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Using Classroom Video in Designing Open-ended Problem Situations

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Abstract

Teacher and teacher trainees have been introduced to practice Thailand Lesson Study incorporated Open Approach Model as the problem-solving-based teaching approach for the past two decades. The problem-solving-based teaching approach has to begin with posing open-ended problem situation in order to encourage students to solve the problem independently using their own method. Therefore, open-ended problem situation design is considered a key factor for teachers or teacher trainees to provide sufficient opportunities to students' learning experiences in solving the problems (Inprasitha, 2017). As a result, this research was aimed to use video recordings of classroom teaching and experts' reflection practice to analyze teacher trainees' abilities in designing open-ended problem situations. A total of 10 teacher trainees were selected from the Department of Mathematics (English Program), Faculty of Education, Valaya Alongkorn Rajabhat University under the Royal Patronage using a purposive sampling technique. A multi-cases study survey research design was employed using a qualitative approach. There were four research instruments used, namely lesson plan, video and audio recording, field notes, and interview protocol. Data were collected using various sources such as research lesson plans, audio, and video recording as well as interviewing. The results revealed that teacher trainees utilized classroom teaching videos to support them in clarifying indecisive problem situations, revising the sequence of teaching, and modifying appropriate words used in giving the direction of the problem situations. On the other hand, the experts' reflection video has successfully assisted them to have a better understanding of mathematical contents in problem-solving teaching approach and teacher trainees' intention of each action in the learning activities.

Keywords: classroom teaching video, experts' reflection video, lesson study, open approach, open-ended problem situations

1. Introduction

Problem-solving refers to the area of cognitive psychology which deals with the process engaged in solving problems (Pal & Poyen, 2017). Hence, the problem-solving approach is defined as students are learning to solve mathematical problems independently. Therefore, Santagata, Zannoni, and Stigler (2007) supported the importance of promoting a problem-solving approach to teacher trainees (pre-service teachers) who are going to be in-service teachers for educational reformation. This is further supported by Inprasitha (2017) and Thinwiangthong, Eddy, and Inprasitha (2020). According to Inprasitha (2017), mathematics teachers must carefully design and refine lesson plans so that the lessons can serve students with a wide range of learning experiences in solving mathematical problems. Moreover, Thinwiangthong et al. suggested that mathematics teachers should foster the best possible learning environment in any type of educational activity by posing open-ended problem situations as an important component of the Open Approach.

Teacher Education is mainly providing teaching professional development training thus aims to assist teacher trainees to translate the theoretical knowledge that they learned to their teaching practices (Darling-Hammond & Bransford, 2005; Goodlad, 1990; National Commission on Excellence in Education, 1983). In this line of reasoning, teacher education training programs have to prioritize the opportunities to develop teacher trainees' abilities with ample hands-on experiences practically such as classroom teaching observation, lesson planning, and teaching experiments so that teacher trainees will be able to translate theory that they learned into teaching practices (Hiebert, Morris, Berk & Jansen, 2007; Lampert, Beasley, Ghousseini, Kazemi & Franke, 2010).

Since most of the teacher education programs around the world are taken into consideration regarding the importance of providing field experiences to teacher trainees (Causton-Theoharis, Theoharis, & Trezek, 2008; Ruys, Van Keer, & Aelterman, 2012; van Es & Sherin, 2010), some common characteristics in providing hands-on learning experiences are found in the teacher education programs. Their common characteristics are as follows: Exposure of good teaching examples for creating learning opportunities for teacher trainees and (ii) practical training through field experiences to translate theories that they learned into teaching practices (Santagata et al., 2007). However, there is still limited good learning resources and corrigible reflective perspectives to improve teacher trainees' teaching practices with sufficient knowledge and substantial understanding (Franke & Kazemi, 2001; Henningsen & Stein, 1997).

Classroom video recording is widely used as a research tool to visualize the lesson implementation thus gain a better understanding of the whole teaching and learning process (van Es & Sherin, 2010). The strength of using classroom video recording is researchers can avoid missing some critical moments of students' performance or other related learning evidence because the lesson implementation itself is always complex and various events could be emerged simultaneously (Seago, 2004). Moreover, researchers can utilize the flexibilities of using video recording as it can be replayed, paused, added the subtitle, and edited functions to support researchers for collecting data related to reflection on teaching practices (Calandra, Brantley-Dias, Lee & Fox, 2009; van Es & Sherin, 2010; Wang & Hartley, 2003).

