Achievement of Pedagogical Competency, Professional Competency, and Self-Efficacy In-service Mathematics Teachers, Through Pedagogical Problem Solving Cycle

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Abstract. The purpose of this study is to improve the achievement of in service mathematics teachers, in pedagogical and professional competences through professional development program by using a Pedagogical Problem Solving Cycle. The research instrument consisted of observation guidelines, interview guidelines, teacher competency tests, and self-efficacy scale. Mathematical pedagogical problems presented to trainees in a number of cycles, which include some mathematical material that is relevant to the 2013 curriculum. The results of data analysis show that overall the achievement of pedagogical competency is better than the achievement of professional competency. Pedagogical competency is achieved in the high category, and professional competency is achieved in the medium category. The results of observations and performance appraisals, showed that more than half got good criteria. From the impressions of the participants, in general it is of the opinion that the use of the training model is very helpful in increasing their competence.

Keywords: Pedagogical competency, professional competency, pedagogical- problem solving cycle, self-efficacy.

1 Introduction

Teaching and learning of mathematics in Indonesia over the past decade has continued to be a concern of teacher educators, this is related to the results of international studies [1] which shows that mathematics achievement of Indonesian children ranks lower compared to neighboring countries and countries joining the OECD. Likewise, if we pay attention to the results of research on teachers, especially those who are young in teaching experience, even though they understand the concept of the material well and understand the learning objectives, but there is still a pedagogical ability that is not yet optimal, namely the ability to teach and understand the needs of students [2].

Concerns about student and teacher achievements have caused widespread criticism of teacher professional education organizations, and training teacher candidates in an effort to enrich PCK [3]. In the opinion of [4], many teachers have weak knowledge and a narrow view of mathematics and mathematical pedagogy which includes the conception of mathematics as a closed set of procedures, teaching that informs, and learning as information accumulation "(p. 576). There is substantial evidence that teachers usually do not have this rich and connected mathematical knowledge, nor do they teach in a way that is consistent with NCTM Standards [5, 6].

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Improving students' ability to learn mathematics depends fundamentally on the skills and knowledge of the teacher. Teachers are often expected to teach mathematical topics and skills in ways that are substantially different from the way they themselves learn the content. Principles and Standards suggest "Teachers must know and understand in depth the mathematics they teach and can utilize that knowledge with flexibility in their teaching assignments" [7].

To foster strong and lasting change in the teaching profession, there is an urgent need to prepare novice professional development facilitators to successfully facilitate newly developed professional development models that offer high-quality learning opportunities for teachers. To meet the increasing demand for teacher learning opportunities, professional development programs must be sustainable and scalable [8, 9]. They must adapt to the local context so that work can be done by schools and districts in the long term, using internal resources [10].

The research conducted in [11] have sought to identify and explain "mathematical knowledge to teach" - mathematical knowledge that teachers must have to do the teaching of mathematics effectively. The study in [12] described knowledge of pedagogical content as "the capacity of a teacher to transform the knowledge of his content into forms that are pedagogically strong but adaptive to variations in the abilities and backgrounds presented by students" (p. 15). Like special content knowledge, pedagogical content knowledge is unique to teachers and is developed over time because teachers gain expertise in their fields, with respect to subject matter and effective pedagogical strategies [9]. The study in [11] divide pedagogical content knowledge into two components: (1) content knowledge and teaching, and (2) knowledge content and students. The first component combines teacher knowledge about content with their knowledge of teaching. These include, for example, the ability to recognize teaching costs and constraints from different representations, and to sort content to facilitate student learning [11]. In Indonesia, based on Government Regulation number 19 of 2005 concerning teachers and lecturers, pedagogical competence is the ability to manage student learning which includes understanding students, designing and implementing learning, evaluating learning outcomes and developing students to actualize their various potentials; and professional competence is the ability of educators in mastering broad and in-depth learning material that enables it to guide students to obtain the competencies that they expect.

For teachers to broaden their pedagogical content knowledge, they need sufficient knowledge and classroom teaching experience. Teachers will use their knowledge when they plan to use pedagogical strategies and teaching material in a lesson. They also make use of their knowledge during class lessons when they reconsider what assignments must be submitted, when to hold class-wide discussions or break into small groups, and when to use informal assessment techniques.

