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Teachers' Learning in Community of Implementing Mathematics Textbooks with Lesson Study and Open Approach

Chanika Senawongsa[1], Maitree Inprasitha[2], Anake Sudejamnong[3]

[1]Doctoral Program in Mathematics Education, Faculty of Education, Khon Kaen University, Khon Kaen, Thailand
[2]Center for Research in Mathematics Education, Faculty of Education, Khon Kaen University, Khon Kaen, Thailand
[3]Mathematics and Statistics Program, Faculty of Science and Technology, Suratthani Rajabhat University, Suratthani, Thailand
Email: chanika_s@kkumail.com, inprasitha_crme@kku.ac.th, sud_anake@hotmail.com

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Abstract

This research aims to analyze how and what teachers learn in community of implementing mathematics textbooks with Lesson Study and Open Approach about addition in number and operations for first grade. The participants were 2 teachers who use the textbook in the classroom using Lesson Study and Open Approach. The mathematics textbooks for this study were Japanese mathematics textbooks (Thai version), and consist of mathematics activities, flow of lesson, and students' mathematical ideas (Inprasitha, 2015b). The data were collected in October 2015 by interview and classroom observation with video recording. The data were analyzed based on communities of practice (CoP) from Wenger, McDermott, & Snyder (2002), and Shulman & Shulman (2004). The result of this research found that how and what teachers learned in community of implementing mathematics textbooks with Lesson Study and Open Approach, are 2 aspects: 1) teachers learned about the content of mathematics from their sharing on the textbook and students' ideas together, and 2) teachers learned how to teach the content, through using the textbook for sharing anticipating students' ideas, observing students' ideas, and reflecting by using evidence from students' ideas that appeared in classroom.

Keywords

Teachers' Learning, Community of Practice, Mathematics Textbook, Lesson Study and Open Approach

1. Introduction

Development of curriculum and instruction in Thailand has been separate, re-

flecting on the problems of system relation and curriculum and instruction development. As the Committee on Education and Sports, The National Legislative Assembly (2015) and Inprasitha (2015a) said that the curriculum and teaching are the same but perform at different levels. When considering the composition and the relationship between each level, there is some improving about curriculum and textbooks, but there is a lack of clear guidance or the process of developing knowledge and understanding for teachers, as their role is textbooks user and has the primary responsibility for teaching and learning in the classroom.

Before entering the 21st Century, the professional development relies on short-term teacher training, that aims to let teachers can learn new knowledge or teaching techniques, to escape from their classroom. And when teachers practice in their own classroom, they use it alone in designing a lesson plan, teaching in a classroom (Inprasitha, 2015c). Therefore, teacher professional development must include both guidelines and communities for teachers to learn by designing a lesson plan, teaching and observing students, and reflecting together (Inprasitha, 2015c; Takahashi, 2015). One of the methods originated from Japan for more than 140 years and has been adapted in Thailand for more than 10 years, namely Lesson Study.

In 2002, Inprasitha (2011, 2015c) has adapted Lesson Study as education innovation which is a professional development of teachers in Japan by preparing the necessary context for teacher. He has prepared a context for teachers to come together every week for designing lesson plan, observing classroom and reflecting after teaching. Open Approach as a teaching method that focuses on solving problem, and incorporating in the process of Lesson Study, by starting the teacher to pose the problem situation, giving students the opportunity to solve the problem by their own, then sharing the idea from solving the problem, and summarizing from linking the concepts of students.

The first step of Lesson Study is collaboratively designing a lesson plan. In this step, lesson study team has to create mathematics problems, and material which is used in the classroom and anticipates students' ideas. Inprasitha (Inprasitha, Pattanajak, & Inprasitha, 2011; Plianram & Inprasitha, 2012) used Japanese mathematics textbooks as an important tool for designing mathematics problems, materials, questions of teachers, as well as anticipations of students' ideas that will occur in the classroom, and be adapted to suiting with Thai classroom instead of the Thai mathematics textbook, which cannot guide to designing mathematics problems.