A long-recognized training of lesson preparation which invented in Japan, the so-called Lesson Study has been in existence for over 130 years (Tall, 2008). Lesson Study was first introduced and adapted under Thailand educational context since the year 2002 encompassing three steps, namely (i) collaboratively design a research lesson (Plan); (ii) collaboratively observe the research lesson (Do), and (iii) collaboratively discuss and reflect on the research lesson (Inprasitha, 2009). A research lesson is defined as the lesson that the Lesson Study team works on, and it is grounded in the research and best practices that team members bring to the process after agreeing upon the learning goals (Paul, 2019). For example, the Plan step creates the opportunity for Lesson Study team members to deepen their content knowledge, share familiar instructional strategies, and create a bank of innovations. This is followed by the Do step which one of the Lesson Study team members is teaching using the research lesson while the other team members are observing and recording how student learning is impacted by the lesson design and how students react during the task of problem-solving. Finally, the See step requires team members to reflect and discuss the supports they provided for students and more importantly, to focus on the barriers to learning that may have been occurred in the research lesson (Inprasitha, 2009). The ideas of the Open Approach that introduced by Nohda (2000) are aiming at allowing students to learn mathematics in response to their abilities, supplemented with a certain degree of self-determination in their learning, which can foster higher-order thinking skills and improve the quality of their learning processes for more than two decades. A Thailand Lesson Study Model was created by incorporating an Open Approach in the second step of the Lesson Study process as illustrated in Figure 1 (Inprasitha, 2011; 2014).

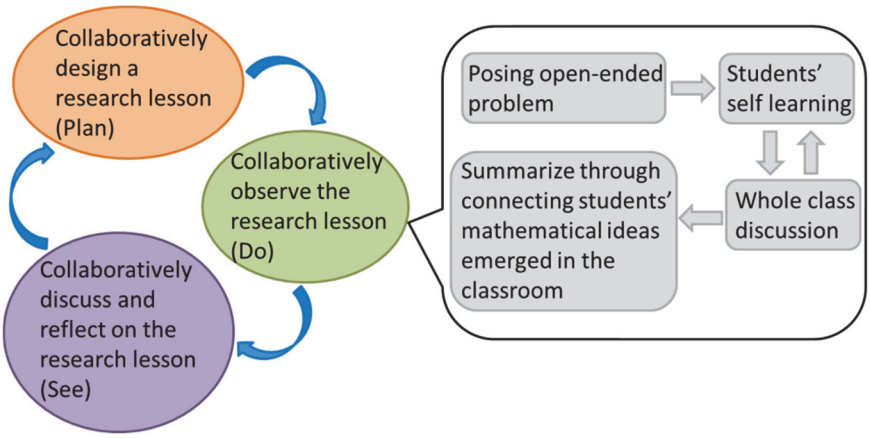

Figure 1. Thailand Lesson Study Model

Inprasitha (2004) recommended preparing the context for using the Thailand Lesson Study Model so that mathematics teachers would teach using mathematical activity based on open-ended problems with the intention to be institutionalized into Thailand's school culture (Manmai, Inprasitha, Changsri, & Pattanajak, 2020). As a

result, the researchers aimed to use classroom video recordings to investigate the intended classroom teaching and observation practice using the Thailand Lesson Study Model. This research was aimed to use video recording of classroom teaching and experts' reflection practice to analyze teacher trainees' abilities in designing open-ended problem situations. This will ultimately support the teacher education program in providing a research tool to associate teacher trainees' theoretical knowledge into teaching practices through visible field experiences.

By the end of this research, researchers could answer the following research questions:

i) How did the use of classroom teaching video help teachers to observe the research lessons using open-ended problem situations in the second step (Do) of the Lesson Study process?

ii) How could teachers derive the examples of open-ended problem situations from the classroom teaching video to discuss in the final step (See) of the Lesson Study process?

iii) How could teachers utilize the classroom teaching video to revise the following lesson plans with appropriate open-ended problem situations?

iv) What did teachers learn from experts' reflection videos?

v) How did teachers revise their lesson plans in designing open-ended problem situations based on the use of experts' reflection videos?

2. Method

A total of 10 teacher trainees from the Department of Mathematics (English program), Faculty of Education, Valaya Alongkorn Rajabhat University under the Royal Patronage were purposively selected because they have been taken those courses related to designing research lessons using open-ended problem situations in preparing contexts for implementing Thailand Lesson Study Model. Furthermore, these 10 teacher trainees participated in three cycles of the Lesson Study process using three content domains from the Japanese textbooks, namely weight, graph, and circle. The Japanese textbooks have been translated into the Thai language and used in more than 200 elementary schools in Thailand.

