A Design of Professional Teacher Training with PMRI and LSLC System

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Abstract: This paper aims to provide an example of mathematics teachers training design as a solution to improve the competence of high school mathematics teachers to be more professional in carrying out the classroom instruction. This training is designed using In-On-In patterns, consisting of In1 activities where the high school mathematics teachers are trained on how to design PMRI-based instruction with 3 principles and 5 characteristics, the instruction using the LSLC (Lesson Study for Learning Community) system, consisting of four stages namely design, do (implementation), see (reflection), and re-design. After training the teacher is asked to implement their knowledge from the training in a class as an On activity which is documented and analyzed. The weaknesses of the instruction during On activities are retrained during In2 activities by individual or group assistance according to their weaknesses. The results of the design of this training design can be an alternative in improving the competence of professional mathematics teachers.

1 INTRODUCTION

The low competence of teachers in conducting mathematics instruction is very influential on the poor quality of students' learning outcomes. Based on this reality, it is necessary to change the system in the instructions. The instruction developed by the teacher should be able to encourage an increase in students' thinking ability to improve their creativities and build their independence in solving the problems given.

Related to the issue of teacher development at the international level, according to the results of the United Nations Educational, Scientific, and Cultural Organization (UNESCO) survey, on the quality of teachers in developing countries in Asia Pacific, Indonesia is ranked 10th out of 14 countries. As for the teachers, the quality is at level 14 of 14 developing countries. One factor that contributes to the low quality of teachers in Indonesia is their lacking of exploring the students' potential. Teachers often impose their will without paying attention to the needs, interests and talents of their students. Teachers should pay attention to the needs of children instead of imposing something that makes children less comfortable in studying. In general, (Marpaung, 2006) mentions that one of the problems in mathematics education is to know how students learn and master complex concepts, rules, procedures, or processes in mathematics. Thus, the teachers need to understand not only mathematical material, but also how their students understand the materials, including their reasoning skills. In other words, a good teacher provides opportunities for children to be creative.

A professional teacher is required to master a number of competencies. The law no. 14 (2005) describes these competencies as a set of knowledge, skills, and behaviors that must be owned, internalized, and mastered by the teacher in carrying out his professional duties. One effort that can be done in addressing this is by improving the mathematics instruction in terms of the process and the quality.

One approach to mathematics instruction that is in accordance with the revised 2013 curriculum is the learning approach of PMRI (*Pendidikan Matematika Realistik Indonesia*-Indonesian Realistic Mathematics Education). The students' real-life situation is not only limited to what is visible, but also all things that are accessible by their imagination (Putri, 2015). In order to improve students' mathematical reasoning skills, firstly the teachers need to understand students' reasoning abilities. This

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is in accordance with the 3 principles and 5 characteristics of PMRI.

The implementation of teacher professionalism development programs in Japan has proved that Lesson Study can improve teacher (Masaki, 2012). There has been a lot of research on lesson study which shows its success when applied to Indonesian teachers. This program, now under the name Lesson Study for Learning Community (LSLC), is a system of teacher professional development through the study of collaborative learning and based on the principles of collegiality and mutual learning to build learning communities and improve the quality of learning which ultimately creates dynamic interactions between teachers so that creativity and motivation are built continuously. This practice will be optimal if the teachers understand the concepts and application methods of the LSLC system and PMRI-based learning. Thus, this paper will discuss the design of PMRI and LSLC system-based professional teacher training.

2 BACKGROUND THEORY

2.1 Professional Mathematics Teachers

According to Law No. 14 of 2005, professions are jobs or activities carried out by a person which become a source of income for life that requires expertise, proficiency, or skills that meet certain quality standards or norms and require professional education. In the meantime, teachers are professional educators whose main jobs are educating, teaching, guiding, directing, training, evaluating, and evaluating students in early childhood education in formal education, primary education, and secondary education. In this paper, teachers refer to Mathematics teachers.

2.2 Teachers' Professionalism Development

There are many ways that can be done by teachers in the context of developing their professionalism. Udin (2009) mentions several alternatives in teachers' professional development programs. One of them is by means of competency-based integrated teacher training program, followed by ongoing assistance.

