The Effects of the Dynamic Electronic Lesson Based on the Open Approach in the Lesson Study Context

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Abstract: *The purpose of this article was to investigate the effects of the dynamic electronic lesson for Mathematics teaching based on the open approach on the mathematical concepts of addition of first grade students. The target group consisted of three teachers, the director, and first grade students in the schools which implemented the innovation of the lesson study and the open approach. The research methodology of this study was the teaching experiment. The data were collected in the form of a video-recording. The results of the study revealed that the implementation of the electronic lesson based on the open approach developed the students' mathematical concepts in addition in two meaning that is the expression "increase" and the expression "combine". Moreover, it could help the students to relate the real world to the mathematical world.*

Keywords: Dynamic Electronic lesson, Open approach, Concepts of addition, Lesson study

Introduction

According to the considerable change and progress of technology in the 21st century and in Thailand, many teachers paid attention to developing the materials and equipment rather than applying the contents from the technological materials and the information to the instruction. Additionally, it is found that the teachers cannot absolutely implement the technological materials to the instructional management. They also lack the ability to apply the technology for developing the instructional materials. As the government relies on the importance of technology which can be applied in the classroom lessons and highly benefit the students, the national electronic-learning system is promoted as the device for changing the learning concept to a learner-centered concept (Ministry of Education, 2013). Thus, the application of the technology is essential for teaching. It interacts between the knowledge and the teacher's methods to be applied in the specific situations or in the classroom context. It can be said that it does not matter what method is considered the best for integrating the technology and the curriculum. However, the attempt of integration need to be concerned about designing the lesson creatively via the technology or providing the content structure specifically in the classroom context (Koehler & Mishra, 2009).

Nowadays the classroom provides the instructional circumstances that the teacher and students can access to modern technology and instructional materials. Thus, the technological integration and application play more important roles as compared to the past. Applying technology in teaching Mathematics is not only the way to teach the students

about the technology, but also it is the way to use the technology to promote Mathematics instruction (Dog˘an, 2012). Similar to the notion of the National Council of Teachers of Mathematics (NCTM, 2000), it places importance on the technology supporting the instruction so that the students can understand Mathematics more effectively. The particular technology implemented for supporting the instruction and promoting the students' learning needs to encourage the students to interact with the technology in order that they can understand the contents the teacher has already planned.

It is rather difficult for first grade students to understand the meanings of addition and subtraction signs. However, the prerequisite of the students' learning is changing the teaching methods to the class discussion about the variety of problem-solving instead of finding the answers quickly and correctly (Fuson, 1992). To supplement the dynamic dimension to the instruction through the electronic lesson with a focus on dynamic objects or materials will promote the students' learning in Mathematics (Inprasitha, 2013). Moreover, Hoyles et al. (2013) discusses that the dynamics help the students develop their understanding of the concepts, and help them couple the existing knowledge with the new knowledge and the mathematical concepts in physical situations. In a similar way, Arcavi and Hadas (2000) mention that the dynamic activities of the Mathematics program will help the students practice, figure out, and learn Mathematics. The principle factor for designing the qualitative electronic lesson is designing the lesson with regard to the instructional approach (Spanovic, 2010; Drijvers, 2012).

The open approach regarding Inprasitha's concepts (2010) implemented in the Thai context is the teaching methods focusing on the problem-solving process. It encourages the students to deal with the problems which are presented by the teacher. To start with, the teacher will raise the open-ended problems and then encourage the students to learn by themselves through problem-solving. At the end of the lesson, the teacher allows the students to discuss, compare the concepts, and summarize the lesson together with relating to the acquired Mathematical concepts. Thus, the guidelines of applying the technology to the instructional management promotes the students' learning, this study presents the effects of implementing the open approach instruction via the dynamic electronic lesson for mathematics on concepts of addition of first grade students.

Research Objective

The objective of the research is to investigate the effects of the dynamic electronic lesson for mathematics based on the open approach to the mathematical concepts of addition of first grade students.