Adjusting the way teachers work is to work together. Classrooms are used as learning area to understand students' concepts in order to develop the thinking processes and learning processes of the learners, and mathematics textbooks used as a guideline regularly, that make "Community of Practice" (Wenger, McDermott, & Snyder, 2002) that teachers come to learn together. As Inprasitha (2017b) state that the classroom is the basic unit in a community of practice and results in a larger professional learning community to learn together.

Communities of Practice (Wenger, McDermott, & Snyder, 2002) are groups of people who are interested in the same knowledge group together to solve problems or develop that knowledge. The key to consider learning from common practice is reflection of results (Shulman & Shulman, 2004).

Therefore, we tried to analyze the learning of teachers in the community of implementing mathematics textbooks and following Lesson Study and Open Approach in accordance with the framework of Inprasitha (2011, 2015b, 2017b) and use the theoretical framework "Communities of Practice (CoP)" by Wenger, McDermott, & Snyder (2002) and the conceptual framework of Shulman, L. & Shulman, J. (2004) to obtain an analysis unit for teachers' learning in community of implementing mathematics textbooks with Lesson Study and Open Approach.

2. Community of Lesson Study and Open Approach

"Lesson Study" is very important method of professional development for teachers and was originally introduced to Japan more than 140 years ago (Shimizu & Chino, 2015). The method popularized in many countries around the world by Stigler & Hiebert's book, The Teaching Gap in 1999. In the US, Lewis (2015) had been implemented the method as "Research Lesson" since 1993.

In Thailand, Inprasitha (2015c) adapted the Lesson Study and Open Approach since 2002, that focused on improving students' learning by using the classroom, and teachers' learning to understand their students together. So, the Lesson Study was named in Thai as "Classroom Study".

The process of Lesson Study that has 3 steps as,

1) collaboratively plan—a teacher and LS team collaboratively design the problem situation, anticipate students' ideas and how to manage the ideas;

2) collaboratively do—a teacher teach the lesson by using the Open Approach and observe students' ideas in the classroom with LS team;

3) collaboratively see—a teacher and LS team collaboratively reflect and share the students' ideas that appeared in the classroom.

In 2006, The Open Approach was incorporated in the process of Lesson Study for improving the teaching approach in weekly (Inprasitha & Isoda, 2010; Inprasitha, Pattanajak, & Inprasitha, 2011; Inprasitha, 2015c, 2017b) as **Figure 1**.

The Open Approach (Inprasitha & Isoda, 2010; Inprasitha, Pattanajak, & Inprasitha, 2011; Inprasitha, 2015c, 2017b) has 4 steps as;

1) teacher pose the problem situation;

2) teacher observe student's ideas while students solve the problem by themselves;

3) teacher and students discuss and compare the ideas together, and support students to explain their ideas;

4) teacher and students summarize through connecting the ideas to conclusion together.

In 2006, the first project on Lesson Study and Open Approach, Inprasitha started with 4 schools located in Khon Kaen province, the north-eastern part of Thailand. In 2009, there are 22 schools located in the north-eastern and northern parts of Thailand. In 2013-present, there are more than 120 project schools