Data were collected using research lesson plans, audio, and video recording while the teacher trainees were discussing and planning their research lesson plans, interviewed them after they finished their lesson plans, and revising their problem situations. The research procedure consisted of the three steps of the Lesson Study process by incorporated the Open Approach. The video recording was used when the teacher trainees collaboratively design research lessons as the normal process. However, the classroom videos were used instead of living classroom observations while the experts' reflection videos were used to investigate the reflection on teaching practices as the final step of the Lesson Study process.

The research procedure consisted of three steps as elucidated in Figure 2. The 10 teacher trainees collaboratively discussed and determined the goals of the lesson and they agreed to use the three content domains from the Japanese textbooks, namely weight, graph, and circle. The researchers started the first cycle of an interview to the 10 teacher trainees related to the problems that they faced, expected students' responses toward the problem situations, and how to determine the goals of the lesson plans. Then, the 10 teacher trainees watched the classroom teaching video before they revised their lesson plans. After they had watched the classroom teaching video, researchers conducted the second cycle of the interview. Classroom teaching videos were used when teacher trainees finished their research lesson plans following after, they collaboratively discussed and revised their research lesson plans. The experts' reflection video was provided and used to investigate the outcomes of the classroom teaching videos by looking into the goal of the lesson, intentions of each action in the classroom, students' ideas that emerged in the problem-solving process, and how teacher trainees would engage for future improvement by further discussing and revising their research lesson plans again. Interviews were conducted to triangulate the obtained data from the video recording. Figure 2 demonstrates the research procedure using classroom teaching videos and experts' reflection videos.

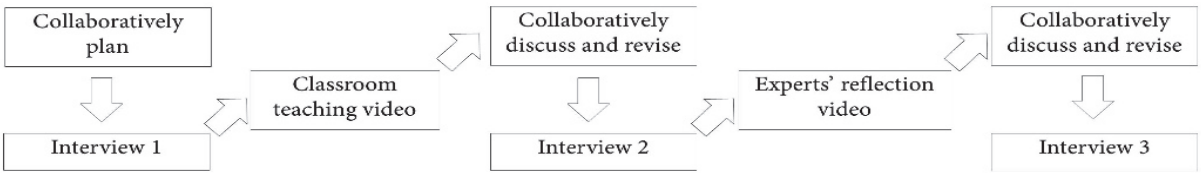

Figure 2. Research Procedure

The research instruments used in this research were comprised of the research lessons, lesson plan evaluation forms, video and audio recordings, and three sets of the interview protocol. The three sets of interview protocol were designed to explore the use of classroom teaching video and experts' reflection video in improving teachers' abilities in designing open-ended problem situations. The researchers employed a qualitative research design seeking to deliver meaning and comprehension focusing on the open-ended problem situations via detailed description. In consequence of this, the qualitative design is a compelling method for investigating educational problems, which demands to develop a comprehension of complex social settings and the meaning that teacher trainees within those settings bring to their real-life experience, which is teacher trainees' abilities in designing problem situations. A multi-cases study was employed as it has an opportunity to bend several methods into justified the research design. Data for this qualitative design were typically obtained from different sources such as interviews, video recordings of real-life settings, and field notes. The obtained data were analyzed using content analysis.

3. Results

The results of this research are presented according to the research aim stated above. The 10 teacher trainees were labeled as P1 to P10.

3.1 The Use of Classroom Teaching Video

After the teacher trainees watched the classroom teaching video, they started to have a deep discussion related to designing problem situation issues and tried to have some ideas to revise the problem situations. Therefore, teacher trainees tried to understand and determine the sequence of teaching in each learning activity that was shown in the classroom teaching video. Besides, teacher trainees tried to explain the differences between the teaching sequences in the classroom teaching video and their research lesson plan. After they obtained sufficient information and understood well about the problem situations, they started to revise the situations as elucidated in the following issues.

3.1.1 Indecisive Problem Situations

The results revealed that the 10 teacher trainees are found to have problems understanding the problem-solving teaching approach because they are at the initial stage of using the translated Japanese textbooks to be the main resources to design the problem situations. Moreover, results also showed that they lacked confidence in designing the problem situations and they wondered whether the created situation could provide students with sufficient learning experiences. The following examples showed that the teacher trainees were in an indecisive problem situation while they designed the research lesson plan.

