Mathematics teacher professional development program: fostering the skills for teaching meaningful mathematics through active learning during pandemic era

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Abstract. This is a report of a community service program for mathematics teachers. This program was held for fostering mathematics teachers’ skills in teaching meaningful through active learning using Google Classroom flat form. The program takes place in the Karanganyar region, Surakarta, Indonesia. The participants of this program were junior high school mathematics teachers from Karanganyar district. They were 28 participants. The workshop was held for three days: two days were face-to-face workshop and one day for the online workshop. There are four main topics for the workshop: (1) active learning; (2) Mathematical Abstraction and Mathematical Skills; (3) Developing Question and Students Worksheet; and (4) Designing Active Learning on Google Classroom. The development of offline and online modules in the workshop was based on the theory of I-CARE model. I-CARE Model comprises of five components: Introduction, Connection, Application, Reflection, and Extension. The module consisted of a package for doing workshop which is: Powerpoint slides for offline and online courses; word documents for explaining the structure of the workshop and the worksheet of the participants; a Google classroom for online activity. Due to the pandemic session, the activities of discussion during the workshop were held on online flat form in Google Classroom.

1. Introduction

Active learning has been recognized to be the most effective ways for teaching in 21st century including for teaching mathematics. Promoting the active learning for enhancing conceptual understanding and thinking skills as the goal of education in science and technology education era is become popular around the globe. Even though there are clear evidence from many research for the benefit of active learning but most teachers still adhere to traditional teaching method. This approach suggested the teacher for stopping transferring the mathematics content to students just directly like in a text book so the learner became a passive one [1]. Traditional teaching method in mathematics were (or probably are still) widely used for teaching and learning mathematics mostly because they perceived that mathematics is a fixed and static body knowledge so that it s taught by drill on number fact and computation [2,3]. Most mathematics teachers teach in a sequences starting with explain the concept then give example of a problem then ask students to solve similar problem and do the drill. This situation lead to the perception of students about...
mathematics as a subject that need memorization of many formulas and do not have any relation with creativity and critical thinking. This traditional teaching of mathematics still common in Indonesia [4].

Long before the covid-19 outbreak hit Indonesia, the implementation of active learning in mathematics classroom is still far from the expected. Many mathematics teachers are feel more comfortable using traditional teaching method [5]. Mathematics teachers actually understand the theory of active learning but some how they found difficulties in implementing the theory into the classroom. Based on this situation, a workshop need to be given for the teachers in order to help them implement the active learning in their classroom. Before the workshop had been conducted out of sudden the covid-19 hit Indonesia. The education sectors need to be adjust for safe mode in teaching and learning process. All schools have to conduct distance learning during the pandemic session. This is a great challenge for teachers because they never have an experienced doing distance learning for teaching mathematics especially in elementary and junior high school levels.

In sort period of time all teachers trying hard to move their face-to-face mathematics classroom into distance learning of mathematics classroom. Mathematics teachers in Karanganyar, Surakarta, Indonesia are expected to teach mathematics using Learning Management System (LMS) such as Google Classroom, Kahoot, Moodle, or other flat forms. Many teachers mostly used LMS just for uploading the content material or giving assignment and doing test using multiple choices problems. They did not understand how to manage the class so that the interaction takes place on the LMS. This situation caused students feel lack of interaction and lack of interest in learning mathematics, on the other side, teachers also feel unsatisfied with the learning process and also the result. Based on the situation described a training in a workshop for mathematics teachers is needed to help them conduct an active learning using ICT in their virtual classroom.

In collaboration between mathematics education department in faculty of teachers training and education, Sebelas Maret Surakarta with mathematics teachers association in Karanganyar district, a training for mathematics junior high school teachers was conducted during the pandemic session. This is a part of TPD program of mathematics teachers in Karanganyar district, Surakarta. This training was aimed for fostering teachers’ skill for teaching meaningful mathematics through active learning during the pandemic era.

