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Does Teacher's Training Affect the Pedagogical Competence of Mathematics Teachers?

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Abstract. Teacher pedagogical competence is one of the factors affects the quality of education. This study was designed to examine the effect of trainings attended by mathematics teachers on their pedagogical competence. Based on this study, pedagogical competence generally involves two aspects: knowledge and skill. This study will examine the effect of training on each of these aspects. The samples in this study were randomly selected by conducting a survey of 20 mathematics teachers located in Indonesia. The tests were administered to measure knowledge aspect and questionnaires were given to measure skill aspect and the trainings. The test data revealed that the trainings contributed negatively to knowledge aspect. While the questionnaire data reveal that the trainings followed by them contributed positively to skill aspect. In this case, the trainings have a positive effect on the pedagogical skills of mathematics teachers. Researchers also found that mathematics teachers need trainings related to learning tools, method / technique / learning strategy, use of information technology and instructional media. Researchers also found other problems of trainings that have been given to the mathematics teachers that is not in accordance with their needs and they required continuous training with active communication between training participants.

1. Introduction

Teachers are educators who have an influence on learning process and have a big role in achieving goals of national education [1]. Teachers have a strategic contribution in determining student successes, the combination of early cognitive abilities and affective of teachers will affect 65% of the success of students and if supported by the quality of learning then the interaction will benefit for 90% [2]. In this case, teachers also influence student achievement [2]. In addition, it is not deniable that to produce students who are ready to compete in modern world, they must be educated by teachers who have adequate capacity and competence in accordance with future needs. In fact, the quality of teachers in Indonesia is still far from adequate to be able to make fundamental changes in education [3]. Therefore, teachers need to improve their knowledge and skills to improve and explore their teaching practices [4].

In order to develop teacher's potension in teaching, teacher competence becomes a matter that needs to be considered and discussed in depth [4]. Teacher competence influences values, behaviors, communication, goals, and teacher teaching practices [5]. In this case, competence can be discussed in



many dimensions such as field competencies, research competencies, curriculum competencies, lifelong learning competences, socio-cultural competencies, emotional competence, communication competencies and information technology and communication competencies [4]. In Indonesia, teacher competence includes pedagogical competence, personality competence, social competence, and professional competency [6]. This research will be limited to the pedagogical competence of mathematics teachers.

Various efforts should be established to improve teacher competence including teachers pedagogical competence [7]. How well teachers in teaching is dependent on motivation, qualifications, experience, training, talents and other factors [8]. Teacher competence also depends on trainings that teachers follow [9]. Teachers must continue to learn, follow scientific activities such as trainings, seminars, workshops to expand their horizons, enhance experience and apply them in teaching and learning activities conducted by teachers [10]. Focused training may affect the professionalism of teachers in teaching. [11]. In addition, teacher trainings should understand the differences that each teacher has, both in terms of the preferred learning activities and the competencies that teachers have acquired, so that the training programs provided are not using only one common approach designed equally for all teachers [12]. Provision of trainings on the use of technology requires teachers to effectively use technology and information applications in the classroom to improve teacher quality in teaching [13].

An educational system with qualified standards will regulate teacher's training strictly in order to obtain higher level of professionalism [14]. Therefore, teacher training must understand the differences of each teacher, both in terms of preferred learning activities and the competencies that have been obtained by teachers [12]. Beside that, teachers should take focused training to improve their professionalism, the training includes various activities that teachers must follow during the training period, as part of teacher professional development [11]. In this case, it appears that trainings have an important role to the professionalism of teachers. Furthermore, this study aims to examine the influence of trainings that mathematics teachers follow to their pedagogical competence. In line with the objectives, the following research questions are directed at:

1. Do trainings affect the pedagogical competence of mathematics teachers in terms of knowledge aspect?
2. Do trainings affect the pedagogical competence of mathematics teachers in terms of skill aspect?