2.3 PMRI (*Pendidikan Matematika Realistik Indonesia* – Indonesian Realistic Mathematics Education)

PMRI is a learning approach that adapts Freudenthal's thinking known as Realistic Mathematics Education (RME), which has been developed in Indonesia since 2001 (Zulkardi, Pengembangan Materi Pembelajaran Bilangan Berdasarkan Pendidikan Matematika Realistik untuk Siswa Kelas V Sekolah Dasar, 2009). Etymologically, realistic word comes from the Dutch language "zich realiser" which means "to imagine" or "to imagine" (Heuvel-Panhuizen, 1998). In the framework of RME, (Freudenthal, 1991) states that "mathematics must be connected to reality and mathematics is a human activity". First, mathematics must be close to students and relatable to everyday life situations. Second, he stressed that mathematics is a form of human activity. This statement means that mathematics is not a finished product, but rather a form of activity or process in constructing mathematical concepts. This process is carried out by students actively finding a mathematical concept with teacher guidance or in the term "guided reinvention". Therefore, many opportunities are given by the teacher to students to build their own understanding.

The use of the word "realistic" is often misinterpreted as "real-world." Based on this misunderstanding, many parties consider that a realistic mathematical approach is an approach that must use everyday problems. (Heuvel-Panhuizen, 1998) argues that the use of the word "realistic" does not merely indicate the connection with the real world but rather refers to the teacher's focus on realistic mathematics in placing emphasis on the use of imaginable situations by students. So, realistic here does not mean concrete in plain view, but also includes what can be imagined by students.

There are three principles in PMRI (Zulkardi & Putri, 2010) namely:

1. Guided Reinvention and Didactical Phenomenology

Based on the principle of guided reinvention, students should be given plenty opportunities to experience the same process when mathematical concepts are found. This principle can be inspired by using informal procedures.

2. Progressive Mathematization/Didactical

The concepts that exist in mathematics are made to regulate existing phenomena, both those originated from everyday life and those originated from mathematics itself.

3. Self-developed Models
The role of self-developed models is to bridge students from real or concrete situations to abstract situations, or from the informal stage to the formal stage of mathematics. In the early stages, students develop a model that they recognize. Then, through generalization and formalization, the model eventually becomes a form of mathematical formula that is in accordance with mathematical concepts. The four levels or levels of the mathematical model are illustrated as follows.

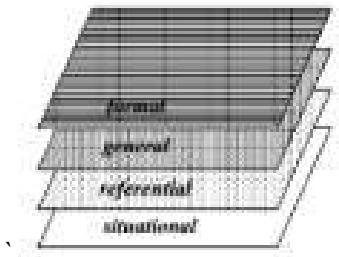

Figure 1: Level of model development.

a. Situational level is the most basic level of modeling where specific areas of specific domains, situational knowledge and strategies used are still in the context of the problem situation used.
b. Referential level is the level where the model and strategy developed are not in the context of the situation, but have referred to the context. At this level, students make a model to describe the context situation so that the results of modeling at this level are called the model of the situation.
c. General level refers to the model developed by students that has led to finding solutions. This model is referred as model for problem solving.
d. Formal level refers to the stage where students have worked using symbols and mathematical representations. The formal stage is the stage of formulation and affirmation of the mathematical concepts built by students.

In addition to these three principles, PMRI has five characteristics (Zulkardi & Putri, 2010). They are:
1. Phenomenological exploration or the use of contexts.
   In the first learning activity, concrete or real context is used as the basis for mathematical activities.
2. Using models and symbols for progressive mathematization
   The second characteristic of PMRI serves as a bridge from the concrete stage to a more formal stage using models and symbols.
3. Using students' own construction and production
4. Interactivity
   PMRI learning activities carried out by students can be seen as individual process as well as social processes. At this writing, students not only carry out individual processes in learning mathematics but also socially involved.
5. Intertwinement
   Intertwinement integrates various mathematical topics in one activity.

2.4 LSLC (Lesson Study for Learning Community)

According to (Baba, 2007), lesson study refers to a process in which teachers progressively try to improve their teaching methods by collaborating with other teachers. In the meantime, (Sukirman, 2006) views lesson study as a model of teacher professional development through the study of collaborative and sustainable learning based on the principles of collegiality and mutual learning to build learning communities. (Masaki, 2012) said that learning club is needed to improve the quality of teachers in order to cultivate a habit of doing activities to learn from fellow teachers. Thus, the name Lesson Study for Learning Community (LSLC) becomes a system of teacher professional development through the study of collaborative and sustainable learning in Indonesia. LSLC consists of four stages namely plan/design, do (implementation), see (reflection), and re-design.
1. Stage of Planning (Plan)
   This planning stage, the teacher collaborates with other teachers in the team to prepare the lesson plans with student-centered activities, analyze the needs and problems faced in learning, and then find a solution to solve all problems found. The results of the needs and problems analysis must be considered, so that the lesson plan becomes a plan that is truly relevant with expectations and applicable regulations, which include all stages of the implementation of learning; the initial, core, and final stage of learning.
2. Implementation Steps (Do)
   The instruction is carried out by one of the teachers who are mutually agreed to practice the lesson plan that has been prepared together. In the meantime, other teachers make observations (These observations could be done by members or the lesson study community which are teachers, principals, or school supervisors, or other invitees acting as observer / observer).
3. Stages of Reflection (See)
   This stage is very important as part of the efforts to improve the instruction. This activity is carried out in the form of discussions attended by all lesson study participants who were guided by one of the

designated team members. The discussion begins with the delivery of impressions of the performing teacher regarding the instruction that they did, such as the difficulties and problems in implementing the lesson plan that has been prepared.

