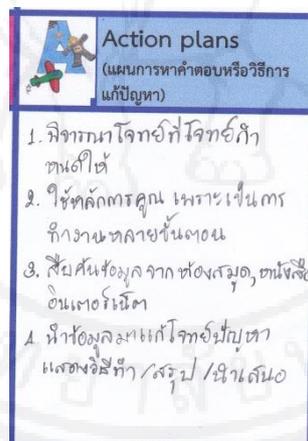


Figure 7 FILA chart of student' problem solving skill with possible procedures for solving problems

After finished with stage of constructing FILA, students would be led to the next stage of learning until in the Stage 6 that they would present their learning outcome and instructor would give additional information

from stage 3 (Knowledge Exploring) to synthesize important knowledge for formulating procedure for finding solutions of the problems in Stage 4 (Knowledge Synthesizing).

for completing conceptual knowledge. Some atmosphere of classroom learning in stage 6 (Solution Presenting) was depicted in figure 8.

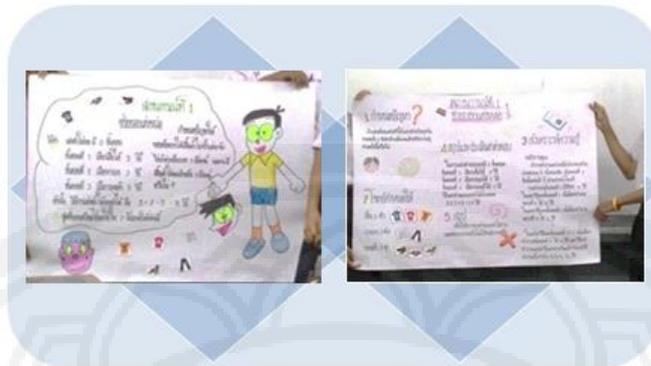


Figure 8 Some atmosphere in classroom of learning activity in solution presenting

Problem-Solving Skills from Learning Based on PBL with Fila Chart

accomplish problem solving would be determined by three subjective tests after the instructional sequence had been finished.

The observation of students' learning outcome from the support of learning activities on their skills to

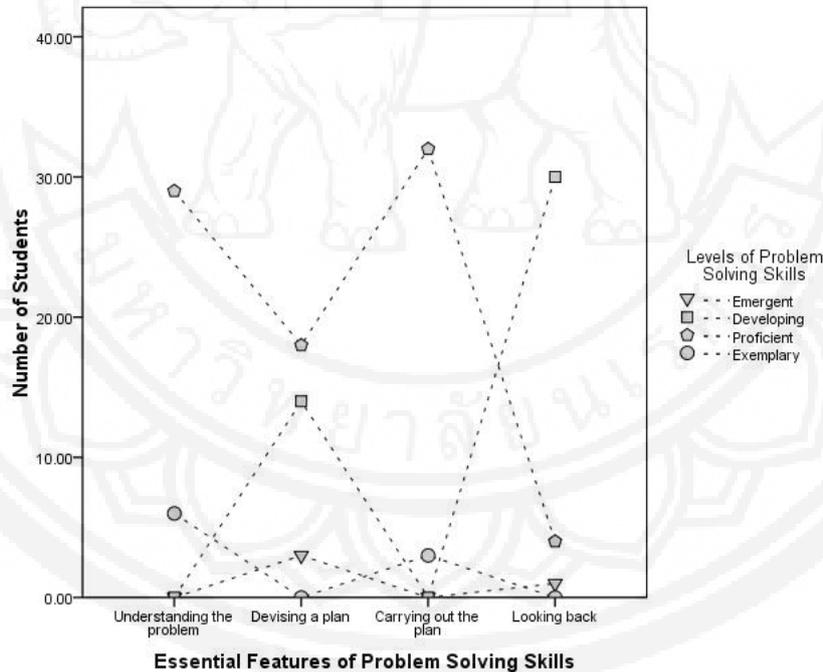


Figure 9 The number of students at each skill level for each essential feature of problem solving skills from subjective test 1

From performing subjective test 1, figure 9 shows the number of students that reached each skill level for each essential feature of problem solving skills. It can

be seen that learning activities using PBL with FILA raised the skill level in understanding the problem of many students to between proficient and exemplary,

raised the skill level in devising a plan of many students to between developing and proficient, raised the skill level in carrying out the plan of many students to between proficient and exemplary, and raised the skill level in looking back of many students to between developing and proficient.

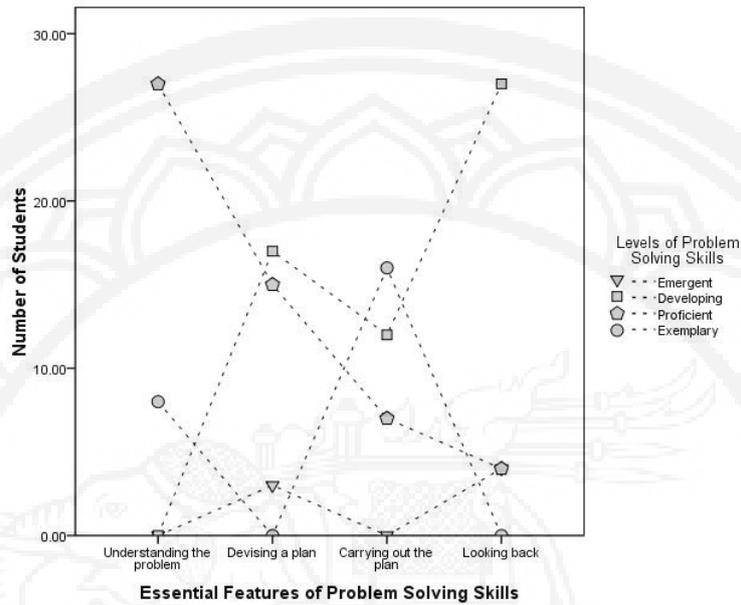


Figure 10 The number of students at each skill level for each essential feature of problem solving skills from subjective test 2

From performing subjective test 2, figure 10 shows the number of students that reached each skill level for each essential feature of problem solving skills. It can be seen that learning activities using PBL with FILA raised the skill level in understanding the problem of many students to between proficient and exemplary, raised the skill level in devising a plan of many students to between developing and proficient, raised the skill level in carrying out the plan of many students to between developing and exemplary, and raised the skill level in looking back of many students to between developing and proficient.