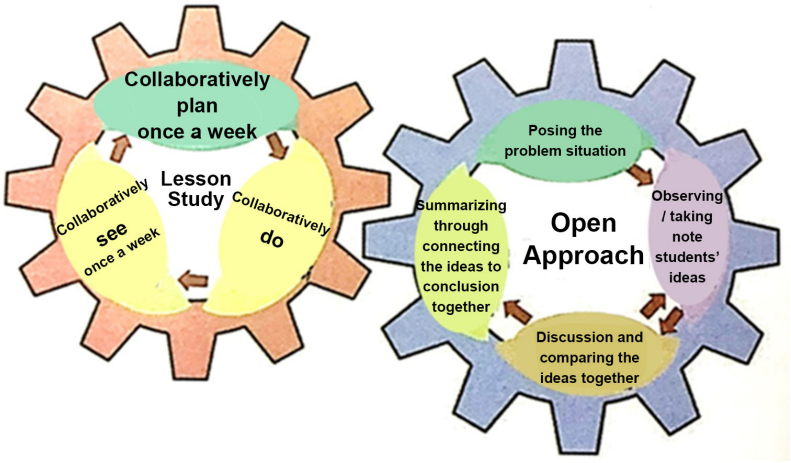

Figure 1. The weekly cycle of lesson study and open approach by Inprasitha, Pattanajak, & Inprasitha (2011) and Inprasitha (2015c, 2017b).

and 20 universities. Each school of the project on Lesson Study and Open Approach was formed a community, LS team, consisting of school principal, teachers, and teacher students.

Wenger, McDermott & Snyder (2002) defined "communities of practice" as are groups of people who share a concern, a set of problems, and who deepen their knowledge and expertise in this area by interacting ongoing basis. As the definition we defined the community of implementing mathematics textbooks with Lesson Study and Open Approach as are groups of people who interested in knowledge of students' ideas and improved the knowledge by using the textbooks to design the lesson and anticipate students' ideas, teach the lesson and observe students' ideas, and reflect on the lesson and students' ideas.

Inprasitha (2017b) forms various of activities for keeping in touch the communities. For example, the open class in school, the national open class, the workshop for teachers, and so on. All of activities, there is a demonstrate classroom as a learning together area for the participants.

3. Implementing Textbook

According to the process of Lesson Study and Open Approach, teachers need to design problem situations that appropriated to provide students' opportunities to learn and solve the problem by themselves, and they need to anticipate students' ideas (Inprasitha, Pattanajak, & Inprasitha, 2011). Consequently, they need a tool that could be supported and guided the problem and how students' thinking, such as mathematics textbooks.

Mathematics textbooks and their guidelines for school level were used in almost Thai schools that were created by the Institute for Promotion of Teaching Science and Technology assigned by the Commission on Basic Education. Inprasitha, 1997; Inprasitha, Pattanajak, & Inprasitha, 2011 analyzed the problem solving in Thai mathematics textbooks for first to ninth grade level. He found that the characteristics of textbooks especially for elementary school level are as

follows: almost of the exercises and word problems contain routine exercises for drilling computational skills, require the students to write symbolic sentence before solving the problem, and have one and only one correct answer.

Inprasitha (2015c) and Changsri (2015) noted that teachers' using of textbooks that consists of mainly routine exercises, may be the cause of poor performance of Thai students in mathematics.

As the limitation of Thai mathematics textbooks were a barrier for helping teachers to conduct the first stage. Therefore, in 2005, Inprasitha introduced Japanese mathematics textbooks to support the teachers.

Inprasitha, Pattanajak, & Inprasitha (2011) showed the characteristics of Japanese mathematics textbooks in dimension of mathematics contents, exercises, mathematical terms, and other. Firstly, mathematics contents in the textbooks were represented as mathematics activities that carry out by problem solving approach. And they guided students' mathematical ideas that important for teachers to anticipate and observe their students' thinking. Secondly, almost of exercises in the textbooks aims to check students' understanding more than repeatedly practice. And mathematical terms were nearly students' natural language.

Although the quality of textbooks has increased, and most teachers used the textbook as the basic instructional material, there are still a variety of constraints that have yet to be overcome. Different ways in using the textbook are important to students' learning. Thus, how well textbooks can support students' learning depends heavily on professional knowledge of teachers who use the textbooks to teach those students (Shimizu & Watanabe, 2010; Takahashi, 2010).

Plianram & Inprasitha (2012) showed the difference on approach to use Thai and Japanese mathematics textbooks between Thai teachers before and during attend the project. After they attend the project, they more examine the textbook with a "critical eye" to decide what and how to teach, and more created problems and questions to stimulate students' ideas.