2. Theoretical Background

2.1 Teachers Pedagogical Competence

Competence is what a person needs to do or about performance, under conditions of what should be done or about conditions and how well it should be done or about the standard, so that competence is more than just a job description or work activity [5]. Competence is an ability to apply knowledge and skills [15]. Competence is sufficient skill and understanding to perform certain types of work satisfactorily [16]. Teaching competence is a set of abilities, knowledge and beliefs that teachers possess and is also used to create an effective learning process [16].

Pedagogical competence is the ability of teachers in managing learning that includes the ability to plan a learning program, the ability to interact or manage the learning process and the ability to perform an assessment [17]. Pedagogical competence consists of knowledge and skills which is successful teaching relies on subject deep knowledge, linking theory and research to teaching and learning, and simultaneously using knowledge and skills in a rational context. [18]. Implementation of teacher pedagogical competence can optimize the development of learners from the intellectual, emotional and moral aspects [17]. Pedagogical competence is the ability and willingness to regularly apply attitudes, knowledge, and skills which aim to encourage learning to create learning in the best way [19]. Teacher pedagogical competence is the ability to manage learning, which includes planning, implementation and evaluation of learning outcomes of learners [7]. Pedagogical competence is the

ability of a person to use a combination of tangible resources (such as instruction materials and technology) and intangible resources (such as knowledge, skills and experience) coordinated and synergized [20]. Teachers with good pedagogical content knowledge can understand the difficulties experienced by students in learning mathematics material so that students can understand its structure and be avoided from its difficulty [21]. The effect of enhancing teacher pedagogical skills is generated gradually toward students, whereas when teachers improve pedagogical skills, student achievement will also increase [22].

2.2 Teachers Training

Truelove reveals that training aims to transfer the knowledge, skills and attitudes needed to carry out tasks related to the work of [23]. According to Solman, the training was marked by interventions that contained various content that led to the desired behavior change [23]. By effectively training and developing individuals, there will be a growth in career potential and encourage increased personal motivation [24].

The teacher influences student learning achievement [25]. Many ways are done to improve the quality of teachers in teaching including by providing training to teachers. therefore, teachers need to be given adequate training to encourage effective learning [26]. This is because training increases the effectiveness of teachers in teaching and training can also improve the quality and professionalism of teachers in teaching [27]. The SEC revealed that teachers must update the results of teaching and academic research, evaluate effectiveness in teaching and change teaching strategies so that each teacher must understand the type of training they need [28]. But unfortunately, the long distance between institutions / locations of training and teachers in the regions sometimes creates difficulties for teachers to identify and find specific training needed by teachers in Indonesia [29].

3. Methods

3.1 Research Method

The research method used is a limited survey method. This method is used because of the research objective to examine if the training influences pedagogical competence either from the knowledge aspect or from the skill aspect in the limited sample. The instrument of this study using tests and questionnaires. The test is used to measure teachers pedagogical competence from knowledge aspect and the questionnaire is used to measure teachers pedagogical competence from skill aspect. Beside that, questionnaire is also used to measure related training that had been followed by teachers. Furthermore, this study will answer research questions about the effect of training on mathematics teachers pedagogical competence in terms of knowledge aspect and the effect of training on mathematics teachers pedagogical competence in terms of skill aspect. Furthermore, simple linier regression is used to review its effects. Tests and questionnaires in structured surveys were developed for data collection.

3.2 Participants

Subjects in this study were an affordable sample that was assumed to be quite representative of the teacher population in junior and senior high schools. The samples in this study were 20 teachers and were randomly selected from 7 junior and 13 senior high schools with 1-6 years teaching experience. Research subjects spread in 4 different provinces in Indonesia namely Daerah Istimewa Yogyakarta, Central Java, DKI Jakarta and Riau Province. The sample selection is based on the ease of research access and the researcher's time limitations.

3.3 Data Collection

To collect information about teachers pedagogical competence, tests and questionnaires were developed. The multiple-choice tests were used to measure the pedagogical competence of the mathematics teachers in terms of the 10-point knowledge aspect: (a) 2 questions about learning

principles (b) 2 questions about approach / strategy / method / technique / learning model (c) 2 questions about curriculum development principles (d) 2 questions on assessment techniques and (e) 2 questions about student characteristics.