(i) Example 1: Lesson of weight

The teacher trainees tried to design problem situations that would lead students to guess the weight of some stuff through their learning activity. They wondered how to introduce those kinds of stuff to their students. Figure 3 shows the content domain of weight in the translated Japanese textbook.

Figure 3. The Lesson of Weight from the Translated Japanese Textbook

While the teacher trainees could not decide how to design an appropriate problem situation based on the translated Japanese textbook, they referred to the classroom teaching video to confirm their indecisive problem situation.

The conversation among the five teacher trainees showed that P4 and P5 could decide on designing the problem situation after they watched the classroom teaching video. This implies that classroom teaching videos can assist teacher trainees in making their decision while they are designing a lesson plan with an appropriate problem situation. Table 1 shows the teacher trainees used the classroom teaching videos to confirm their indecisive problem situation thus design the problem situation and related teaching materials.

Table 1. The Use of Classroom Teaching Video in Assisting the Indecisive Problem Situations

Teacher Trainee	Verbatim Data
P1	As we talked, firstly, the teacher will ask students about "What have they seen in our classroom?" Students answered and then ask them "Which one is heaviest?" I think it is ponderous.
P2	I think so, can we put kinds of stuff that students will guess in a bag and let them hold it instead of a bowl of water?
P3	I agree. It will make our students feel excited if we pick items one by one from the bag.
P4	From the video, the **student gave enough concentration to the situation and got their own problem.**
P5	I think it is compact and **we can select the kinds of stuff that we want**.

Moreover, results also revealed that teacher trainees discovered the ideas and adapted the ideas from classroom teaching videos while they were preparing learning materials for the designed activities. Figure 4 shows that a teacher trainee gradually pulled out covers to show students the learning materials were the ideas derived from classroom teaching video.

Figure 4. The Ideas of Using Learning Materials that Derived from the Classroom Teaching Video

3.1.2 Sequence of Teaching

Results revealed that the teacher trainee wound not intervene with students while they were thinking and solving the mathematical problems. Obviously, teacher trainees would provide students guidance by giving students more hints or breaking down the problem-solving process to assist students to complete the problem situation. The results from the research lesson plan showed that teacher trainees were facing some obstacles on how they could support their students to use the learning materials. They realized that if they give their students the learning materials, and tell them how to use them directly, it will disrupt the problem-solving process because students will get the answer. The following example indicated that classroom teaching video has successfully provided them sufficient information to decide the sequence of teaching in their research lesson.

(ii) Example 2: Lesson of circle

Students were required to explain the ways to find standing points in an in-ring tossing game that everyone will have equal chances to win. Students have to use some materials to assure that the distance from the pole to every student is equal. Teacher trainees shared their ideas on the sequence of teaching when they could send students rope or wooden stick to measure distance. They planned to give students a stick after they ordered students to stand in three forms like the forms suggested in the translated Japanese textbook to make sure that students would understand the meaning of the circle as shown in Figure 5.

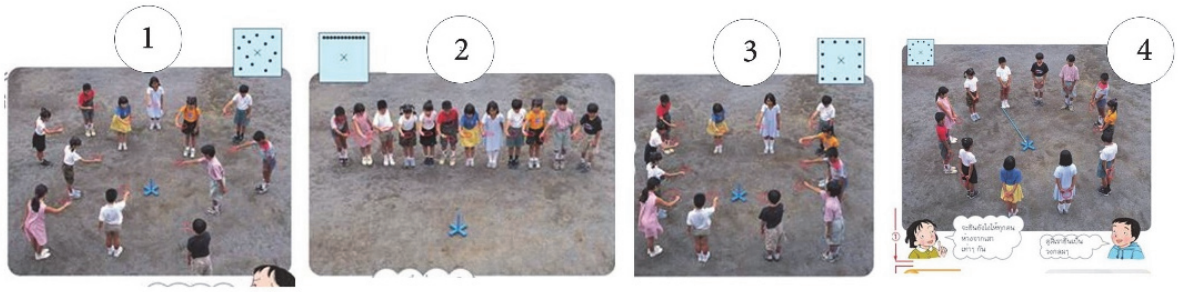

Figure 5. Students' Ideas of on Ring Tossing Activity as Suggested in Translated Japanese Textbook

Table 2 demonstrates the results of teacher trainees' discussion about the sequence of teaching after they have watched the classroom teaching video. According to the conversion among the teacher trainees, they used the classroom teaching video to revise the sequence of teaching to assist their students in solving mathematical problem situations without their interventions. They also guaranteed that students would need teaching material to make the same distance by discovering through classroom teaching video in terms of teaching image and students' responses.

