

# PROFESSIONAL DEVELOPMENT OF PMRI TEACHERS FOR INTRODUCING SOCIAL NORMS

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## *Abstract*

This paper reports implementation results of designing a workshop for mathematics teacher in introducing classroom social norms. The participants are eight mathematics teachers in primary and junior secondary level. Teachers learned and did some activities about social norms during the workshop. First, they watched an example of learning videos about social norms. Then they discussed and shared in the group about their experiences in using social norms in the classroom. Finally, they made a commitment to try their knowledge about social norms in their classroom. This research used the design research method. Data were collected using videotaped, interview, and focus group discussion and were analyzed qualitatively. Results show that: (1) Teachers satisfied in following all activities relating to the social norms in the workshop. (2) Teachers realized that they had used some activities of social norms such as guiding students to communicate, asking questions and giving argumentation. (3) Teachers have more confidence to use social norms in their mathematics classroom.

**Keywords:** Classroom Social Norms, Teacher's Workshop, Design Research, PMRI

## *Abstrak*

Makalah ini melaporkan hasil pelatihan yang didesain untuk guru matematika dalam menggunakan normas sosial di kelas. Peserta pelatihan terdiri dari 8 orang guru matematika SD dan SMP. Aktivitas dalam pelatihan tersebut adalah memberikan contoh melalui pembelajaran menggunakan norma sosial di kelas; berbagi pengalaman melalui diskusi kelompok mengenai pengetahuan tentang normas sosial di kelas; dan setelah pelatihan peserta diminta untuk menerapkan pengetahuan mereka tentang norma sosial di kelas masing-masing. Data yang dikumpulkan melalui video rekaman, wawancara, dan diskusi kelompok terfokus dianalisis secara kualitatif. Hasil dari penelitian menunjukkan bahwa (1) peserta senang mengikuti semua aktivitas pada workshop terkait norma sosial di kelas (2) guru sadar bahwa mereka selama ini telah menggunakan beberapa aktivitas yang termasuk norma sosial di kelas seperti menggiring siswa untuk bertanya dan berargumentasi; (3) guru lebih percaya diri untuk menggunakan norma sosial di kelas yang diajarnya.

**Kata Kunci:** Norma Sosial di Kelas, Lokakarya Guru, Design Research, PMRI

Pendidikan Matematika Realistik Indonesia (PMRI) is an innovation in mathematics teaching in Indonesia. It has been initiated by a group of teacher educators and mathematicians since 2001 (Sembiring, Hoogland, & van den Hoeven, 2009; Putri, 2011). Up until now, many efforts have been carried on by the PMRI team to develop mathematics education in Indonesia. In South Sumatera, 20 pilot schools have been encouraged to implement the PMRI in their classrooms. The PMRI has been widely applied in mathematics learning, starting from the elementary to university level in the form of lectures, research, and community services. The learning used student-centered approach. The learning material has employed local-culture contexts which experientially real to students. Using a context the

students would not learn directly to the formulas (Putri, 2012). Classroom activities designed by the teachers also have engaged students in group and classroom discussions.

Mathematics education in Indonesia has been changing: from instruction as the ‘transmission of knowledge’ toward ‘learning as the construction knowledge’ (Gravemeijer, 2010). Often in group and classroom discussion, many students find struggles to explain clearly and understandably to their friends. These difficulties might indicate that the teacher has not used the social norms in his/her classrooms. Meanwhile, a problem-centered and interactive classroom requires a difference didactical contract called classroom social norms. In the learning process, students have the obligation to think themselves, and to explain and to justify their solution. In addition, they also try and understand other student’s reasoning, to ask a question about the explanations they do not understand, and challenge arguments they do not agree with (Gravemeijer, 2010).