Inprasitha (2015b) has defined how to use the new mathematics textbook that focus on problem solving as follows: 1) what are the mathematics contents in this lesson? 2) what are the students' real world in this lesson? 3) what is the purpose is hidden in the lesson? 4) what are students' ideas along with the reasons in this lesson? and 5) what are flow of lesson that encourages students to solve problems by themselves in this lesson? Those suggestions for implementing the textbook can proceed with the process of Lesson Study and Open Approach as **Figure 2**, formed a community of implementing mathematics textbooks with Lesson Study and Open Approach.

4. Teachers' Learning

The community of implementing mathematics textbooks with Lesson Study and Open Approach provides teachers with opportunities to work collaboratively to plan, teach, observe, and reflect on a lesson by using the textbook as a guideline,

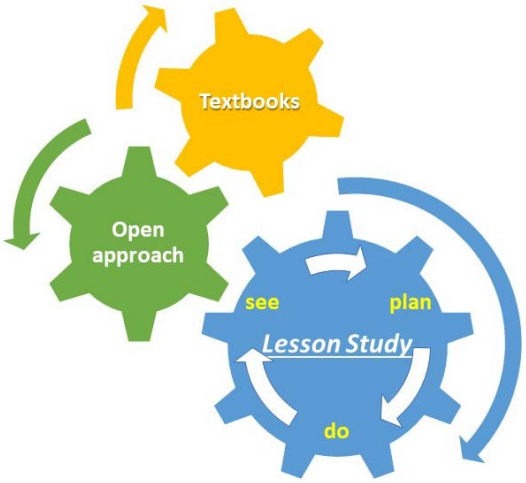

Figure 2. Implementing mathematics textbooks with lesson study and open approach by the approach of Inprasitha (2015c, 2017b).

that support teachers' learning (Inprasitha, 2017b; Murata et al., 2004; Takahashi, 2015).

The process of reflection is the key to teacher learning and development as Shulman & Shulman (2004) state. Because they can learn from their own and one another's experience. So, what could be learned from their experience is important to reveal. We were focused on reflection of the teachers about the students' ideas by experiencing in implementing mathematics textbooks with Lesson Study and Open Approach.

5. Methodology

This research analyzes two cases of teachers who participated in the projects and has experience from using mathematics textbooks, Lesson Study and Open Approach. The case 1 was a newcomer in the community and the case 2 was an expert teacher with experience in using mathematics textbooks, Lesson Study and Open Approach more than 10 years. In October 2015, they participated in a workshop on the use of mathematics textbooks, Lesson Study and Open Approach in Chiang Rai province.

This workshop is a part of the Students' Mathematical Higher Thinking Development Project in Northeastern of Thailand under Center for Research in Mathematics Education (CRME) and Institute for Research and Development in Teaching Profession for ASEAN, Khon Kaen University.

There were 150 participants, including teachers, school principals and experts. On the first day of the training was a special lecture by experts on "How to use a new mathematics textbook that focused on problem solving with Lesson Study and Open Approach". Later, participants designed lesson plan together by using Mathematics textbooks. All participants were divided to 2 teams of Lesson Study for designing Lesson plan about "addition with answer more than 10" in first

grade. Next day, bringing those lesson plans to teach in classroom by reprehensive teacher of each team. After that, they gave reflection together.

In the workshop, they used mathematics textbooks on pages 77 - 78 for discussion as **Figure 3**. It provides some guideline for teachers to design the lesson such as student's real world, mathematics problems, flow of lesson, and students' mathematical ideas (Inprasitha, 2015b).

Data collected include videotapes of planning, of classroom, and of reflections, audiotapes of teachers' interviews, lesson plans, fieldnotes, and student work. Data analysis method based on Wenger, McDermott, & Snyder (2002)'s framework for describes the community that teachers' participating and based on Shulman, L. & Shulman, J. (2004)'s framework for describes what teachers learned in the community.