Table 2. The Use of Classroom Teaching Video in Assisting Teacher Trainees on Sequence of Teaching

Teacher Trainee	Verbatim Data
P6	I think there are too many sequences in our lesson plan. Our students are different from Japanese children.
P7	I think it is not about difference, but the **textbook and video** have shown that students can think and solve problems freely.
P8	It means that we have to prepare everything as much as possible.
P9	I agree. If they want to stand in a straight line, square, or round the pole, we will allow them.
P6	How about the stick?
P10	**We will let them find a way to confirm everybody gets the same distance as shown in the video. The teacher let their students present their way**, stand around the pole by holding hand then move, everyone step backward from the pole. **Teachers wait until their students ask for the rope so we will encourage students to find the way and wait for them.**
P7	Reduce time for arranging the 4 forms to increase time in the proof process.

3.1.3 Words Using to Provide Direction

The results showed that classroom teaching video has successfully provided guidelines to lead teacher trainees to create directions of a problem situation by using the appropriate words that could give the command to the students to do something directly. For example, in a lesson on the circle, teacher trainees designed appropriate words used to give directions to command students to arrange standing in points that students want, such as straight line, square shape, circle shape, and circle shape with measuring distance. The results revealed that teacher trainees started to gain their new ideas to give appropriate directions while students may respond in various ways after they watched the classroom teaching video. Moreover, teacher trainees are found to be influenced by the classroom teaching video and decided to change the words in the same direction as shown in the classroom teaching video: "Find the position for the tossing ring that everybody can get equal chance to finish target". Besides, they realized that some directions such as "How did you know?" are more friendly to respond to than "Explain why it works." or "How do they relate?" because it is more familiar to students.

3.2 The Use of Experts' Reflection Video

The results revealed that teacher trainees spent more time discussing the contents of the experts' reflection video after they watched the experts' reflection video. Besides, the experts' reflection video has successfully provided some ideas that they did not realize before. For example, in a lesson of the circle, students held each other's hands

and moved to stand around the pole. In traditional teaching, students could be seen that they had already understood what circle is, but experts' perspective provided more insight into mathematical concepts related to the activities students participated in, as shown in the following protocols:

Table 3. New Ideas Created from Experts' Reflection Video

Teacher Trainee	Verbatim Data
P3	**From the experts' talk about holding hands to form a circle, students have already known the circle, but they might not know how to create a valid circle**. Teachers have to retain students in their problems that are how to make everyone have the same distance, which shaped students' thinking about a tool to measure standing points. **As we work on our own, we do not know how the child will need this tool.**

Another significant result derived from the experts' reflection video indicated that teacher trainees discussed the link between the sequence of teaching and the knowledge gained to help students be able to gradually connect from the real world to the mathematics world as reflected in the lesson on weight. Table 4 displays the related protocol to support this issue.

Table 4. New Ideas Created from Experts' Reflection Video

Teacher Trainee	Verbatim Data
P8	The first activity, lifting a bowl of water, I think is not related to this lesson until an expert said that everybody has different feelings while they are lifting the bowl, someone feels it is heavy but someone not, so weight is hard to understand and express. **I have just realized from experts that they designed three parts of sequences to provide tools step by step in order to lead students understanding of weight by observation, touching and lifting, and using elastic strings.**

In sum, the researchers found that the use of classroom teaching videos is beneficial to teacher trainees as they start to revise their initial problem situation and make necessary modifications after they have watched the classroom teaching video. On the other hand, the experts' reflection video is more helpful in providing a better understanding of teaching that they must perform in their classroom.

4. Discussion

The results of this research imply that both classroom teaching videos and experts' reflection videos assist teacher trainees in designing open-ended problem situations. Classroom teaching videos can be used as resources to confirm their indecisive problem situations to design the problem situations and related teaching materials. Moreover, teacher trainees also are found to use classroom teaching videos to revise the sequence of teaching so that students can solve the problem situations without teacher trainees' intervention. On top of that, classroom teaching videos can provide guidelines to teacher trainees to create suitable instruction and command to direct their students through a comprehensive designing the directions for problem situations.

On the other hand, the experts' reflection video has given more detailed information to teacher trainees to understand classroom practices, mathematical activities, and words selection to make up the directions that are familiar to students' experience which may help them to approach their authentic problems to solve on and for their own.

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