Research Design

This study presents the effects of the dynamic electronic lesson through the open approach. It was considered to be a teaching-experimental research based on the notion of Steff and Thomson (2000), which are the sequences of the instruction comprising the teachers and, students' grade 1, the observations of teachers as witnesses of the instruction, the researcher, and the researcher's assistant. During the instruction, the video, photos, and sound were recorded. The procedures of the lesson study (Inprasitha, 2010) were as follows: 1) the research team planned the lesson, and explored the concepts in addition of students' grade 1 and the materials from the Japanese Mathematics textbooks which were translated into Thai (Inprasitha et al., 2010), and designed the dynamic electronic lesson; 2) the student

teacher implemented the dynamic electronic lesson, and was observed by others in the research team. The procedures of the open approach consisted of four steps; 1) the teacher employed the electronic lesson to present the problems; 2) the students in each group helped one another to solve the problems while the teachers were observing the students' concepts; 3) the students presented their concepts together with discussion with the whole class; and 4) the teacher concluded the lesson from the students' concepts and related it to the lesson goals: 3) the research team reflected the students' concepts and the interaction among the students, the teachers, and the electronic lesson. The target group consisted of students' grade 1, a student teacher, two teachers, and a school director. Both of the teachers and the director had 8-years experience in teaching through the open approach and had participated in the project of the professional development of the Mathematics teachers through the lesson study and the open approach, which was held by the Center for Research in Mathematics Education, Khon Kaen University in 2005, and followed up the three phases of the lesson study (Inprasitha, 2011).

Data Analysis

The data from the audio transcription and video recording during the instructional management in Unit 1: Addition (1) were analyzed and interpreted based on the conceptual framework of Hattori (2010). The data obtained were analyzed. The students' products and concepts were also analyzed in each teaching procedure of the open approach and in each electronic lesson. In addition, the results of the reflections were analyzed as in the following examples. Having implemented the electronic lesson based on the open approach (Inprasitha, 2010), it was found as follows:

Phase 1: Posing open-ended problems

The teacher turned on the motion of pouring the fish in an1 aquarium to stimulate the students' interest as shown in Figures 1 and 2. All of the students said, "Wow, there are three fish here and there are two fish over there", which indicated that all students were interested in the problem that the teacher dynamically presented. They were curious to know, and needed to find out the answer. It was remarked that all students said, "All fish go around in the aquarium." Then, the teacher asked the students to count the total amount of the fish in the aquarium. (See figure 1).

Figure 1: Presenting the Dynamic Problem Situation through the Electronic Lesson

Figure 2: The Dynamic Problem Situation Presented via the Electronic Lesson about Pouring Two Glass Jars of Fish Simultaneously in the Aquarium

Phase 2: Students' self-learning

The teacher gave the students worksheets relating to the motion in order that the students could describe their methods to figure out the total amount of the fish. At the same time, the teacher observed the methods the students used, and facilitated the students while they were accomplishing the activity. The following figures demonstrated the methods used by the students in each group.

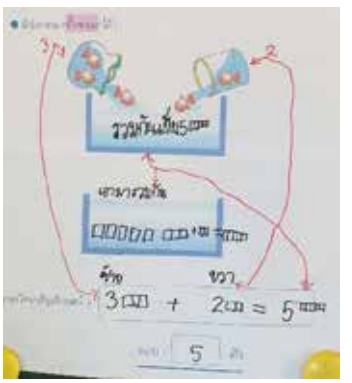

Figure 3: Concept of Group 1

Group 1

The students used the blocks representing the amount of the fish in each glass jar and then wrote " *There are totally 5*." to represent the total amount of fish. They wrote the sentence " *Put them together*" to represent pouring the fish into the aquarium. They wrote the digit 3 to represent the fish on the left and 2 to represent the fish on the right. Then, they wrote the digit 5 to represent the total amount of the fish, whereas the signs (+) and (=) appeared after the whole class discussion.

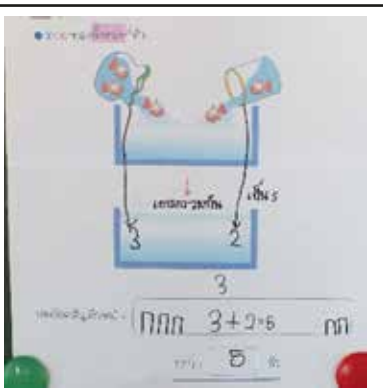

Figure 4: Concept of Group 2

Group 2

The students used the blocks representing the amount of the fish in each glass jar and then wrote the digits 3 and 2 at the aquarium to represent the total amount of the fish. In addition, they used the arrow to connect the digits with the amount of the fish in each glass jar. After that, they wrote "Put them together" to represent pouring the fish in the aquarium simultaneously. However, the equation was written after discussing with the whole class.

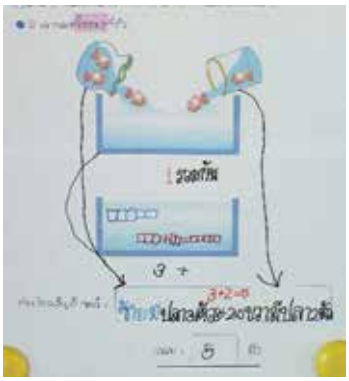

Figure 5: Concept of Group 3

Group 3

The students used the blocks representing the amount of the fish in each glass jar and then wrote 5 blocks at the aquarium and described that " *There are 3 fish on the left and 2 fish on the right*. *The answer is 5*". They also drew the arrow to connect the amount of the fish in each glass jar with the digits they had written. However, the equation was written after discussing with the whole class.

