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Lesson Study as a Means to Innovation for Good Practices in Teaching and Learning Mathematics in Vietnam

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Abstract: This paper will demonstrate that lesson study may be adapted from its primary use as a professional development strategy to an effective means for good practices in teaching and learning mathematics. Having launched the National Standard Mathematics Curriculum in Vietnam in 2006, classroom mathematics teachers have learnt more about innovative teaching strategies as a means of implementing more effective lessons, focusing on mathematical thinking. The aim of this paper will be to try to answer four questions related to innovations and good practices in mathematics classrooms. Firstly, how does lesson study as a means of innovation affect the teaching and learning of mathematics? Secondly, how does this innovation affect the improvement of student learning? Thirdly, how does lesson study support the professional development of teachers and, finally, how does the use of innovation in teaching and learning mathematics affect the implementation of curriculum reform? Research findings of the study will shed light on the relative contribution of lesson study in both the teaching and learning of mathematics with main focus on higher order thinking.

Keywords: Good practices; lesson study; professional development; school reform mathematics; teaching and learning mathematics.

1. Introduction

In Vietnam, since the emphasis of the old mathematics curriculum was on procedural knowledge and memorization of algorithms, students often worked independently to complete exercises from textbooks and workbooks. When asking students questions, most teachers seek one "right" answer to the mathematical problem and will explain why that answer is correct. The reform curriculum tries to reduce the amount of basic skills and procedures in mathematics, while increasing hands-on activities that help students to grasp new ideas and develop mathematical thinking. School reforms in mathematics education aim to help students achieve the following four objectives: knowledge, skills, thinking and attitudes (MOET, 2009).

In the regulation of professional standards for school teachers, there is a section on the application of teaching methods which promotes students' positivity, perseverance and creativity, as well as enhancing their self-motivation and thinking (MOET, 2009). It is new innovations in teaching and learning methods in mathematics that needs to be encouraged. The teacher ought to think of

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teaching in terms of several principal hands-on activities, problematic real-life situations, and open-ended questions. This innovation in teaching should help students construct their own knowledge in an active way, and enhance their higher order thinking through solving non-routine problems while working cooperatively with classmates, so that their talents and competencies are developed (Tran Vui, 2006a, 2006b).

There are several possibilities for the innovation of mathematics education in an economy. Lesson study has its origins in Japan where it has been used as the primary means of professional development for teachers, for comprehensive details of Japanese lesson study see Isoda, Stephens, Ohara & Miyakawa (2007). Lesson study is currently a central focus in the United States and other economies, where it is being used in innovative ways to enhance good practices in actual classrooms and to help towards the development of students' mathematical ideas. Lesson study has also been credited with dramatic successes in improving classroom practices within the elementary school system (Lewis, 2002).

The aim of this paper is to report on how lesson study was used as a means of innovations in teaching and learning mathematics in Vietnam.

2. Literature review

2.1. Lesson Study

The concept of lesson study seems simple and obvious: if education needs to be improved, then teachers need to be introduced to the processes of teaching and learning in classrooms, and then they need to devise ways to improve them. Remarkably, lesson study is not only a means of improving the skills and knowledge of teachers, but also a way to improve the knowledge base of the teaching profession. Japanese teachers are not only meeting in groups to improve teaching and learning, but writing books for other teachers in order to share what they have learned from practices (Fernandez & Yoshida, 2004).

A particularly noticeable accomplishment in recent years of lesson study in Japan has been the transformation from teacher-directed instruction to student-centered instruction in mathematics and science education. The success of lesson study can be found in two primary aspects: improvements in teacher practice and the promotion of collaboration among teachers (Takahashi, 2006).

In this research paper, a lesson study cycle was adopted that comprised four stages: planning → implementing and observing → discussing and reflecting → revising.

Teaching school mathematics aims to equip students with basic mathematics, and develop and nurture their mathematical thinking to solve real life problems. Many teachers in Vietnam really need a practical framework within their classes to develop the student mathematical thinking. Of course, each country has a slightly different approach to teaching mathematics, but there are still many commonalities that can be shared, so that a realistic framework can be constructed which can help classroom teachers in each ASEAN country.

The research focuses on lesson study as a means to innovation for good practices in mathematics classrooms. The results from this research on lesson study show that good teaching practices are powerful models for changing the quality of mathematics education.