6. Results

The results showed that how and what the teachers learned in community of implementing mathematics textbooks with Lesson Study and Open Approach, who designed lesson plan together in first grade about addition with answer more than 10.

There is 2 lesson study team: for case 1, the teacher participated as a classroom teacher in lesson study team include teachers (who work in different schools), school principal, expert teacher and experts. For case 2, the teacher participating as an expert teacher in lesson study team includes teachers (who work in different schools), school principal, and experts.

The 2 teams designed their lesson plan by analyzing mathematics textbooks, follow by Inprasitha (2015b)'s suggestion. Then the teachers were the representatives

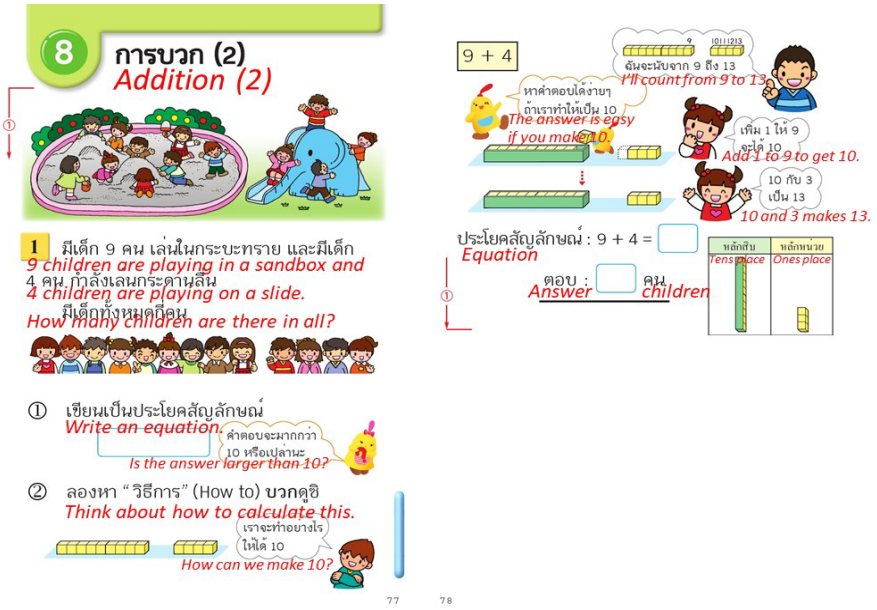

Figure 3. Example of addition for first grade in Japanese mathematics textbook (Thai version), pp. 77-78.

of their group, taught in the classroom, from this practice show that what teachers learned about students' ideas from community of implementing mathematics textbooks with lesson study and open approach in two aspects.

6.1. Teachers Have Learned about Mathematics Content from Students' Ideas

Analyzing this data since lesson study team designed lesson plans together, taught in the classroom and reflected together, found that while they were designing lesson plans together, the teachers analyzed mathematics content, is "Addition that answers with no more than 20" and "Addition that answers that exceed 10, more than 10" and when they anticipated students "ideas and observed students" ideas that occur in the classroom, found that teacher learned mathematics content from students' ideas such as meaning of addition, and addition using the comparing size of the equations and the decimal system, as the following evidence.

1) The meaning of addition

For case 1, the teacher learned about the meaning of addition, that the teacher analyzed from the textbook, this situation is a combined or incremental addition. Which group of case 1 and group of case 2 seen as addition, or any combination, by anticipating students' ideas that "bring children together two groups" "Count the number of boys and count the number of girls together" and "4 children who play the slide board come to play in the sandbox 9 people because the kids want to play both".

And from the following dialog examples

Teacher: "*Another combined addition is added. The situation has already been added.*"
Expert: "*Just the magnetic slide, the situation is combined, add or remove.*"
Teacher: "*Can be added*"
Case 1: "*Can be added in two forms*"

2) Addition using the comparing size of the equations with the decimal system

The teacher learned about addition by using the comparing size of the equations and the decimal system, which the teacher analyzed from the textbooks and suggestions from the experts in the analysis of textbooks that anticipating students' ideas, teachers thought that this method will not happen. Later, experts suggested using questions from the textbook. By asking students "9 + 4 more than 10?", teachers anticipated that children can answer more than because the answer is 13.