2. Theoretical Framework
Active learning is associate with the constructivism paradigm which mean that students become the centre of the learning not the teachers who dominating the learning process. Establishing a learning culture that can promotes deep understanding through a process of intelligent learning become the goal of teaching process in mathematics. The teaching process should be focus on how mathematical concepts can be actively constructed by the students in a sequential activities. The result from this activities described as a relational understanding by Skemp [6]. The relational understanding and conceptual knowledge are the result of an intelligent learning that is when the learner is given the possibility to actively construct rich structures of cognitive connections within and between mathematical concepts [1].

One of the most important concepts in mathematical thinking is a concept of abstraction. An abstraction is a mental representation of a mathematical object. Abstraction without an article is the mental process by which an individual construct such an abstraction [7]. This process is considered very important in learning mathematics. This process is difficult to be expected happen naturally in students’ mind so that teachers need to design a context so that this process could take place in the classroom [8]. Teachers need to understand the meaning of this process and have to be able to design a context for abstraction.

Another important topic in mathematics education that need to be learned by teachers is concept of mathematical skills. Mathematical skills in this paper referred to standard process that published by the NCTM [9]. It comprises of mathematical connection, representation, communication, reasoning and proof,
and problem solving. In addition, as the workshop was held on blended type so these topics will be added by LMS as a tool as well as a material that need to be accomplished by the participants.

As the workshop would like to promote active learning for mathematics teachers in junior high school, so it should be designed based on theory of active learning. This is very crucial for mathematics teachers having learning experiences in constructivist learning environment. Teachers who have not experiences with active learning tend to skeptic in implementing the active learning in their classroom. Referred to this condition, the workshop should be design using an active workshop model.

In order to design the TPD program based on active learning framework, below are the characteristic of active learning that should be carried out during the learning process [1]: The learner is the key-person in active learning process, this is a student-centered learning. It means that the learner should be active mentally, socially, and physically.

The teacher should respect the learner as an individual who think and socially active because she is an authority and she has knowledge of mathematics and mathematics learning. It means that teachers should understand that she is the manager of the learning environment she also become as one of learning resources and she have to support the learner from non-threatening, communicative, and inclusive environment.

The teacher have to provide open-ended and mathematically rich learning task as a prerequisite for the possibility of constructing a conceptually rich cognitive structure and a relational understanding of mathematical concept. It means that procedural training and repetitive still needed but it should be integrated in and subordinated to mathematical task embedded in meaningful and social situations which can motivate the learner to be more active.

Teacher have to set the classroom in order to promote the interaction in small groups, whole-class discussion and individual seat work in accordance with the needs of the learner and learning task. It means that the set-up of the classroom should be flexible for students to be able to move around and the culture of the discussion should be open so that the interactions will be rich not only between teacher and students but also among students.

According to the characteristics of active learning so in this program a model has been chosen for designing the training, it called as I CARE model [10]. I CARE model comprises of five components activities, Introduction, Connect, Apply, Reflect, and Extend. It is developed for giving training/workshop or teaching in online form. The introduction section will present the information about how the training or workshop and course will be conducted in a whole, the aims of the training or the composition of the module as well as what prior knowledge needed to engage in the course or training. Based on [11] the connection section is primarily to deliver the new information in the context or to give instruction what material that participants need to be read either online or offline. In the application section, the participants need to practice the module, for example writing an article or sort paper, doing a hands-on activity, analyzing, designing etc. These activity can be done individualized or in small group. In other word, in this section participants are given opportunity to implement the new information/new concept in an appropriate context through some activities in a fair game. Reflection section is design in order to give opportunity for participants to reflect on their newly acquired skills and knowledge. The instructor need to provide questions to prompt the participants responses. It can be implemented a online form such as using Google form or in offline form by writing a journal. The extension section has many possible functions. It can provide a conclusion, prompt further exploration and learning, or assess participants’ skills or knowledge. It also can give opportunity to participants evaluate the workshop or course.
The program that held in this paper is not a fully online training. It is a blended type of training. The blended type of workshop model has been decided to be implemented based on the characteristic of the participants in this study. The culture of mathematics teachers in this site were socially reluctant to join a fully online workshop due to the lack of technology literacy. Most participants were familiar with the technology but not competence enough to operate the software or LMS by them selves.

