C-2-1 **PP-082**

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Challenges Presented in Solving Mathematical Problems

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During the 2012-2013 school year, we developed some suggestions from the Japanese proposal called 'Lesson Study' with some teachers in training in Mexico. In that experience, we reported that children do addition and subtraction algorithms in a correct way, but they could hardly find the meaning of the implicit magic in the properties of numbers and its operations.

Questions.

We have been asking: Which strategies allow children to learn math by themselves with their own previous knowledge? What strategies do those children use to identify regularities and patterns, in order to build mathematical knowledge collectively?

Strategy developed.

In response to these questions, we have been working mathematical challenges which rise multiple solutions with children of 'Basic Elementary Education' in Mexico. We call 'mathematical challenges' to the mathematical problems with certain properties of numbers and its operations. These types of problems are not routine, but as it is described by Santos (1992), in his document 'Sesoluci~n de problemas; El trabajo de Alan Schoenfeld: Una propuesta a considerar en el aprendizaje de las matematicas' those are the ones that have several methods of solution or require more than a simple application of rules, formulas or algorithms. Like this example.

To identify and apply the mathematical property $a-b=(a \pm c)-(b \pm c)$.

Method.

We have been attending those problems with some suggestions from the "Lesson Study" in planning, implementation and evaluation stages, and we have achieved the participation of all children in their resolutions. In the first stage, we considered among others, the purposes and the manner of the content presentation. A lesson plan which specifies the start, development and closure, is developed in order to achieve the stated objectives. In the second stage, the lesson plan and the inclusion of observers are implemented. And the third stage is the evaluation of what has happened during the class. This process takes place after the end of the same class. During this phase, the teacher conducting the session, exposes his experience, the difficulties and strengths experienced during the session based on the purposes, results and expected learning outcomes. Subsequently, observers participate actively with the results of their observation reflecting, among others, so as the learning achieved by the children during the class.

In the class implementation, inductive processes are used to promote reasoning with a great number of proposed values. To this form, a problem with multiple solutions is constructed. A purpose is suggested and the class is planned. In the initial stage of the class, the resolution of the problem is shown to children, where every child can answer it in an empirical way using their previous individual knowledge. At the development stage, it is planned to invite children to solve the problem with different variants. The variety of examples elaborated by children, are organized on the board. Children observe the situation as a whole, and this process allows them to identify regularities and explain their reasons why certain mathematical conditions are accomplished. Finally, in the closing phase, variants of the problem are presented to give some feedback on the lessons learned.

Some conclusions.

With these experiences, we have found that children create mathematics by themselves; they use their own strategies to identify regularities and patterns of a mathematical problem. The solutions have been built based on children knowledge, and we have allowed the generation of new challenges that enable children to develop mathematical thinking.

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Adapting Mathematical Discourse in Instruction Framework for Planning and Analyzing Research Lessons

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In this paper, we report on our use of mathematical discourse in instruction (MDI) framework (Adler & Ronda, 2015; 2017) to analyze and plan the mathematics content of our research lessons. Our motivation in undertaking this activity is to find out how we may adapt the framework to help us think about the mathematics we make available to learn. The use of the framework would also provide some theoretical basis for our instructional decisions in our lesson study works apart from the empirical evidence we gather during the lesson implementation. We think that having a research-based framework is important especially that we do not always have a knowledgeable other from university to help us towards deeper learning out of our lesson study.

The MDI framework is a sociocultural tool for analyzing the quality of mathematics made available to learn in lessons. It consists of six analytic constructs: the object of learning and four instructional tools for mediating the object learning namely tasks, examples, naming or word use and substantiating. It also includes descriptions of the nature of learner participation during the lesson. The framework was introduced to us by the third author of this paper as tool for us to think about our teaching particularly in our lesson study activities. In the study we report here, we sought to answer the questions (1) What is the quality of mathematics we make available to learn in our research lessons? and (2) Which aspect of the MDI framework is helpful and productive for us? Our method involved analyzing previous versions of our research lessons and then use it to inform the revised version for our lesson study. In the presentation, we will illustrate our use of the framework on our research lesson on division of monomials. Our results suggest that there is a need for us to pay attention to our explanatory talk which includes naming or word use to refer to mathematical aspects of the lesson and to making explicit the kind of mathematical substantiation we expect especially in our written research plan. We report the details of our results here together with how we have adapted the MDI framework in paying attention to the mediational tools even in our teaching outside lesson study activity.

References:

Adler, J., & Ronda, E. (2015). A framework for describing mathematics discourse in instruction and interpreting differences in teaching. African Journal of Research in Mathematics, Science and Technology Education, 19(3), 237-254. doi:10.1080/10288457.2015.1089677.

Adler, J., & Ronda, E. (2017). Mathematical discourse in instruction matters Research for Educational Change: Transforming Researchers' Insights Into Improvement in Mathematics Teaching and Learning (pp. 64-81).

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Students' Mathematical Reasoning Habits in Mathematics Classroom Using Lesson Study and Open Approach

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A reasoning habit is a productive way of thinking that becomes common in the processes of mathematical inquiry and sense making (Martin et al., 2009; NCTM, 2000; Russell, 2010). Students also need to experience and develop mathematical reasoning habits (Cuoco, Goldenberg, and Mark, 1996; Driscoll, 1999; Pólya, 1952; 1957; Schoenfeld, 1983; Harel and Sowder, 2005). In addition, Lesson Study and Open Approach Contexts in Thailand is innovation that supports to solve mathematical problems both teachers and students as well (Inprasitha et al., 2015) and changing mathematics instruction of 21st century that emphasized thinking to generate the remedies themselves (Inprasitha, 2015).

This research was aimed to explore the mathematical reasoning habits of students in mathematics classroom using Lesson Study and Open Approach. Methodology is qualitative research that focuses on protocol analysis and analytic description. The target group was 6 grade students in the first semester of 2016, 8 students were divided into 2 groups, at Chumchon Ban Kaeng Khro Nong Phai School, Chaiyaphum Province. This classroom is in the School of Professional Development of Mathematics Teachers Project by using the Innovation of Lesson Study and Open Approach of the Center for Research in Mathematics Education (CRME), Faculty of Education, Khon Kaen University. The data was collected by using lesson plans, video recorder, audio tape recorder, field note, images recorder, and student work of task-based learning activities. The data was analyzed by using Martin et al. (2009) to explore the students' mathematical reasoning habits during their problem solving.

The finding found that, in the mathematics classroom using Lesson Study and Open Approach were evident four categories of students' mathematical reasoning habits: 1) Analyzing a problem ‘ students could analyze the problem situations that the teacher assigned. They made reasoned conjectures in the classroom; representations; applying previously learned concepts; seeking patterns and relationships, 2) Implementing a strategy ‘ students could implement the ways of problem solving by using mathematical operations to solve problems, 3) Seeking and using connections ‘ students could discover the link between different the sorting out the problems; finding the relationship of that approach by getting the same answer, and 4) Reflecting on a solution ‘ students could find different ways; considering the reasonableness of a solution; interpreting a solution; justifying or validating; generalizing a solution.