2.2. Well-constructed Lesson Plans: a Vietnamese Approach

Classroom teachers know how to design lesson plans and this is reflected in the ability to identify the right objectives, contents of the lesson, intended teaching strategies and aids, and appropriate allocation of time, according to lesson flow. In the teaching standards, the components for developing a well-constructed lesson plan are defined as follows (MOET, 2009):

- The teacher designs a lesson plan, in accordance with regulations, on the subject structure;

- Lesson plans must suitably reflect the objectives of the lessons;

- Lesson plans are consistent throughout the major content of the lesson;

- Lesson plans present a selection of teaching methods to facilitate the students' learning initiative;

- Learning materials, aids and resources are selected and used effectively to improve teaching quality;

- Assessment tools and methods are included in lesson plans;

- Timing for teaching activities in the classroom must be clearly indentified in the lesson plans.

In the guidebook for mathematics teachers there are four main activities in a lesson at each grade that teachers should follow to develop mathematical thinking:

Activity 1. The teacher motivates students to work and achieves the following aims:

- Examining the students' previous knowledge;

- Consolidating previous knowledge involved with the new lesson;

- Introducing the new lesson.

Activity 2. The teacher facilitates the students' exploration of mathematical knowledge and allows them to construct new knowledge by themselves.

Activity 3. Students practice the new knowledge by solving exercises and problems in the textbook.

Activity 4. The teacher reviews what the students have learnt in the new lesson and assigns the homework.

Engaging with the lesson will give students an opportunity to demonstrate their mathematical thinking through:

- Lhe ability to observe, predict, and apply rational and logical reasoning;

- Knowing how to express procedures and properties through language at specific levels of generalization (by words, word formulae);

- Knowing how to investigate facts, situations, and relationships in the process of learning and practicing mathematics;

- Developing the ability to analyse, synthesise, generalise, specify, and start to think critically and creatively (MOET, 2006).

2.3. Types of lessons that support the curriculum

From the curriculum and textbooks lessons can be categorized into two main types as follows:

a) New lessons

- Help students pose, explore and solve problems

The teacher facilitates the students in posing questions, and exploring problems when they engage in a problematic situation. The teacher then enables the students to mobilize what they have experienced and learnt, in order to search for and recognize the relationship between the posed problem and their accepted knowledge for the ultimate purpose of

developing an appropriate strategy to solve the problem.

- *Give the students opportunities to consolidate and apply their constructed knowledge after learning the new lesson, so that they can start to absorb the new information*

After a new lesson in the mathematics textbook, there are usually three exercises that students can use to consolidate and practice what they have learnt in the lesson. The two first exercises require students to have an appreciation of how to practice and directly apply the new knowledge, while the third is usually a problem which requires the indirect application of the new knowledge.

b) Consolidation, practice and general practice lessons

- Help students recognize learnt and new knowledge in various problems.

- Help students practice within the sphere of their individual capabilities.

- In small groups, give students the opportunity to assist one another by effectively interacting through the use of worksheets.

- Help students form the habit of checking, and evaluating their work.

- Help students form the habit of finding various strategies and choosing the most appropriate for problem solving.

2.4. Open-ended problems

Pehkonen (1997) states that problems dealt with in school mathematics are usually closed problems, which do not leave much room for creative thinking. The idea of using open-ended problems to improve school mathematics teaching, to develop and foster methods for teaching problem-solving and thinking skills, has appeared in the curriculum of many countries in a form that allows teachers the freedom to adopt an "open approach" (Pehkonen, 1997; Foong, 2000). Nohda (2000) holds the view that open-ended problems are atypical and should have two prerequisites. Firstly, they should suit every single student by using familiar and interesting subjects. This implies that students realize it is necessary to solve the problems, feel it possible to solve them with their own knowledge and have a sense of achievement after having solved them. Therefore, the problems should be sufficiently flexible to take into account the students' different mathematical abilities. Secondly, open-ended problems should be suitable for mathematical thinking and it should be possible to restructure them into new problems.