The questionnaires were developed through 51 statements of pedagogical competence of mathematics teachers. The questionnaires were used to measure the pedagogical competence of the mathematics teachers in terms of the skill aspect, questionnaire contained: (a) 17 statements about teacher ability in managing learning (b) 6 statements about application of method/technique/learning model (c) 9 statements about teacher's communication (d) 9 statements about understanding the characteristics of students, (e) 3 statements about the use of learning resources and (f) 7 statements about utilizing technology. The measurement scale used in this questionnaire was the Likert scale.

In order to collect information related trainings that teachers followed, the questionnaires were developed in 16 items of statement: (a) 5 statements about training curriculum, (b) 5 statements about techniques / methods / strategies / learning models, (c) 5 statements about learning media including technology. The measurement scale used in these questionnaires was the Likert scale. In addition, the researcher also provided open question to the mathematics teachers about the types and characteristics of trainings needed by mathematics teachers and the questions about the suitability of the trainings that they followed with their needs.

This research instrument has been validated by expert judgment. The reliability estimate using Cronbach's Alpha reliability coefficient formula.

3.4 Data Analysis

This study used inferential statistics with simple linear regression to examine if training influences pedagogical competence in terms of knowledge aspect and skill aspect.

4. Results and Discussion

To answer this research questions, the researchers first performed the reliability test on the instrument test and the questionnaire. The composite reliability value between 0.6-0.7 is acceptable in the preliminary study, but in large studies the expected value is 0.7 to 0.9 [30]. The coefficient reliability from instrument test and questionnaires of pedagogical competence can be seen in table 1 below.

Table 1. Reliability coefficient of pedagogical competence in terms of knowledge aspect (a) and Reliability coefficient of pedagogical competence in terms of skill (b)

Reliability Statistics	
Cronbach's Alpha	N of Items
.716	10

(a)

Reliability Statistics	
Cronbach's Alpha	N of Items
.718	51

(b)

Based on table 1 it is found that pedagogical competence instrument is viewed from knowledge and skill aspects as well as reliable skill because value of Cronbach's Alpha > 0.7. Furthermore, it will be reviewed the reliability of the trainings followed by the mathematics teachers.

Tabel 2. Reliability coefficient of training that teacher's followed.

Cronbach's Alpha	N of Items
.822	16

Based on table 2 it is found that the teacher training instrument is reliable because value of Cronbach's Alpha > 0.7 . Furthermore, we will examine the effect of trainings on pedagogical competence from the aspects of knowledge and skills. The effect of trainings on pedagogical competence of mathematics teachers in terms of knowledge aspects is shown in table 3 below.

Tabel 3. Anova^a

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	3,298	1	3,298	.492	.492 ^b
	Residual	120,702	18	6,706		
	Total	124,000	19			

Based on table 3, it was found that F arithmetic = 0.492 and p value > 0.05 . This means there is no significant effect between trainings and pedagogical competence in terms of knowledge aspect. Furthermore, we will discuss about the causes of this condition might occur, based on the questions given in the questionnaire related to trainings followed by teachers, this following result were found.

Are the trainings you (Mr/Mrs) were getting according to your needs in improving your pedagogical competence?

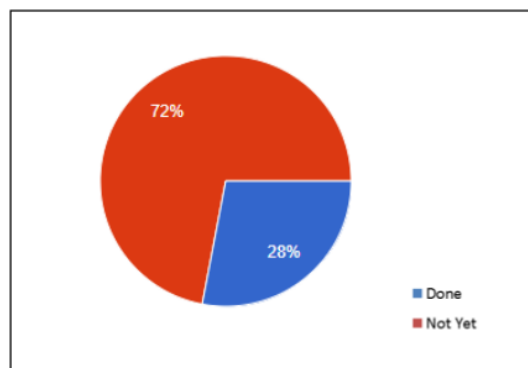


Figure 1. Teacher-related training questions.

