The innovative lesson study for enhancing students’ mathematical ideas about addition and subtraction through open approach

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Abstract. The paper aimed to clarify the innovative lesson study learning activities of “how many and how many”. The activities provided concept of mathematical addition which were developed through open approach. The development of initiative the innovative lesson study learning activities on mathematical addition was processed based on Lesson Study. Methodology regarded interpretive paradigm. The understanding of innovative learning activities was developed through the activity of lesson study. The tools of interpretation included participant observation, reflection of lesson study teachers, and developing lesson plan document. Through this process, the learning activities could be clarified in this paper. The highlight of learning of activities included 1) making 5 and 6 from the Opaque and translucent double slit box (OTD box), 2) making 7 from playing 2 dices for 7 times, and 3) Making ten from the two slits box. The paper will discuss more about these three activities. These activities may have implications to mathematical teaching through open approach for primary school students.

Keywords: mathematics, addition, subtraction, lesson study, open approach

1. Introduction
Preschoolers have different experiences with numbers, they learn through play, other children and adults. Children usually has experiences about counting and subtilizing through social interaction. This could be assumed that they have already learned some ideas involving addition and subtraction [1]. Young children may make sense of solving additions and substractions when they will communicate by counting amount of something in totally or how many something left [2]. Literatures revealed that 3-4 years old children could be able to compare the amounts in groups by their counting skills. Older preschool students could solve real world addition and subtraction problems. They understood the part-whole relationships and partition groups into subgroups of equal size [3]. They also learn about addition when they play about collections of something because the collection allowed them to construct meaning of adding something more and taking away something out [4].
Regarding on literatures about how young children making sense addition and substraction in everyday life, teachers were suggested how to develop mathematics learning activities to enhance constructing meaning based on their existing ideas. The mathematics instruction may provide children chances to investigate their ways for construction of rules and procedures of addition and substraction. Teachers may provide some scaffolding for students as they work collaboratively to make sense of mathematics through meaningful tasks [4][5][6][7].

Meaningful tasks or activities of develop possible solutions about real life experiences of counting and collection could be provided through play, discovery, and exploration in natural environments. These activities will help young children to connect real life experiences to mathematics concepts. Then, young children probably is exciting and love to learn mathematics through playing or doing some activities related to their contexts. They also are challenged to learn mathematics with more drills and practices in counting and adding [8].

In practical terms, first grade students (e.g. in Vietnam) officially study in formal program about numbers, addition and subtraction. Natural numbers from 1 to 5 taught is an finite aggregate, and teachers help students get acquainted with relational operator (“less than”, “greater than” or “equal”) by using one to one correspondence. Natural numbers from 6 to 9 is introduced in form of an finite aggregate adding one element of the number (for example: adding 1 flower to the set of 5 flowers to have 6 flowers), and comparing in between numbers from 1 to 9. Next is the introduction of number zero and ten. Addition in the number range 3, 4 and 5 is taught by combining two parts to make a whole (part-part-whole model). Subtraction in the number range 3, 4 and 5 is taught by taking away one given part (direct substraction strategy). Then, students are learned addition and substraction in the number range from 6 to 10, and extended it in the number range 20 and 100. In brief, at the beginning, addition and substraction is taught by counting the number in a finite aggregate after adding or taking away elements of it. After that, substraction can perform through addition. Nevertheless, first grade students have different experiences about operations through play activities, playing with friends and variety ways to give guidance by adult from the previous period. For instance, with a math problem: 9 – 3=?, students can do substraction directly, or explain why 9 – 3 =6 (because 6 +3=9), or use count down method (counting down to him/her self or using fingers) to count from bigger number down to smaller one to calculate a right result (there are 3 ways in total) [9][10].

Vision of mathematics teaching and learning in Thailand considered on life long learning. Thailand curriculum mentioned the constructivist paradigm of learning as reference. Goals of mathematics learning, therefore, were provided regarding on individual make sense of mathematics concepts. The mathematics learning activities should enhance students to interact to their whole environment and to apply learning methods to their daily life [11][12][13]. Mathematics literacy also should be recognized as core students’ competency. Mathematics learning in real world problem, then, should be provided by earlier students’ learning. The mathematics problem should enhance students to learn mathematics related to their context and to develop their divergent thinking on problem solving. The literatures suggested that the mathematics problem should not be provided as a closed problem. Instead, the mathematics problems should be provided as open-ended problems in order to challenge and foster students to hold divergent thinking and reasoning for constructing their own concrete and informal problem solution strategies. The open-ended problems will bring the new contexts of mathematics to allow students to positively and actively learn. The use of open-ended problems is another issue of provide learning environment for constructing mathematical knowledge [14][15]. In Thailand, mathematics open-ended problems were introduced by Maitree Inprasitha as open approach which was initially implemented in Thailand mathematics classroom in 2002. And, he suggested that development of mathematics learning activities based on open approach should be developed through the lesson study [17][18][19][20].