Classroom social norm is a challenging practice for both teachers and students because in many countries it is not considered a part of the classroom culture yet (Widjaya, 2012). Several norms used in the traditional teaching method, are still existing in today’s classroom. For instance, teacher gave instructions, asked closed questions while the students would just try to understand what the teacher said and acted according to the teacher’s expectations. The teachers get used to traditional teaching for many years. They were used to explaining all the materials to students. In such a method, the teacher usually posed only yes-or-no questions for students. Besides, the classroom condition is still chaos, for example, when answering teacher’s question, the students would raise their hands while yelling disorderly ‘Me... Me...’. This situation is in line with the study of Widjaya (2012) who identified the noisy situation in Indonesian classrooms as a consequence of the absence of the rules on how to answer teacher’s questions.

Implementations of PMRI should result in problem-centered and interactive mathematics education. However, inability of the teacher to well manage the classroom remains a problem (Bustang, 2013). Although in the learning, contexts are used, and the learning process has encouraged students to interact one another, the classroom situation is still poorly controlled. As the consequence, the students could not understand the mathematics concept well. Bustang (2013) suggested the need for helping teachers in Indonesia to develop norms in PMRI classrooms in order to encourage them to move from perceiving teacher as the provider of knowledge the teacher as a knowledgeable orchestrator.

The research question of this article is how to support teachers to implement social norms in the classroom? The research goal is to report an analysis of designing teacher’s workshop in introducing social norms in the classroom.

### **Social Norms**

The notion of “norm” in the classroom is processed as a device to interpret classroom processes and clarify how children’s beliefs and value develop (Yackel and Cobb, 1996: 460), organize and stimulate the pupils to compare their solutions in a class discussion, and ask the pupils to communicate,

argue and justify their solution (Zulkardi, 2002: 25). Several classroom social norms work on some project classrooms, such as “students were obligated to explain and justify their reasoning” (Yackel and Cobb, 1996: 460). Yackel and Cobb (1996: 458-477) have found that teachers who work to establish social norms created a classroom climate that supports problem solving and inquiry, such as students question others’ thinking; students explain their ways of thinking; students work together to solve problems; students solve problem using a variety of approaches; and student see making mistakes as a natural part of learning. The use of social norms in Indonesian classrooms to facilitate interaction between teacher and students and among the students themselves in the learning process requires not only answering, but explaining how to get to the answer.

An individual and social construction in a learning process is inseparable. Therefore, an individual development when learning mathematics is not independent of the social and cultural interaction in their learning community in a classroom (Cobb, 2000; Yackel & Cobb, 1996).

There are three important aspects in a learning process, according to socio-constructivists view, such as:

1. Social norm. Social norm consists of regulations that teacher and students agreed to use during the classroom sessions. An example of a social norm is when a teacher asks students to explain their problem-solving strategy. In this manner, the students should try to understand the answer of his/her fellow students by asking.
2. Socio-matematical norms. Cobb and Yackel (1996) defined the socio mathematical norms as norms that speak of mathematical differences, mathematical sophistication, and acceptable mathematics problem-solving. For instance, teacher’s and students’ agreement that correct answers contains not only a correct mathematical calculation, but also correct understanding and interpretations toward the questions.
3. Mathematics classroom practice. Mathematics classroom practice involved documentation of students’ mathematical development, classically or individually. These employed the trace of students’ learning trajectories, when the teacher and the students were discussing mathematical problems, discussed on the problem orally or involving mathematical symbols.

Cobb, et al. (1996) and Wijaya (1999) categorized the norms into social norms and socio-mathematical norms. Social norm controls a more general social interaction, which might not relate to the topic of the lesson. Meanwhile, the socio-mathematical norm is related to mathematical argumentation.

Graveimejer (2010) and Widjaya (2012) related the socio-mathematical norms to the tenet of “vertical mathematizing” in RME or PMRI. In PMRI classes, teacher encourages students to participate actively by answering the questions from the teachers.

## **METHOD**

Participants of this research are eight teachers involved in this study. Those teachers are home to the PMRI project schools in South Sumatera. The present study is a design research aiming to develop a local instruction theory based on the existing theories and empiric data gathered under the collaboration of the researcher and teachers. This method is chosen to excel the relevance between educational policies and practices (Gravemeijer & van Eerde, 2009).