The open-ended problems give students good opportunities to discover new mathematical ideas. Since the discovery of new mathematical knowledge alone does not guarantee certainty, the hypothetical knowledge has to be verified. To express a discovery only means an explanatory hypothesis is becoming plausible. Nevertheless, the correctness of the rule and the case, as well as the coherence between the rule and the observed fact, could remain vague (Meyer, 2007, 2010).

3. This Study

3.1. The Research Lesson

In the study reported here, the focus is on the exploration of good practices that lead to the designing of well-constructed lessons, using open-ended problems to promote student discovery of new mathematical ideas. Since the Vietnamese secondary mathematics teachers who were involved in this research were not familiar with the use of lesson study to improve their good practices in actual classrooms, a workshop on "Lesson study as a means to

innovation of teaching and learning mathematics" had to be conducted first. Twelve teachers, including one specialist in mathematics, attended this workshop, and most of them were from a secondary school in Hue City, Vietnam. The objectives of the workshop were:

- Helping teachers how to use lesson study as a means to innovation of teaching and learning mathematics;

- Helping teachers how to use the innovation to improve student learning;

- Discussing with teachers how the lesson study should support the professional development of teachers;

- Helping teachers how to use innovation in teaching and learning mathematics to implement the reform national mathematics curriculum;

- Selecting two well-known and experienced teachers to prepare and implement the lesson plans in the classroom as a future observation and discussion tool.

At the end of the workshop, a group of teachers was formed to participate in this study. This first team worked as a research group to create the lesson plans, worksheets and instructional materials suitable for the units selected from the reform mathematics curriculum for grade 7 in Vietnam (Ton Than, 2003). The lessons chosen by the teachers were taken from the national text book. The teachers agreed in the meeting that these lessons are too difficult and abstract for the students. The presentations of these lessons in the text book are not relevant to students. Traditionally, the definitions are merely stated, and students have to accept these new mathematical concepts from the text book without any real understanding. In this research, teachers created problematic situations to help students explore new mathematical ideas and concepts more profoundly.

3.2. Objectives

The study aimed to explore and investigate the implementation of lesson study as a means to encourage good practice in teaching and learning of selected topics in lower secondary mathematics in Vietnam.

The research sought to find answers to the following questions:

- How does the innovation affect the improvement of student learning?

- How does the lesson study as a means to innovation affect the teaching and learning of mathematics?

- How does the use of innovation in teaching and learning mathematics affect the implementation of the reform curriculum?

- How does the lesson study support the professional development of teachers?

The findings of the study will shed light on the relative contribution of the lesson study as a means to innovation of the teaching and learning of mathematics.

3.3. Methodology

The study was conducted in two school-years. All teachers were introduced to lesson study for the first time at the research workshop. The methodology of the research was also explained and discussed at the workshop, i.e. it was made clear that the teachers were responsible for their own use of innovation and good practice in teaching mathematics. What was required of them were observations on the things which happened in their classes and their reactions to the innovation.

Four classes were involved in the research. The study involved grade 7 students with ages

ranging from 12-13 years. Overall a total of 185 students and 8 teachers were involved in the study. The lessons covered some selected units in geometry at grade 7.

To prepare the lesson plans, the role of these units in the curriculum and how they were usually taught was considered and discussed. Teachers agreed that the lesson plans should have some of the following characteristics:

- The mathematics content taught should be meaningful;

- The thinking processes of students should be obvious in their answers, products, and presentation and that anyone watching the video should be able to recognise them.

- The innovation in teaching and learning should be discussed, and prepared in the mathematics division of the school. Every teacher in the division should have his/her own contribution to the innovation.

- The lesson should use instructional materials that are innovative and appropriate to the school.

The teachers who were to implement these lesson plans were chosen by teachers in the division. They already had experience of creating problematic situations and asking open-ended questions that required mathematical thinking of the students.

The lessons were videotaped and analyzed using the video recording and the transcript. The actual lessons included several open-ended activities.

4. Research Findings

These lesson plans designed by senior teachers were implemented in four different classes before filming. In the first classes, there were seven observers, who were mathematics teachers at the school. Through discussion, teachers found out that the lesson plans needed to be changed in some places to help the students answer the open-ended questions in problematic situations. Some questions were not clear and were too general, so students did not feel confident enough to answer. Some questions merely required a good memory and recall and students were not interested in answering these. The lesson plans were consequently revised and taught in other classes. In the second classes teachers observed students folding, drawing and measuring and discovered that students exhibited good responses to questions and actively engaged in the tasks. This time, the teachers agreed that the lesson plans and their progression suited the students in every grade 7 class. The lessons, however, still required revision. It was then decided, in the third round, for the purposes of filming, to implement the revised lesson plans in two actual classes. The students' responses to instructional activities at both consideration and evaluation points were recorded and analysed.