The lesson study enhanced teachers to find the appropriate ways of teaching mathematical ideas based on open approach. The literatures suggested that the most effective place to improve teaching is in the context of a classroom lesson. The lesson study may allow us to design and delivery of one mathematics lesson of mathematical ideas on addition through open approach [21].
The lesson study is collaborative planning of a research lesson because teachers have to build a small group (4-6 teachers) of teachers who teach students in same level and/or content. Then, they need to begin to design the lesson together. After the lesson is designed, a teacher from the group will teach the lesson. And, the rest of group members will observe and collect data about the lesson process. The data collection may focus on students’ learning for the specific topic taught, and variety of students’ issues of learning. Then, each member of group will reflect his or her interpretation of classroom data collection to the group as individual reflections. Based on these reflection, the group have to review and revise the lesson for the next teaching. And then, another group member will teach the revised version of lesson plan to another class of students. And, the group may keep doing classroom observation and interpreting data for giving reflection for further refinement [22]. To suggest teachers going on culture of lesson study, many educators provided the cycle of lesson study. One of those is about the cycle of plan, do, and see. Inprasitha [20] suggested that lesson study in Thai school could be implemented for 3 simple steps. These included collaboratively designing research lesson (Plan), collaboratively observing their a group member teaching the research lesson (Do) and collaboratively doing post-discussion or reflection on teaching practice (See).

Regarding on literatures and experiences on lesson study, it would be challenged for mathematics teachers if we wish to develop learning activities through the open-ended mathematics problem about mathematical ideas on addition and subtraction through open approach for young children (Grade 1 students). The lesson study may support our group to find the appropriate ways of teaching mathematical ideas on addition and subtraction through open approach in children contexts.

2. Methodology
Methodology regarded interpretive paradigm. The understanding of innovative learning activities was developed through the activity of lesson study. The tools of interpretation included participant observation, reflection of lesson study teachers, and developing lesson plan document.

Method of inquiry
The development of initiative the innovative lesson study learning activities on mathematical addition and subtraction was processed based on Lesson Study. To process, school setting included 72 Grade 1 Thai students’ learning about mathematical ideas on addition and subtraction through open approach. Based on lesson study, teachers discussed how to enhance students’ mathematical ideas on addition and subtraction through open approach. Teachers began to raise the real world problems that related to students’ context of addition and subtraction. Teachers selected some real world problems which could align to Thailand mathematics curriculum. One of the teachers agreed to present the lesson based upon the lesson plan made cooperatively with his or her colleagues. The rest of member group teachers played their role as active observers to notes on what happened in the classroom. All of the teachers then met again as a group for analysis, criticism and evaluation of the lesson plan in order to examine the appropriateness of teacher’s performance, materials used and problems involved in enhancing students’ learning about mathematical ideas on addition and subtraction. Finally, teachers discussed necessary revisions to the lesson plan based on their observations and reflections. Throgh the lesson study, the innovative learning activities, then, will be categorized.

3. Findings
Through the process of lesson study, the innovative lesson study learning activities of “how many? and how many?” was developed. The innovative learning activities could be clarified in this paper. The highlight of learning of activities included 1) making 5 and 6 from the Opaque and translucent double slit box (OTD box), 2) making 7 from playing 2 dices for 7 times, and 3) Making ten from the two slits box.
3.1 Making 5 and 6 from the Opaque and translucent double slit box (OTD box).
This Opaque and translucent double slit box (OTD box)
The OTD box allow students to find several ways to
“make five”: (0 and 5, 5 and 0, 4 and 1, 1 and 4, 3 and 2, 2 and 3)
and make six (0 and 6, 0 and 6, 6 and 0, 5 and 1, 1 and 5, 4 and 2, 2 and 4, 3 and 3).

3.2 Making 7 from playing 2 dices
This activity will provide students’ ideas of making 7 through playing on 2 dices for 7 times. For example, the first try got 3. To make 7, students have to get 4 for other try. And, other making 7 may happen as following two try the dices: 6 and 1, 5 and 2, 3 and 4, 2 and 5, and 1 and 6.
3.3 The activity of making 8 with prediction for how many flowers in each hand of your friend.
First, teacher gives student 8 flowers. Then, he or she holds the flowers hiding on his and her back. After that, other students predict how many flowers are held on his or her right hand and how many on his or her left hand. The making 8 may happen like 0 and 8, 1 and 7, 2 and 6, 3 and 5, 4 and 4, 5 and 3, 6 and 2, 7 and 1, and 8 and 0.

3.4 The activity of making 9 with picking up flowers from the bag of 9 flowers
This activity, students have to close their eyes and then pick up the flowers from the bag of 9 flowers. Students count how many flowers they got and how many left on the bag. Therefore, they could make 9 as following: 9 and 0, 8 and 1, 7 and 2, 6 and 3, 5 and 4, 4 and 5, 3 and 6, 2 and 7, and 1 and 8, and 0 and 9.

3.5 Making ten from the two slits box
Making ten from the two slits box, students have to separate ten balls into two slits box. Number of balls in each slit box could be counted together to make ten. Each slit box could make 10 as following: 10 and 0, 9 and 1, 8 and 2, 7 and 3, 6 and 4, 5 and 5, 4 and 6, 3 and 7, 2 and 8, 1 and 9, and 0 and 10.
4. Conclusion

This study shares the grounded knowledge of mathematics teaching and learning which could be developed through lesson study. Group for analysis, criticism and evaluation of the lesson plan allowed teachers to find the appropriateness of teacher’s performance, materials used and problems involved in enhancing students’ learning about mathematical ideas on addition and subtraction. Therefore, the learning activities was provided as innovative learning activities. The study highlighted innovative learning activities about mathematical addition called “how many? and how many?” These activities included included 1) making 5 and 6 from the Opaque and translucent double slit box (OTD box), 2) making 7 from playing 2 dices for 7 times, and 3) Making ten from the two slits box. This study may suggest some ideas how to develop learning activity from grounded or teacher practicing in profession learning community (PLC) of lesson study.

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