According to the above figures, it showed the students' problem-solving by describing the amount of the fish in each glass jar and in the aquarium, the mathematical sentence, and the diagrams to connect the fish (real world) with the mathematical sentence (mathematical world).

Phase 3: Whole class discussion and comparison

The teacher asked the students to present the concepts of each group to the whole class. Then, the teacher and the students discussed about the amount of the fish in each glass jar, and the direction of pouring the fish in the aquarium through the motion together with writing the mathematical sentence on the electronic lesson due to the following protocols.

Teacher 1: Where can we get these three fish?
Student: From the left of the goldfish.
Teacher 1: Where's it? Here?
Student: Yes, that's right.
Teacher 1: Let me connect the digit with the fish.
Teacher 2: Is that correct?
Student: Yes, of course.
Teacher 2: Then 2 is from…, isn't it?
Student: Yes, it is. 5 is from the goldfish on the left and right.
Teacher 2: And put them together in…
Student: In the aquarium.
Teacher 2: Yes, the goldfish are in the aquarium.
Student: 3 plus 2 equals 5.

The above protocols showed the interaction between the teachers and the students in discussing the digits that represented the amount of the fish in each glass jar and the result after pouring the fish altogether.

Figure 6 : Students' Presentation and Comparative Discussion as the Whole Class

Phase 4: Summarization through connecting students' mathematical ideas emerged in classroom

The teacher and the students made conclusion by relating the mathematical sentence to the picture of pouring the fish, and circling the fish in each glass jar and the mathematical sentence. The diagram was written in order to relate the problem situation to the students' mathematical concepts as shown in Figure 7.

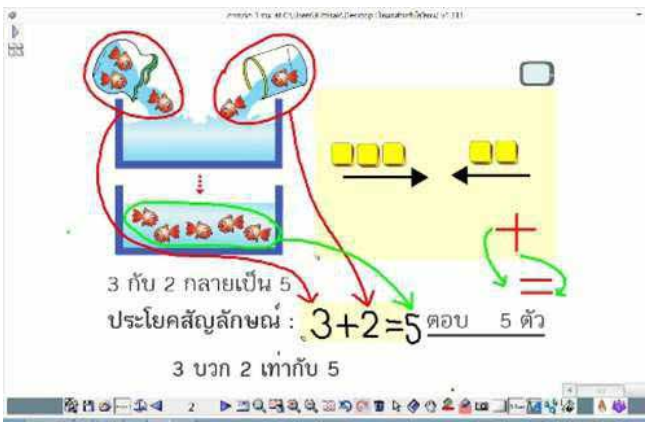

Figure 7 : Students' Mathematical Concepts

According to the teacher's reflections after the instructional activities, the teacher and the observation teacher gave the opinions that the instructional management through the electronic lesson could help the students to learn more quickly and grasp the students' interests as noticed from the teacher's reflections below.

> *"This electronic lesson can encourage the students to understand the concepts in addition because the students can see the fish pouring in the aquarium simultaneously instead of pouring from one side and then another side. This can be considered that it accomplished the objectives. In addition, the students use their body language to understand the concept that the hands move at the same time, and that one hand doesn't*

go after another hand. There are fish in two hands and then the fish are filled in the aquarium..."

(Teacher 1 reflecting on July 1, 2015, translated from the Thai original)

"The video allows the students to see the movement and the students can find that there is a glass jar on the left and another one on the right, which elicits the students' concepts and can classify that the fish on the left are three. After switching on the video, the students can immediately answer that there are five goldfish totally. They give the answer together with showing their fingers. It is rather different from the traditional method that uses the paper… That is we know when it needs to show, to hide, or to hint. This is what we can manage. Unlike the paper, pouring the fish in the aquarium lets the students see the fish obviously and the teacher can manage it."

(Teacher 2 reflecting on July 1, 2015, translated from the Thai original)

"I think it is important and I feel excited for the students today. Generally, the instructional medium is a paper or an authentic fish which we don't really want to kill them unintentionally. This activity doesn't tend to torture an animal, and the teacher can grasp the students' attention to the video because it seems that the fish are authentically swimming. The students are excited and understand. Thus, using the hands while watching the video can help the students to understand what the addition symbol is."