However, having a deep understanding of what professional development looks like should only be part of the equation. the variable that is often seen is to have facilitators who are well prepared to ensure the effectiveness of professional development [13, 14].In addition to the issue of pedagogical and professional competence, Indonesian teachers often seem to lack confidence in mastering content of mathematics and confidence in teaching it, namely self-efficacy. If this problem is allowed to continue, it is not impossible to weaken the conditions of learning. Self-efficacy is a general ability that consists of aspects of cognitive, social, emotional and behavioral aspects. Individuals must be able to process aspects of those aspects to achieve certain goals. The research in [15] states that self-efficacy is an individual's trust in his ability to achieve results in accordance with the expected goals. Self-efficacy is an attempt to understand the functioning of human life in self-control, the regulation of thought processes, motivation,

affective conditions, and psychological. Self-efficacy is believed to make individuals able to interpret and translate internal and external factors into concrete actions.

Therefore, selective-efficacy is one of the hidden variables that is important to study. Based on the above thinking, it can be concluded that the problem of achieving pedagogic competence, professional competence, and self-efficacy is a major concern in research that promotes the application of teacher candidate training models, namely cycle pedagogical- problem-based learning.

2 Method

The method used in this study is a quasi-experimental design X O, the treatment given is cyclical pedagogical problem solving. Pedagogical Problem-Solving Cycle (PPSC), a model of professional development that is situated in classroom practice and designed to help teachers deepen their edagogical competence and profesional competence or knowledge of mathematics for teaching. The research incorporated classroom artifacts and interviews to document the preparation and support provided to the in service teacher; the range and quality of their implementation of the PPSC. The cycle model carried out in learning is as follows in **Figure 1**.

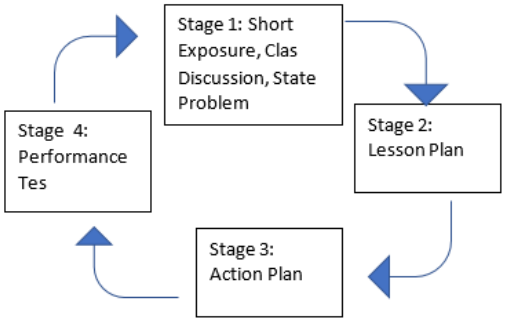

Fig. 1. The Pedagogical Problem Solving Cycle : model of professional development

In one cycle there are four stages of activities, starting from stage 1 in the form of a brief description of the training material, the relevance of the curriculum and competencies that must be achieved, class discussion, and giving pedagogical problems in accordance with the material contained in the curriculum, followed by stage 2 making learning plans in accordance with given problems, stage 3 implements and makes learning tools according to plan, and stage 4 performs performance tests through peer teaching. The workshop is held in two cycles, cycle 1 focuses on pedagogical problems for learning in junior high schools, and cycle 1 focuses on pedagogical problems for learning in high school. After the two cycles are completed participants are given a test of pedagogical and professional abilities, and given an attitude scale test. Interviews were conducted after the test took place on selected participants.

3 Participants and research duration

The training participants consisted of 58 in service mathematics teachers who have taught more than two years in schools in five districts in West Java. Each school has the same characteristics as a national standard school. This research was conducted in Bandung for three months and assisted by 15 observers and assessors of the performance of prospective teachers.

To obtain the data needed, the research instrument consisted of tests and non-tests. Test instruments are used to measure professional competence and pedagogical competency tests, in the form of multiple choice and essays, non-test instruments in the form of interview guidelines, observation guidelines, and self-effficacy questionnaires. All instruments were validated by two experts in teaching and learning, and an expert in mathematics for teaching.

4 Results and Discussion

Descriptively the results of achieving pedagogical, professional and self-efficacy competencies for teacher candidates are as follows.

Table 1. Paired Samples Correlations

PAIR	N	Correlation	Sig.
PEDAGOGIK & PROFESIONAL	58	-,017	,902

From table 1 it appears that because the two variables are from the same subject, there is a significant correlation. Then the paired average difference test is performed with a significance level of 0.05 as follows.

