

HASIK CEK_Lesson Study To Improve Competence Of Mathematics Pre-Service Teacher In Developing Lesson Plan Based-On Etnomathematics

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Submission date: 01-Mar-2022 12:20PM (UTC+0700)

Submission ID: 1773625600

File name: e-Teacher-In-Developing-Lesson-Plan-Based-on-Etnomathematics.pdf (439.32K)

Word count: 3853

Character count: 22147

Lesson Study To Improve Competence Of Mathematics Pre-Service Teacher In Developing Lesson Plan Based-On Ethnomathematics

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Abstract: Students of Mathematics Education are mathematics teacher candidates who must have various competencies before becoming a teacher. These competencies are obtained through the learning process at the university. Many ways can be done to develop student pedagogical skills at the university. One of them is through lesson study. This research aims to figure out the effectiveness of lesson study in improving the competence of mathematics pre-service teachers. The competency is developing a lesson plan based on ethnomathematics. The ethnomathematics used in this study is limited to the culture in Yogyakarta and its surroundings, namely Prambanan Temple, Borobudur Temple, and Yogyakarta Palace. The research sample was 6th-semester pre-service teacher of the Mathematics Education Study Program of Yogyakarta State University in the 2018/2019 academic year. This research is a quasi-experimental study with the design of Pretest-Posttest One-Group. The instrument of data collection uses an assessment sheet. Data on the results of the lesson plan assessment were analyzed using the one-sample test. The results of the study at a significance level of 5% showed that the implementation of Lesson Study was effective in terms of student competence in developing a lesson-plan based on ethnomathematics.

Index Terms: Ethnomathematics, Lesson plan, Lesson study, Mathematics, Pre-Service teacher, Teacher-competencies, Yogyakarta..

1. INTRODUCTION

Student of mathematics education study program at Yogyakarta State University are candidates for mathematics teachers who are prepared to have various competencies. These competencies are listed in the Law of the Republic of Indonesia No. 14 of 2005 regarding teachers and lecturers stating that the competencies that must be possessed by a teacher are personality, pedagogic, professional, and social competence [1]. Professional competence, according to Shulman [2] is also called content knowledge, while teacher pedagogical competence is also called pedagogical knowledge. Shulman further explained that the competencies that must be possessed by pre-service teachers are explained in the Theoretical framework, which is described as Pedagogical Knowledge and Content Knowledge [3]. De Jong [4] also mentions pedagogy and mastery of material as competencies that must also be mastered by the teacher. The combination of pedagogic competencies and content competencies is essential in the learning process — many studies on the importance of pedagogical competencies and content competencies that have been done. From the various studies, it is concluded that pedagogical competencies and content competencies are essential for the development of the professional abilities of teachers and pre-service teachers [5],[6]. Teachers, especially mathematics teachers, must have pedagogical and content competencies. Mathematics teachers have a heavy-duty in teaching mathematics subject matter because most students find it difficult to learn mathematics. The difficulty of mathematics subjects for students is revealed by Haylock [7] that students, parents, and even teachers describe mathematics as difficult subjects. The difficulties experienced by these students are due to the abstract mathematical concept. This abstract concept is a challenge for

teachers, how to teach abstract mathematical concepts through more concrete learning.

Mathematics pre-service teachers must undoubtedly master the concepts of the mathematical material taught. Content mastery competence is the ability of pre-service teachers to master the subject matter to be taught; in this case, is a mathematics subject [8]. Even though a teacher has mastered mathematics subject matter, it does not guarantee that students can understand what is conveyed by the teacher. Pedagogic competence is needed here. Pedagogic competence is the knowledge of teachers or pre-service teachers about student characteristics, development of lesson plans and evaluation of learning outcomes, and what are the methods/models/strategies that can be used in mathematics learning [9]. Pedagogic competence also includes the ability to learn the latest learning methods or even create learning strategies according to class needs. The ability of teachers to prepare the learning to be more concrete and accepted by students is also one part of pedagogy competence. Based on the description of pedagogy and professional competencies above, this means that a teacher does not only master the content or learning subject matter but also must have knowledge of how to teach particular material that must be developed since becoming a teacher candidate. However, teacher competency testing in Indonesia showed unsatisfactory results. The average pedagogic and professional competence is less than 60 [10]. The results of teacher competency tests in Indonesia are presented in TABLE 1

The teacher competency test in TABLE 1 shows that the ability of teachers in Indonesia still needs to be improved. TABLE 2 present the results of the teacher competency test seen from pedagogy and professional aspects.