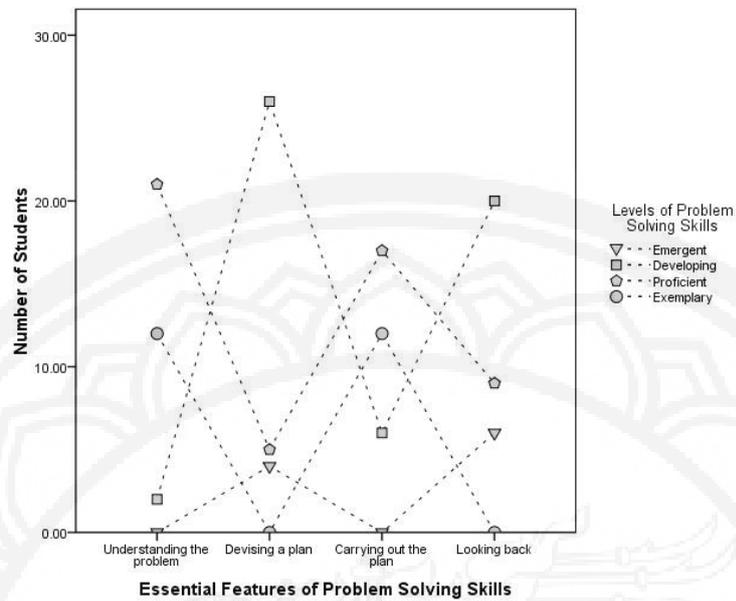


Figure 11 The number of students at each skill level for each essential feature of problem solving skills from subjective test 3

From performing subjective test 3, figure 11 shows the number of students that reached each skill level for each essential feature of problem solving skills. It can be seen that learning activities using PBL with FILA raised the skill level in understanding the problem of many students to between proficient and exemplary,

raised the skill level in devising a plan of many students to between developing and proficient, raised the skill level in carrying out the plan of many students to between proficient and exemplary, and raised the skill level in looking back of many students to between developing and proficient.

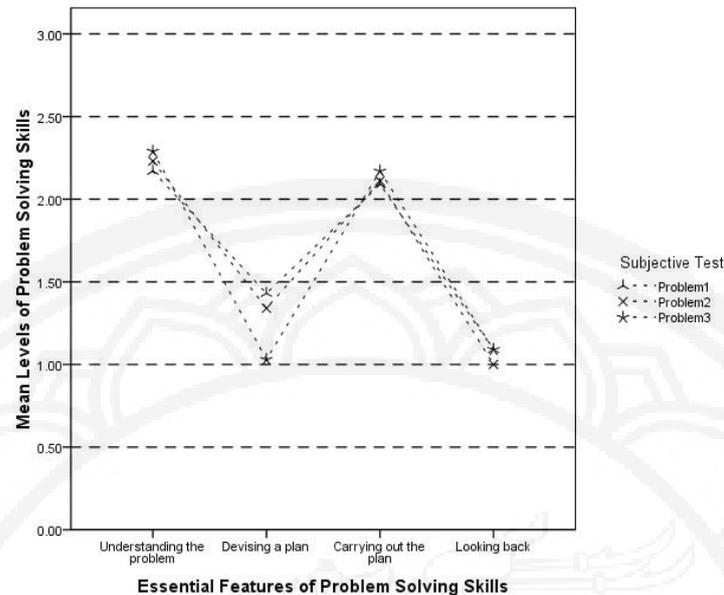


Figure 12 The mean score for skill levels of students for each essential feature of problem solving skills from performing in three subjective tests

From performing all subjective tests, figure 1 2 present the mean skill level of students for each essential feature of problem solving skills to indicate the tendency of students' skill levels in problem solving. It can be seen obviously that learning activities using PBL with FILA have an effect on problem solving skills in understanding the problem of students in proficient, problem solving skills in devising a plan of students in developing, problem solving skills in carrying out the plan of students in proficient, and problem solving skills in looking back of students in developing.

Summary

Concerning our study goals, the attempt to explore the supportive use of learning activities using PBL with FILA chart on the student's skill level in problem solving, we had verified the significant effect that learning activities using PBL with FILA chart had an effect on students' problem solving skills. Students could acquire all topics on Fundamental Principle of

Counting through problem solving process. Students supported each other when encountered with problems by resolving process. In working groups with constructing FILA chart, they collaborated to identify problems, helped each other search information for solution, and made a discussion to reach conclusion. Thus, learning activities using PBL with FILA not only encouraged students to learn content knowledge on Fundamental Principle of Counting but also supported them to practice problem solving skills. In conclusions, the results we have created satisfy the results in Sulong et al., 2007; Manaf et al., 2013; Peen and Arshad, 2013. In other words, FILA is efficient and significant solving problems in order to reduce abstract procedures in PBL.

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