When teacher taught in classroom, teacher asked such questions with students, and found that there were students who answered 9 + 4 more than 10 and 9 + 4 less than 10. Teachers allowed students to use the block to explain their ideas more. There were 2 ideas in their classroom such as students' idea (1) and students' idea (2).

By students' idea (1) from **Figure 4** shows the sequence of using the blocks to

describe their ideas, by starting with the students use the blocks instead of the number of children who play the sandbox 9 pieces and instead of the number of students who play slides 4 pieces, then pick 1 piece from the block instead of the number of students who play the slide is 10 and 3.

Students' idea (2) from Figure 4 shows the sequence of using the blocks to describe the ideas. Start with the students using the blocks instead of the number of children who play the sandbox 9 pieces and instead of the number of students who play slides 4 pieces, then moving both blocks together, and then spliting the blocks into 10 and 3.

From both ideas, the positive concept is used by comparing the size of 9 + 4 to the decimal system, which is a concept that teachers do not expect to happen in this classroom.

6.2. Teachers Have Learned How to Teach the Content

From the analysis of data, it was found that teachers reflected on issues related to teaching methods from anticipating students' ideas and observing actual students' ideas, such as

1) Starting from the real world of students and problem situations

At the step of designing lesson plan, teachers are in teacher A's team analyzed the real world of students from the textbook that "There are 9 children playing in the sandbox and there are 4 children with a slide board. How many children are there in the playground?". Experts have reflected the connection from the real world of the students to the situation. The problem in the class is when starting teaching in the classroom. Teacher A told the story before starting the situation. "Teachers have come to school during school holidays and meet children. Come to play at the school playground". Before starting to add pictures to the playground enable students to access the playground image.

2) Management of students' ideas by using Open Approach

Results in teachers anticipating the ideas of students, include considering the use of teaching materials to explain students' ideas in this classroom. Teachers reflected that giving students time to solve problems on their own and saw the ideas of the students that occurred by teacher did not tell the solution and using blocks in this classroom. Teacher A has never been used before. But when they were planning together with the lesson study team and teach in the classroom, make they saw the importance of the blocks that allowed teachers and students in the classroom to understand students' ideas as shown in Figure 4.

7. Conclusion and Discussion

From the research results, it was found that how and what teachers learned in community of implementing Mathematics Textbooks with Lesson Study and Open Approach, are 2 aspects: 1) teachers learned about the content of mathematics and 2) teachers learned how to teach the content, through using the textbook

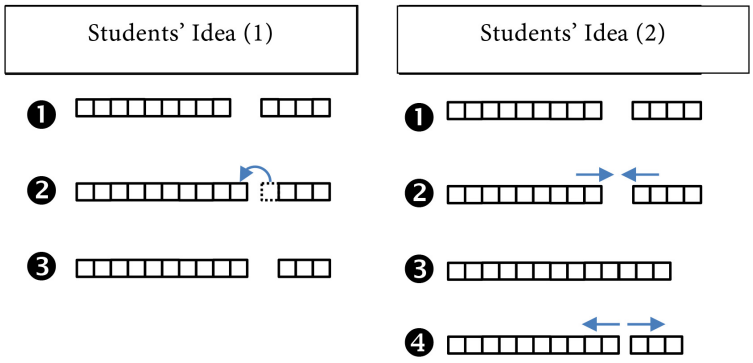

Figure 4. Example of students' ideas that appeared in the classroom's teacher A.

for sharing anticipating students' ideas, observing students' ideas, and reflecting by using evidence from students' ideas that appeared in classroom.