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TABLE 1
TEACHER COMPETENCE TEST RESULTS

Degree	Average
Junior High School	55,70
Senior High School	59,16
Vocational High School	54,52

The teacher competency test in 2018 is indeed a particular concern for lecturers at the University. One of them is the Yogyakarta State University Mathematics Education Study Program, which is a place to educate mathematics pre-service teacher. Pedagogy and content competence can be obtained through the learning process at the university. Many ways can be done to develop professional abilities as well as student pedagogy at the university. One of them is learning through

TABLE 2

PEDAGOGIC AND PROFESSIONAL TEST RESULTS

Competence	Average
Pedagogy	50,43
Professional	55,45

lesson study. The results and impacts of the implementation of

TABLE 4

CRITERIA FOR IDEAL ASSESMENT OF LESSON PLAN

Score	Criteria
$80 < x \leq 100$	Very High
$66,67 < x \leq 80$	High
$53,33 < x \leq 66,67$	Moderate
$40 < x \leq 53,33$	Low
$20 < x \leq 40$	Very Low

lesson study that has been conducted in several universities show that the lecturers who carry out lesson study better understand the problems of student learning. [11] Lesson study is a model of professional development originating from Japan. In the beginning, Lesson study was developed in primary education but is currently starting to be applied in secondary education and higher education. Lesson Study is classroom research in which several educators collaborate to investigate the learning process [12]. Lesson study is a professional coaching model for lecturers conducted collaboratively and continuously based on the principles of collegiality and mutual learning [13]. Lesson study is a collaborative process in designing learning, implementing and evaluating through reflection. Lesson study is expected to be able to build a learning community, and student performance in learning becomes the most crucial part of the learning process, student-student interaction, student-lecturers, students of teaching materials and students-environment, are things of concern. Lesson study will improve the learning process, which ultimately improves the quality of education. Doig & Groves [14] stated that lesson study could be used as a process that supports professional development. Rock & Wilson's research results [15] found six reasons why lesson study can be used as a professional development program, which can support and focus on work, professional confidence, peer collaboration, can review and share experiences with sources that are experts, peer coaching and mediation, can improve instructional improvement. The teacher or lecturer works in a group together in a certain period of time and performs the following activities: make a group agreement about the lesson study learning objectives, design learning together, carry out and observe learning, review learning and its impact on students, improve and

adjusting lessons, estimating and sharing findings in learning [16]. The implementation lesson study in Indonesia consists of three parts, that is, plan, do, and see [17]. The Plan is lecturers design learning to achieve learning goals. Do is the implementation of the learning process that has been designed in the planning stage. At this stage, one lecturer conducts learning, and the other lecturer observes the learning process. See is a reflection stage after learning. This research aims to figure out the effectiveness of lesson study in improving the competence of mathematics pre-service teachers. The competency is developing a lesson plan, based on ethnomathematics. Developing a lesson plan is one aspect of pedagogy and content competence. It is revealed by Chordnork [18] that teachers who have excellent pedagogy and professional skills can design learning that can facilitate the diversity of students and understand why the design can help students to understand the subject matter.

In developing lesson plans, students must be able to apply specific strategies and make mathematical material according to student development. Besides, the cognitive development of students must also be considered. In abstract mathematics concept, students will more easily understand the material if using learning related to the life or culture around it. One approach that uses culture around students is ethnomathematics. Ethnomathematics is one way that is considered to make mathematics learning more contextual so that students feel that mathematics is close to their daily lives [19],[20],[21]. Shirley [22] argues that ethnomathematics that grows and develops in society and accordance with the culture around students can be used as the center of the learning process. This opinion is supported by various studies which have shown that ethnomathematics has a positive effect on mathematics learning. Research conducted by Laurens [23] shows that learning mathematics with Malay culture can be used to increase the quality of mathematics learning in the concepts of numbers, fractions, and geometry. Also, the results of Richardo's study [24] show that ethnomathematics provides a new atmosphere, learning mathematics is not only done in the classroom but can also be done outside the classroom by interacting with the local culture. The culture used in this study is limited to the culture in Yogyakarta and its surroundings, namely Prambanan Temple, Borobudur Temple, and Yogyakarta Palace.

2 METHODOLOGY

The research was conducted at the Yogyakarta State University mathematics education students who took ethnomathematics courses in the 2018/2019 academic year. The study sample consisted of 31 students from a population of 60 students who were taken randomly. This research is a quasi-experimental study with the design of the Pretest-Posttest One-Group. The instrument for collecting data uses a validated lesson plan assessment sheet. The lesson plan assessment component is presented in TABLE 3. The results of the lesson plan assessment are analyzed as a whole or per aspect based on the assumption of a normal curve, which is comparing with the ideal score. Criteria for the ideal assessment of lesson plan can be seen in TABLE 4 [25].