Based on the diagram above, it is known that 72% of mathematics teachers feel that the trainings has not represented the needs of mathematics teachers to improve their pedagogical competence. This can be one of the factors that caused the training does not significantly affect the mathematics teacher pedagogical competence in terms of knowledge aspects because the training that teachers followed has not represented the needs of teachers in improving their pedagogical competence.

In addition, there are several reasons that training can not represent the teachers' needs in improving teacher pedagogical competence in term of knowledge aspect as follow.

Table 4. Teachers' reasoning that training can not represent their needs.

No.	Causes

1.	Training rarely discuss about teacher pedagogical competence theories (training is more focused on practice)
2.	Training focused on learning media
3.	Training is done in a short time
4.	Training is not continuous

The things mentioned above (especially about the pedagogical competence theories that is rarely discussed) can be the reason why the pedagogical competence of teachers viewed from the knowledge aspect is not influenced by the training that teacher's followed. Based on table 4, it can be seen that the training did not represent the teacher's needs and the training carried out is only in the form of seminars within a certain timeframe. The training also did not involve continued communication between fellow trainees. In addition, training focuses more on practices and related learning media. Furthermore, the effect of trainings on pedagogical competence of mathematics teachers in terms of skill aspects is shown in table 4 below.

Tabel 5. Anova^b

Model	Sum of Squares	df	Mean Square	F	Sig.
1. Regression	717,989	1	717,989	6,231	,022 ^b
Residual	2074,211	18	115,234		
Total	2792,200	19			

Based on table 5, it is found that F arithmetic = 6,231 and p value < 0.05. This means there is a significant influence between trainings with pedagogical competence in terms of skill aspect. In this case, previous research also found that providing training for teachers in the use of technology is important to do because technology is effectively used in classroom to improve the quality of teaching and learning [13]. Beside that, teachers should be given adequate pre-service training courses characterized by effectiveness, creativity and improvement, highest attention should be given to the use of relevant technology in the field of education [8]. In this respect, this study showed that the training influences the pedagogical competence of mathematics teachers in terms of skills aspects where utilizing technology's indicator is included in the skill aspects of pedagogical competence.

In other hand, based on the questions given in the questionnaire related to trainings followed by teachers, this study also found the results according to figure 2 below.

Do you (Mr/Mrs) need continuous and communicative trainings among fellow trainees even when the training time is over?

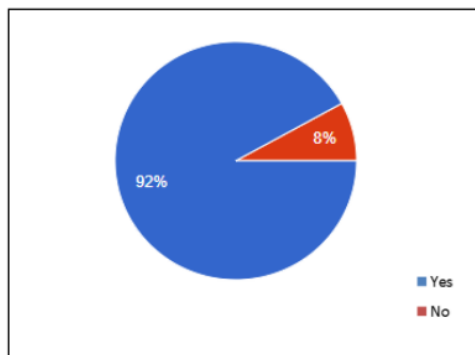


Figure 2. Questions regarding teacher training characteristics required.

Based on the diagram above, it is known that 92% of mathematics teachers feel the need of continuous trainings and communicative among fellow trainees so that the trainings are held not only in the form of workshops that will end in a matter of days. Furthermore, it was also found that mathematics teachers desperately need trainings related learning tools, model / methods / techniques / learning strategies, use of information technology and instructional media.

5. Conclusion

Pedagogical competence of mathematics teachers viewed from knowledge aspect is not influenced by teacher's training and pedagogical competence of mathematics teachers viewed from skill aspect is influenced by teacher's training. In addition, mathematics teachers need continuous and communicative trainings with types of trainings in the form of training learning tools, models / methods / techniques / learning strategies, use of information technology and learning media.

6. Recommendation

Based on the research findings, the researchers recommend that related institutions should pay attention to the needs of each teacher before conducting a training including the type of training required by the teacher because proper training will greatly help the teacher to improve pedagogical competence from the skill aspect by the mathematics teachers.

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