4. Stages of Follow-up (Re-design)

From the conclusions from reflection stage, a number of new knowledge to improve the learning process can be obtained. Various valuable findings and input delivered during the discussion certainly become the basis for the teachers, both those who acted as instructors and observers to develop better instruction. Then all results of the input become a concern for the preparation of the next lesson plan.

3 DISCUSSION

3.1 Training Design

The government has implemented many ways to improve teachers' competencies through IN-ON-IN training patterns (on the job training and in service training) because the results are more effective. The design of teacher training with the IN-ON-IN pattern in this paper is as follows:

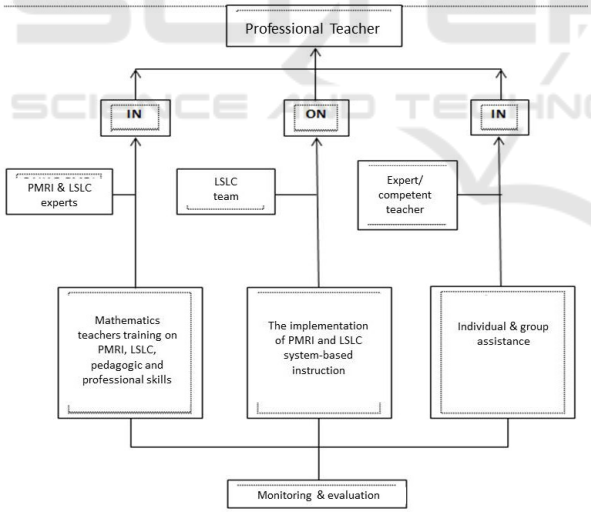

Figure 3.1 Workshop design of mathematics teacher.

3.1.1 Stage IN1

The training participants, i.e. math teachers, are trained by PMRI experts and LSLC on how to design lesson plans with 3 principles and 5 characteristics from PMRI starting from the initial, core and final activities; the assessment, i.e. task sharing and jumping tasks which are the characteristics of LSLC, referring to HOTs questions; the collaborative teaching simulation, consisting of how the LSLC system stages start from plan/design (planning), then do (implementation), see (reflection), and re-design. At this stage there are also examples of instruments for PMRI-based lesson plan review, observation instruments and training participants' satisfaction instruments to measure the participants' understanding on the materials.

3.1.2 Stage ON

After the training, at this stage the teacher is asked to implement all the training materials in their respective schools, by forming an LSLC team. The activities consist of: a) setting teaching schedule, b) arranging classroom in the U-shaped seating plan, c) selecting students in groups of 4, 2 boys and 2 girls crossed, the model teacher, the appointed observer team, d) bringing video recordings, photo documentation, and notes during classroom learning activities, e) filling all previously designed instruments, and finally f) carrying out all stages of LSLC starting from the Plan (PMRI-based lesson plan that has been designed during training), do (implementation of the instruction), see (discussion of the observation report) and re-design (the result of discussion is revised to fix the mistakes).

3.1.3 Stage IN2

At this stage, all the weaknesses experienced by the teacher when ON activities are identified and analyzed according to the category of weaknesses. After that, the resource person or designated teacher (the teacher who is able to carry out all stages properly) is invited back to provide assistance to overcome all weaknesses that occurred during ON activities. This activity is carried out routinely and continuously until potential effects are seen. After the teacher is better prepared, the teacher is asked to carry out "open class" activities which are attended by school supervisors, principals, LSLC teams, other mathematics teachers, etc.

4 CONCLUSION

The design of PMRI and LSLC system-based mathematics teacher training with the IN-ON-IN pattern is expected to be an alternative in realizing professional teachers, because it can help mathematics teachers develop their professional and

pedagogical abilities in conducting classroom instructions. In addition, teachers' collaboration provides many opportunities for them to get new ideas also and have direct consultation with experts during training or IN activities. In conclusion, this design can improve the quality of teachers to become professional teachers, and the quality of instruction which in turn can improve the quality of graduates.

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