3. The Methods
There are five topics that had been presented to all participant in this study using ICARE module of training:

- Key points in active learning
- Mathematical abstraction and mathematical skills
- Creating questions and designing mathematical worksheet
- Using Google Classroom for Active Learning

The workshop was held in blended mode in 32 hours. The first session is face-to-face mode that was held in SMP N 1 Kebakkramat, Karanganyar, Surakarta. The participants in this workshop were 35 mathematics teachers in junior high school level and there were five trainers and two assistant trainers. The second and third sessions as held in an offline mode to delivel the concep of mathematical abstraction and mathematical skills for about 8 hours. The third session held inofline form also still in the same place in the week-2 and week-3. In every week the training was held on Wednesday because this is a day for mathematics teachers can have time to do TPD program based on the regulation in Karanganyar district. Actually, even though the workshop was held in face-to-face mode but at the implementation we use an internet technology for doing group and whole class discussion. This type of discussion could prevent the participants to move from their chair and interact directly with their peers as recommend by the ministry of health to maintain the distance between the participants. The fourth session did in online form directly using Google Classroom as the LMS.

The workshop used module that consist of power point slides, learning material in word document, and worksheets. There are some targets that need to acquired by the participants, the final target was to design a virtual mathematics classroom that used active learning approach and trigger the abstraction process and mathematical skills.
4. Result and Discussion

The workshop has been conducted in four days with type of blended mode between on-line and off-line forms. The adjustment of the training model was did to fit with the new normal protocol for combating the Covid-19 outbreak. In the process of designing the workshop, some improvement of the module were taken placed, especially related to how the Application session would be carried in form of group discussion during the workshop without direct interaction in face-to-face mode. The idea was creating a space for online discussion using Google Classroom menu. Here is the example how we provide space for online discussion in Google Classroom:

![Figure 2. An online group discussion during application session.](image)

The participants actively involved in the activities that provided by the trainer. It can be seen by their reponses in the whole-class discussion in figure 3 below:

![Figure 3. The whole-class discussion on google classroom.](image)

When the participants were learning how to use Google Classroom, they also learn how to use the Google Document, Google Drawing, and Google Spread Sheet at the same time. Below is an example how they have to fulfill the group assignment using Google Spreadsheet that was embedded in Google Classroom menu:
In figure 4 the participants were asked to differentiate between productive and unproductive questions that had been constructed individually by every participant before they worked on group discussion. The result of this workshop is in line with [2] that stated Google applications and tools could be used to teach mathematics in 21st century classroom so that it can foster students to engage in more critical thinking, in collaboration activities and the address the mathematical practice [13]. Participants could actively involved in online activities when they already familiar with the menu on the application. For some participants who lack of experiences in using technology, need more time to be accustomed with the application. The elder participants mostly felt afraid of making mistake with some menu in digital classroom while younger participants were eager to deal with all type of application.

Based on the result the we have from the training session this type of blended training is the suitable one for training model during the pandemic session in Surakarta. Most participants were preferred to joint an off line form of training rather than on line learning, so that the blended type that we used in this paper is not type of flipped classroom but blended type in face-to-face and online discussions.

5. Conclusion
Based on the data analysis it can be concluded that the workshop was effectively could foster the participants in order to: understanding the essence of active learning in mathematics classroom, creating a context in online form to trigger mathematical abstraction and mathematical skills of the students, designing questions and worksheet that in line with the theory of mathematical abstraction and mathematical skills using Google application and finally designing a virtual mathematics classroom using Google Classroom.

6. References
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