Table 2. Paired Sample Test

PAIR	Paired Differences					t	df	Sig. (2-tailed)
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
PED -PROF	1,96552	5,89667	,77427	,41507	3,51597	2,539	57	,014

From table 2 above it can be concluded that there is a significant difference between the achievement in pedagogical competence and professional competence, and the achievement of pedagogical competency is higher than the achievement of professional competence. In general self-efficacy illustrates confidence in the mastery of mathematical subject matter both to solve problems or to teach. The achievement of self-efficacy surveyed through the attitude scale questionnaire shows that the majority are at a high level, and only a few are still in the low category, in the sense that they feel unsure about mastering the subject matter.

Table 3. Self-eficcacy.

Category	Frequency	Percent	Valid Percent	Cumulative Percent
Lower	2	3,4	3,4	3,4
Medium	15	25,9	25,9	29,3
High	41	70,7	70,7	
Total	58	100,0	100,0	

Table 4. Performance.

Category	Frequency	Percent	Valid Percent	Cumulative Percent
Good	34	58,6	58,6	58,6
Poor	5	8,6	8,6	67,2
Excellent	19	32,8	32,8	100,0
Total	58	100,0	100,0	

From the performance aspect, it turns out that more than half (58.6%) get good categories, and more than a quarter (32.8%) get very good categories, but there are still those who get bad categories by less than 10%.

Are there differences in achievement of competencies for prospective teachers from different regions of origin? The results of the one-way ANOVA analysis are shown as follows.

Table 5. ANOVA.

		Sum of Squares	df	Mean Square	F	Sig.
PEDAGOGICAL COMPETENCY	Between Groups	45,579	4	11,395	,697	,597
	Within Groups	866,076	53	16,341		
	Total	911,655	57			
PROFESSIONAL COMPETENCY	Between Groups	54,554	4	13,638	,735	,572
	Within Groups	983,515	53	18,557		
	Total	1038,069	57			

From table 5 above we get the sig value. which is more than 0.05 so it can be concluded that there is no difference in the achievement of competencies for each group. The results of observations and performance appraisals, showed that more than half got good criteria. From the impressions of the participants, in general it is of the opinion that the use of the training model is very helpful in increasing their competence.

In achieving competence, for all teachers from various regions pedagogical competencies are easier to achieve compared to professional competencies. These results are in line with the results of research on pre-service teacher candidates conducted by [16]. There is an interesting thing in achieving pedagogical competence where when participants are asked to design

learning based on pedagogic problems in the topic of learning opportunities and algebra learning topics, the solutions offered by participants are relatively unsatisfactory to the assessors, in other words more revisions must be done by participants to improve the solution. And based on a search on solving the problem of professional competence, it turns out that the majority of participants received lower scores in the material opportunities and algebra than in other materials. Based on the results of interviews with the participants, information was obtained that the CPPBL model provided a new atmosphere in the training process. The participants felt challenged to explore new ideas in solving pedagogical problems given by the instructor. The results of the observation in the discussion group showed a positive trend, that participants unwittingly had collaborated and actively communicated in the process of solving the problem. The pedagogical problem given by the instructor always has very diverse and open solutions, many alternative solutions can be offered by participants and become an interesting discussion. Following [17], this implies designing, enacting, assessing, and revising hypothetical learning trajectories in an iterative series of mathematical teaching cycles. In the course of observational learning, the model teacher has presented a lot of learning that is more interactive, involving the remainder in finding his own formula, this can be said that the training results already support what was stated by [18] that Mathematics should not merely be taught as a set of procedural competencies; rather, teachers should help students gain sufficient conceptual knowledge along with a flexible understanding of procedures to become competent and efficient problem solvers [18].

5 Conclusion

The main issue of this article is what the cycle pedagogical- problem based learning has offer to reform mathematics education, whereas classical instructional design theories do not fit mathematics education that tries to capitalize on the inventions of the students. Based on the results of research and discussion the following conclusions are finally obtained. Cycled pedagogical problem-based learning model have good potential to be developed as innovative training models for prospective teachers, so that in turn they can be promoted as part of ways to reform mathematics education in Indonesia. The achievement of pedagogical competence is better than professional competence. There is no significant difference in the achievement of competencies between prospective teachers from each region. The performance of prospective teachers in improving their competence is considered quite good.

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