There are three phases in design research according to Gravemeijer and Cobb (2006:19) and Bakker (2004), such as:

1. The first phase: Preparing for the experiment

Gravemeijer & Cobb (2006) stated the main aim of this phase, such as to formulate a local instructional theory which is elaborated and refined during the experiment process. In this phase, a sequence of activities including conjectures of students' thought was developed in a hypothetical learning trajectory (HLT). Activities performed in this phase include: selecting a model teacher; analyzing learning process using social norm in the classroom; setting and establishing starting point of the experiment; and designing and developing material for the workshop. Afterward, the researcher observed the classroom, interviewed the model teacher to gain an insight of the ability and the initial condition of the class. Next, the researcher recorded the learning video that took place in the classroom before introducing the social norm. Then the researcher introducing social norm to the model teacher. Also, designing learning material on the quadrilateral topic together with the model teacher, and recording the activities took place in the classroom that already implement the social norm.

2. The Second Phase: The design experiment

Activities performed in this second phase follow the design of the learning designed in the initial phase. The aims of this implementation are to explore and to observe students' strategies and thought on the topic of quadrilateral. There are two cycles in this phase; that is:

- a. First cycle: Pilot experiment

The goal of this cycle is to increase the quality of HLT designed in the initial phase through workshops. Therefore, all the participants can understand what the social norm means by watching videos about a teacher who knows nothing about social norms beforehand and also discussing and commenting at the video.

- b. Second cycle: Teaching experiment

In teaching experiment, there were 8 participants as the subject of the experiment. They watched learning video for an example of the social norm activities. Afterward, those participants discussed and gave a comment on the video of the class situation which has not showed the social norms. After that, those participants watched the learning video of the same class situation after the treatment. Again, the participant discussed and commented on the video focusing on

- students' thinking process, mathematical activities, classroom social norms and socio-mathematics norm. Then, the activity is concluded once teacher model shared her experiences.
3. Phase 3: The retrospective analysis
- In this phase, all the data gathered in the teaching experiment will be analyzed, not only the ones who are in accordance to the HLT but also those that contradict the conjecture designed initially. The result of the retrospective analysis will be used as the topic of the discussion regarding the whole workshop activities, and as a conclusion or a recommendation of the HLT.

Techniques of data collection employed in this research are:

1. Interview

The interview was done with the eight teacher participants to gain information related to this research. The interview conducted before the implementation of the first and the second cycle. Thus, the researcher got insights about students' conditions, appropriateness of the contexts used, and the compatibility of the learning materials, timings, and the teacher's opinion about the HLT.

2. Classroom Observation

Classroom observations were conducted in each stage, starting from the stage 1 before the first cycle and during the first and second cycle. Preliminary observations of the first cycle were meant to gain insights about the social norms and socio mathematical norms existing in the classroom, teacher's method of teaching, class organization, and rules in the class.

Meanwhile, classroom observations conducted during the first and the second cycle aimed to observe students' learning and to confirm the practicability and the effectiveness of the instructional designs and the revised version of the instructional designs. Specifically, the observations of the first cycle were employed to find out students' strategies compared to the first version of the HLT. The data were registered using video cameras and field notes.

3. Documentation

Documentation of data of the students' strategies, individually or in a group, during the learning was taken using video camera. We employed two types of video camera for registering the data:

a. Static video camera

It functions to register all activities in the class.

b. Dynamic video camera

It functions to register specific fragment of students' activities during the class discussion or group discussion. Moreover, the observer was also documented crucial moments of students' learning using photographs.

4. Field Notes

The observer makes field notes which aimed to support the registered data in the video camera, observation sheet, and interviews.

## RESULTS AND DISCUSSION

### *The First Stage*

The teacher involved in this study is Nurjanah from SMPN 1 Palembang, a public junior high in Palembang. Earlier, the teacher was trained how to use social norms in teaching and learning. The topic taught was 'quadrilateral' and the teacher asked the students to explain their answers and solutions of the given problems. Then, the students tried to understand the other students' answers and reasoning by asking, such as giving questions at the beginning of the lesson as shown in the following fragment.