There were thirteen mathematics teachers observed in the classes. After observing the actual classes, a meeting was organised in order to share ideas and provide feedback. During the meeting, the teachers gave a lot of comments about four main issues with corresponding research questions and these were recorded as follows.

4.1. Lesson study as a means to innovation

In the lesson study teachers played a central role in deciding on the innovation in teaching and learning. They were the ones to implement the innovations in their actual classrooms. Teachers helped each other to improve mathematics instruction in the classroom. The innovation can be shared with other teachers.

What was the innovation in teaching method that appeared in the lessons?

There were many answers to this question:

- Lessons started with some real life situations by asking students to investigate open-ended problems rooted in real contexts. The learning process involved all students working in small groups.

- Students actively sought and explored mathematical knowledge with the help of the teacher.

- The teacher used a means of posing a problem that was based on a real-life situation to engage the students' interest at the beginning of the lesson.

- The lesson was student-centered, and required cooperative learning. From a problematic real-life situation, the teacher facilitated the students to seek for and construct new knowledge.

- The students actively worked with mathematical problems.

- The teaching was innovative; it differed from the old approach of merely 'lecturing'.

4.2. The improvement of students' learning

Good practice as a means of improving student learning is being pursued. The good practice exhibited in this lesson study is based on actual outcomes of successful student learning, including students' mathematical thinking, and can be used for further development.

Was the mathematical content taught in the lesson meaningful and realistic?

- Students understood the relationship between mathematics and real life.

- By folding papers, and measuring lengths on the papers, students explored some properties of geometric figures.

- The lesson started within a real life scenario with the aim of developing meaningful mathematics knowledge and then students adapted the constructed knowledge to suit the real life situation.

- A mathematical concept was generated from a familiar situation in the real world. The information thus constructed helped students solve real-life problems.

- Students felt that there was really a link between mathematics and real life.

How were the key points intended to enhance students' mathematical thinking demonstrated in the lessons?

- Students demonstrated good responses to the questions, but it depended on the ability of each class as to the appropriateness of the questions.

- Students practiced measurements, induced from concrete data to generalize the mathematics properties.

- The open-ended questions gave students a chance to explore the property of three medians by themselves.

- Students commented positively on some mathematical ideas. .

- Students understood the problem solving process for real-life situations.

How was students' ability in responding to the questions and tasks requiring mathematical thinking reflected in the lessons?

- The tasks and questions were relevant to the students' previous knowledge, so they felt confident in seeking new information.

- Most of students applied mathematical reasoning to explain any new knowledge they found.

- Students then had to provide a logical breakdown of their results.

4.3. Lesson study supports the professional development

How did the instructional materials support the lesson?

- The instructional materials greatly assisted the lessons, and supported students in exploring and discovering new information.

- Low-cost instructional materials such as paper, and grid paper, combined with modern computers, helped students successfully explore mathematical ideas.

- The teacher used many kinds of instructional materials that helped students explore corresponding mathematical ideas effectively.

- An in-service training course for developing instructional materials is required, especially for computer software.

How did the interaction student - student - teacher show in the communication and discussion?

- The students worked in small groups with the guidance and evaluation of their teacher. Hints from the teacher were effective in discussions between the students.

- Some students were shy and hesitant when sharing their knowledge with friends.

What should be changed in the lesson to improve the learning study next time?

- One student should have a separate set of activities, so they can independently manipulate the object to explore mathematical ideas.

- These lessons can be applied broadly to other classes, but the professional ability of the teachers needs to be improved the students' assessment needs to be reformed.

4.4. Innovation in the implementation of the reform curriculum

How was the thinking process of students demonstrated when doing specific mathematical tasks in the lesson that were identified in the reform curriculum?

- Students had to accurately explore the mathematical properties of the triangles by observing, folding, measuring and inducing.

- Students could apply what they had learnt to solve some specific problems posed by the teacher.