(Teacher 3 reflecting on July 1, 2015, translated from the Thai original)

According to the director's reflection after having observed the class with the electronic lesson, it was found that it interested the students as if it was authentic material. It could be repeated and different from the former materials. Additionally, it could encourage the interaction between the students and the teacher as evidenced in the excerpt below.

"…it's the dynamic tool as if they are real fish. I t can be said that it provides the authentic and dynamic dimensions which interest the students. It's not the raw material that the students only watch on television, but it's the material that can encourage the students' interaction."

(Director reflecting on July 1, 2015, translated from the Thai original)

Results and Discussion

The electronic lesson with the dynamic dimension could initiate the students' mathematical concepts in addition as evidenced in the followings.

1. Combine: According to the Figures 3-5, it showed that the students could describe the problem situations presented through the electronic lesson (Figure 2) about pouring the fish from two glass jars in the aquarium simultaneously and the fish were swimming in the aquarium. This demonstrated the direction of putting two objects or numbers at the same time. The students' concepts occurred after accomplishing the mathematical activity

to find out the amount of the fish in the aquarium were 1) the students drew the blocks to represent the amount of the fish and the arrow to represent the addition of the blocks; 2) the students wrote the texts to represent the amount of the fish and the way of pouring the fish in the aquarium; and 3) the students wrote the mathematical sentence 3+2=5 to represent the process of pouring the fish from the two glass jars in the aquarium, noting that 3 represented the fish in the left glass jar and 2 in the right one, and 5 represented for the total amount of the fish in the aquarium. Moreover, the students could draw the diagram to relate the real world (fish swimming in the aquarium) to the mathematical world (mathematical sentence 3+2=5). The students could also demonstrate the direction of two objects moving towards each other at the same time to represent the combine of addition, which encouraged the students to discern the Part-Part-Whole concept as noticed from the gestures that the students moved their hands simultaneously at the same time to describe the combine of addition.

2. Increase: With regard to the problem situation as the Figure 8, it described the way of pouring the fish from the glass jar in the aquarium and the fish were swimming in the aquarium. This represented the existing objects or amounts and the direction of adding the objects or the amounts to escalate the amounts or the objects.

Figure 8: Problem Situation Presented through the Dynamic Electronic Lesson about Pouring the Fish in the Aquarium

The students' concepts occurred after accomplishing the mathematical activity to find out the amount of the fish in the aquarium were as follows 1) the students drew the blocks to represent the amount of the fish; 2) the students wrote the texts for examples, "original-new" and "existing-adding", and the diagram to relate to the amount of the fish; and 3) the students wrote the mathematical sentence 6+2=8 to represent the amount of the fish, noting that 6 represented the fish in the aquarium or the original fish, 2 represented the fish that were poured or the additional fish, and 8 represented for the total amount of the fish in the aquarium. Additionally, the students could draw the diagram to relate the real world (fish swimming in the aquarium) to the mathematical world (mathematical sentence 6+2=8). The electronic lesson could demonstrate the motive direction of two groups of the objects moving towards to represent the increase of addition, which encouraged the students to discern the Change-Add-To concept as noticed from the gestures that the students moved their right hands towards their left hands to describe the increase of addition.

Conclusion

The open approach was considered an instructional approach focusing on the students' problem-solving through the problem situations presented by the teacher. The problem situations designed in the form of the dynamic electronic lesson (Inprasitha, 2013) could encourage the students to understand the problems through the problem situations, and

to admit that the problems belonged to them (Isoda, 2012) and needed to be solved. In addition, the electronic lesson could develop the students' perception of the mathematical concepts. In other words, it could encourage the students to notice the motion of the object and then describe the concepts in addition quickly that there were two types of its meanings: the combine and increase of addition (Hattori, 2010). According to the empirical evidence derived from the teachers' reflections, noting that "As soon as turning on the motion, the students can answer that there are five goldfish totally, and they describe together with showing their hands that three fish are on one side and two on another side." Another teacher reflected that "It can elicit the students immediat ely", which pointed out that the electronic lesson with the dynamic dimension (Inprasitha, 2013) in the virtual situation that the teacher carrying out for the instructional management could encourage the students to perceive the mathematical concepts through the relation between the physical situation and the mathematical concepts in addition comprising the meanings of the addition, symbols (+) and (=), writing the mathematical sentence from the problem situation, constructing the problem situation from the mathematical sentence, and enabling to add the amount with its result that was less than 10.

Acknowledgements

This research is supported by the Center of Excellence in Mathematics, the Commission on Higher Education Thailand, and Graduate School of Khon Kaen University, and the Center for Research in Mathematics Education (CRME), Faculty of Education, Khon Kaen University.

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