Teacher: This one is Box or... In mathematics, we call it Cuboid. Do you know Cuboid?

Teacher: What is the meaning?

Student: Balok (in Bahasa)

Teacher: Balok, yes.

Teacher: In this cuboid, is there any line?

Teacher: How many lines?

Student: (counting) twelve

Teacher: it a line one

Teacher: What is the parallel line of the line in the base?

Teacher: Can you show me?

As shown in the fragment, we may know that the teacher was not have time to explain the answer or even to make other students understand the student's answer. After followed the workshop, the teacher's performance in applying social norms in her classroom showed a positive change. Her abilities to change in questioning, managing classroom discussion, and guiding students to understand the concept of quadrilateral shown in the following fragment.

Teacher : What do you know about acute triangle?

Teacher : How about the angle? In Indonesia, it is ok. Please...

(the teacher gives the student time to think)

Student 1 : Segitiga 'lancip' (in English lancip means acute triangle) Teacher: What are the characteristics of an acute triangle?

Student 1 : It has three acute angles

Teacher : Ok,.. please repeat it again and give time for another student

Student 2 : (thinking...), one of its angles is an acute angle

From the fragment, we can observe that the teacher has showed a small change in the way she teaches. For instance, the way she gives students time to think by themselves and if one student answer a question, she gives another student a chance to explain and rephrase the answer.

### ***Teacher Professional Development***

After the teacher was able to apply the socio norms in teaching, the researcher conducted trainings for eight teachers from the project schools. The training was aimed teachers to be able to apply the socio norms in their classes due to the importance of the socio-norms for the teacher to manage the learning.

The aims of the training of social norms are:

1. The participants are expected to be aware of how to implement socio norm in the classroom. They saw some examples of learning (videos) of how to implement socio norms during the learning and teaching situations.
2. The participants showed some video fragments of learning which showed a teacher teaches in traditional ways of teaching. After that, the participants were asked to give comment of the learning videos related to socio norms. The following are some comments from group 1.

Commentaries:

Firstly, the interactivity among students is rarely observable.

It means that the communication occurred only from a teacher to students.

There is no communication among students.

Secondly, teacher-dominated the learning and teaching process in the class.

Teacher only gave the explanation without giving more chance to students to answer the question.

Third, the teacher's question could not encourage the students' curiosity and the reasoning ability.

It means teacher stop only in 'yes-no question' without asking why the students give the answer.

Finally, students looked passive in the classroom because of language barriers.

From the commentaries above, we may see that the participants in group 1 were able to describe the socio norms implementation in the classroom. It said that the use of socio norms in the class was not well implemented.

On the second session, after the teachers used socio norms in their classes, they were given another learning video. The following are commentaries from group 2.

In the second video, almost all categories of social norms were satisfied in the learning activity.

In apperception, overall students have given change to answer question one by one. However, there is no change for other students to give responses.

In the main activity, students had a discussion in groups, shared their strategies.

In the closing, activity, the students present their work in front of the class.

During the implementation of the next training, the model teacher shared her experience with the participants. It was intended to let the participants know the reasons why the teacher model can make changes to the learning process emphasized on the social norms. The following are several grounds revealed by the teacher model.

1. Before familiar with the social norms, the teacher model experienced difficulty to deal with their students in junior high school who has the different background during the first semester. They do not understand the best way to study it. Thus, it became difficult for to change their mindset.
2. What I have to do in order to make it better is applying social norms. That is the reason I want to know which part I should emphasize
3. When the students gave their answers, we should give more challenging questions to explore their understanding. Although they only listen from their colleague's opinion, we have to ask how they can get the answer.
4. Questioning technique should be developed to make students courage. For instance, when students give the answer, we should ask them "why".
5. Do not stop on "why question". Thus, it is important to develop the questioning technique

Based on the teachers' explanation, the implementation related to the social norms in the classroom let them realize the importance of questioning skill. Therefore, the students have good communication skill such as explaining their answer or opinion in accordance with social norms, namely an explanation, justification, and argumentation (Yackel and Cobb 1996, p. 460).