- Most of the students showed that they understood the lessons, and solved the problems set by the teachers. These problems were revised from the text books.

What were the outcomes of the application of these lesson plans in the curriculum of lower secondary mathematics?

- With some schools having good facilities such as computers, and projectors these lesson plans will be very effective.

- This lesson study should be applied to other topics and classes.

- The curriculum is still too overcrowded, with teachers having to deliver a lot of the content knowledge from text books. Time constraint is, therefore a big issue if all students are to work at their own paces.

- Relevant facilities must be provided if schools are to prepare appropriate instructional materials for specific topics in the curriculum.

- The practical theories that help classroom teachers develop good practices which are relevant to the reform curriculum need to be implemented.

5. Conclusions

The lesson study cycle was introduced in a secondary school in Vietnam. All mathematics teachers in the school agreed that lesson study provided them a good opportunity to see teaching and learning in a classroom scenario.

From that actual scenario teachers developed innovative teaching practices to help student learning. The use of this innovation for the teaching and learning of mathematics in the classroom must be implemented to engage students in meaningful mathematical tasks that require higher order thinking. The innovation provides all students access to a broad range of mathematical ideas. Specifically, the research sought to find answers to the research questions.

Lesson study guides teachers in focusing their discussions on getting the effective innovation through the cycle. By discussing and sharing new ideas on good practices, observing what happens in the actual classroom, teachers improve their teaching and consequently enhance the students' learning. Lesson study can be applied to many topics in the reform curriculum. Lesson study as a means of innovation, actively affected to teaching and learning of mathematics in the school.

The innovation as a product of the lesson study helps students have a better and more meaningful understanding of difficult mathematical concepts. Students were able to discuss and interact freely within their groups while answering relevant open-ended questions. The students communicated amicably while they were engaged in the mathematics activities. With hands-on activities, students always have something to share with their friends about any problems involving with mathematical thinking. For giving them the opportunities to come up with new mathematical ideas as possible solutions for a non-routine problem rooted from real life, the students were exposed to a problematic situation they could not solve with their former knowledge. They had to construct new ideas as plausible solutions (Tran Vui, 2014).

The lesson study as a means to innovation for good practice in teaching and learning mathematics actually supported the professional development of teachers. Teachers learnt some new things from their peers and can now apply them to the teaching of mathematics. The reform mathematics curriculum requires students to learn mathematics in an active way to enhance mathematical thinking, so the innovation in teaching and learning mathematics can help teachers implement the curriculum effectively.

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Nghiên cứu bài học làm phương tiện đổi mới các thực hành tốt trong dạy và học Toán ở Việt Nam

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Tóm tắt: Bài báo này minh chứng rằng nghiên cứu bài học có thể được thích ứng từ việc sử dụng cơ bản của nó như là một phương án phát triển nghề nghiệp đến một phương tiện hiệu quả cho những thực hành tốt trong dạy và học toán. Kể từ khi chương trình toán chuẩn quốc gia của Việt Nam được ban hành năm 2006, các giáo viên toán đã học được nhiều hơn về các phương án dạy học tiên tiến như là phương tiện để thực hiện càng nhiều các bài học hiệu quả đặt trọng tâm vào tư duy toán học. Mục đích của bài báo này là để trả lời bốn câu hỏi liên quan đến những đổi mới và thực hành tốt trong lớp học toán. Thứ nhất, nghiên cứu bài học như là một phương tiện để đổi mới có ảnh hưởng như thế nào đến dạy và học toán? Thứ hai, đổi mới này ảnh hưởng như thế nào đến việc nâng cao việc học của học sinh? Thứ ba, nghiên cứu bài học hỗ trợ việc phát triển nghề nghiệp của giáo viên như thế nào? Cuối cùng, việc đổi mới dạy và học toán có tác động như thế nào lên việc thực hiện đổi mới chương trình? Các kết quả của nghiên cứu này sẽ làm sáng tỏ những đóng góp mang tính tương đối của nghiên cứu bài học ở cả việc dạy và việc học toán với trọng tâm chính là tư duy bậc cao.

Từ khóa: Thực hành tốt; nghiên cứu bài học; phát triển nghề nghiệp; toán học nhà trường đổi mới; dạy và học toán.