Besides, classroom makes students learn, and then teacher learn students' ideas as well. The students' ideas are part of School Mathematics, according to Inprasitha (2016, 2017a, 2018) who said that School Mathematics is the basic mathematics, that is viewed from the position of advanced mathematics under the context of teaching and learning at the school. There are 4 important contexts about learning and teaching: first context is "Context that considers students' ideas, must be mathematics that have meaning to students in their real life". From this research, it can be seen that the former teacher considered the mathematical content according to the topic, that they was familiar with in the textbook, formerly "adding the number of results not more than 20 (Ministry of Education, 2011)". When they analyzed mathematics textbooks and participated in community of practice, they found that mathematics content relates to students' ideas.

Next context, Inprasitha (2016, 2017a) suggests the context in considering and integrating "Contents" and "Pedagogy", such as knowledge in integrating teaching that is appropriate to the extent Pedagogical Content Knowledge (PCK). The old method of teaching content in grade 1st is telling the method and doing exercises to tell them how, as shown in the Thai Mathematics textbook (Inprasitha, 2015c); for example, "adding the number that results in no more than 20" in the Thai textbook would begin to teach students how to add ten followed by exercises as **Figure 5**.

But considering the research results, teachers learn how to teach from community of implementing mathematics textbooks with Lesson Study and Open Approach. That must start with the problem situation that comes from the real world of students, gives students the opportunity to solve that problem on their own and observes the students' ideas that are in line with the addition method with which students have found themselves, such as asking questions of teachers about addition by using the method of comparing the size of symbolic symbols with the decimal system "9 + 4 more than 10", which makes teachers learn students' ideas and how to deal with students' ideas.

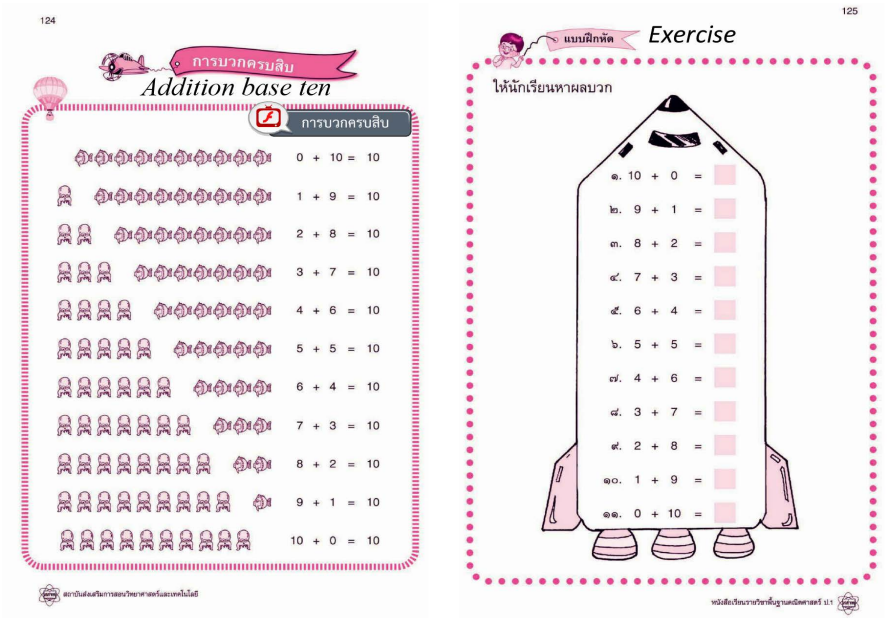

Figure 5. Example of addition for first grade in Thai mathematics textbook (Ministry of Education, 2011), pp. 124-125.

8. Limitations/Future Research

According to this research aims to analyze how and what teachers learn in community of implementing mathematics textbooks with Lesson Study and Open Approach. The limitations are many points, such as a small of participants, the contents focused only on addition. So, we suggested to improve this research, such as more teachers, and difference contents in the future research. For example, this study we focus on limit of the participants that impact to the result, for the future study should concern about number of participants and various of their experience.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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