At the end of the training, the participants implemented the result of the workshop in their classroom to examine the achievement related to the implementation of social norms. The participants are suggested to apply their understanding to social norms for a certain topic. Then it will be evaluated by their pairs in order to get a meaningful and maximal learning process.

## **CONCLUSION AND SUGGESTION**

The results of the professional development of teachers showed that (1) teachers satisfied in following all activities relating to the social norms in the workshop. (2) Teachers realized that they had used some activities of social norms such as guiding students to communicate, asking questions and giving argumentation. (3) Teachers have more confidence to use social norms in their mathematics classroom. These results imply that the workshop has a potential effect on helping teacher to learn social norms in the mathematics classroom.

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## REFERENCES

- Bakker, A. (2004). *Design Research In Statistics Education: On Symbolizing And Computer Tools*. (Doctoral dissertation). Utrecht: CD-β Press, Center for Science and Mathematics Education.
- Bustang, B., Zulkardi, Z., Darmawijoyo, D., Dolk, M., & van Erde, D. (2013). Developing a Local Instruction Theory for Learning the Concept of Angle through Visual Field Activities and Spatial Representations. *International Education Studies*, 6 (8), 58-70. DOI: 10.5539/ies.v6n8p58
- Cobb, P. & Yackel, E. (1996). Constructivist, Emergent, And Sociocultural Perspectives In The Context of Developmental Research. *Educational Psychologist*, 31 (3/4), 175–190.
- Cobb, P. (2000). Conducting Teaching Experiments In Collaboration With Teachers. In: A. E. Kelly, & R. A. Lesh (Eds.), *Handbook of research design in mathematics and science education* (pp. 307–334). Mahwah, NJ: Lawrence Erlbaum.
- Gravemeijer, K. (2010). Realistic Mathematics Education Theory As A Guideline For Problem-Centered, Inter-Active Mathematics Education. In R. K. Sembiring, K. Hoogland & M. Dolk (Eds.), *A decade of PMRI in Indonesia* (pp. 41-50). Utrecht: APS International.
- Gravemeijer, K. & Cobb, P. (2006). Design Research From The Learning Design Perspective. In Van den Akker, J., Gravemerijer, K., McKenney, S., & Nieveen, N (Eds.), *Educational design research*. London: Routledge.
- Putri, R.I.I. (2011). *Improving Mathematics Communication Ability of Students In Grade 2 Through PMRI Approach*. Paper presented in International Seminar and The Fourth National Conference on Mathematics Education UNY, Jogjakarta.
- Putri, R.I.I. (2012). Developing Learning Trajectory Using Traditional Games In Supporting Students Learning Greatest Common Divisor In Indonesian Primary School. *Proceeding ICME-12*, Seoul, Korea.
- Gravemeijer, K. & van Eerde, D. (2009). Design Research As A Means For Building A Knowledge Base For Teachers And Teaching In Mathematics Education. *The Elementary School Journal*, 109 (5), 510-524.
- Sembiring, R., Hoogland, K., & Dolk, M. (2010). *A Decade of PMRI In Indonesia*. Utrecht: APS.
- Widjaya, W. (2012). Exercising Socio-Mathematical Norms In Classroom Discourse About Data Representation: Insights From One Case Study Of A Grade 6 Lesson In Indonesia. *The Mathematics Educator*, 13 (2), 21-38.
- Wijaya, A. (2008). *Design Research In Mathematics Education: Indonesian Traditional Games As Preliminaries In Learning Measurement In Length*. (Master Thesis). Utrecht University.
- Yackel, E. & Cobb, P. (1996). Sociomathematical Norms, Argumentation, and Autonomy In Mathematics. *Journal for Research in Mathematics Education*, 27 (4), 458-477.
- Zulkardi, Z. (2002). *Developing A Learning Environment On Realistic Mathematics Education For Indonesian Students Teachers*. (Dissertation). University of Twente.