Before testing to answer the problem statement, several assumption tests must be fulfilled first. The test of the

TABLE 3
THE COMPONENT OF LESSON PLAN

No	Component
1	Conformity of Indicators and Learning Objectives with KI / KD
2	Learning strategies and resources
3	Development of ethnomathematics-based material
4	Learning Activities
5	Assessment

assumption that must be done is the normality test; then, the hypothesis test is performed using the one sample test to figure out the effectiveness of the lesson study. The implementation of learning is adjusted to the lesson study stage; plan, do, and see. In the Plan stage, the lesson study team, namely four lecturers, exchanged ideas to design learning. In the Do stage, one model lecturer teaching, and the other lecturer observes. At this stage, students are given the task to make lesson plan based-on ethnomathematic. Before making a lesson plan, students have to make observations in the field about the cultures in Yogyakarta and its surroundings. The culture observed is limited to Borobudur temple, Prambanan temple, and Yogyakarta Palace. After making observations in the field, students are given the task of making lesson plan based-on ethnomathematic and developing the material. The last stage is See, the lesson study team reflects and evaluates learning.

3 RESULTS AND DISCUSSION

Based on data analysis, the average competency of pre-service mathematics teacher was 71.67. Based on the evaluation criteria in TABLE 4, the competencies of the mathematics pre-service teacher are in the High criteria. Descriptive analysis of data from the lesson plan ethnomathematics-based is presented in TABLE 5.

The distribution of the number of pre-service teacher who are in the medium, high, and very high criteria is presented in the pie chart in Fig. 1.

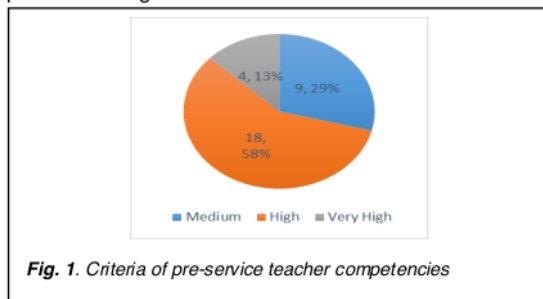


Fig. 1. Criteria of pre-service teacher competencies

Then each component of the lesson plan was analyzed to find out which aspects included at the very high, high, medium,

low, and shallow levels. The results of each component are

TABLE 5
CRITERIA OF PRE-SERVICE TEACHER COMPETENCE

Description	Ideal score	Empiric score
Average	60	71,67
Standard Deviation	13,33	7,05
Maximum	100	82
Minimum	--	--

presented in TABLE 6.

Based on TABLE 6, it is known that the component of Suitability Indicators and Learning Objectives with KI / KD is at a High level. It shows that mathematics pre-service teachers can develop indicators according to KI / KD and use appropriate operational verbs and can adjust the allocation of learning time well. Besides, pre-service teachers are also able to formulate learning objectives following indicators that are developed, observable, and operational.

Components for selecting learning strategies and learning resources are at a high level. It means the pre-service teacher can choose a method or strategy that is following the character of the student and the mathematics material to be taught. The methods or strategies chosen by pre-service mathematics teachers include scientific, inquiry, problem-based learning, and Real Mathematics Education. The pre-service teacher also uses varied learning resources, and learning resources are appropriate to support the achievement of basic competencies (KD). Examples of strategies and learning resources used by pre-service teachers are presented in Fig. 2.

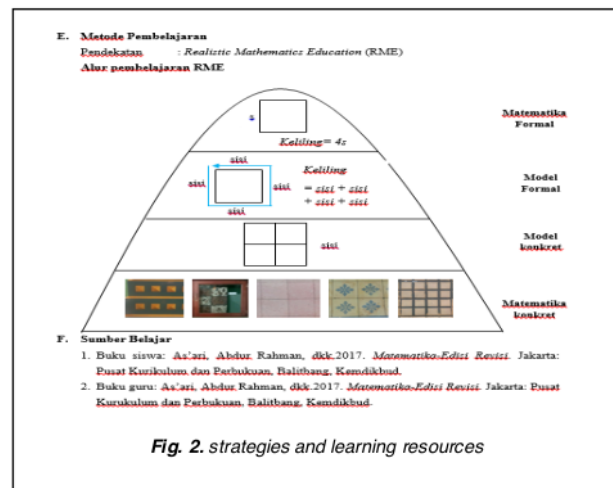


Fig. 2. strategies and learning resources

The components of the development of ethnomathematics-based material are of very high criteria. It shows that pre-service teachers can develop mathematics learning materials that support the achievement of basic competencies. The pre-service teachers are also able to use culture in Borobudur temple, Prambanan temple, or Yogyakarta palace to develop material. Examples of the results of material development are presented in Fig. 3.

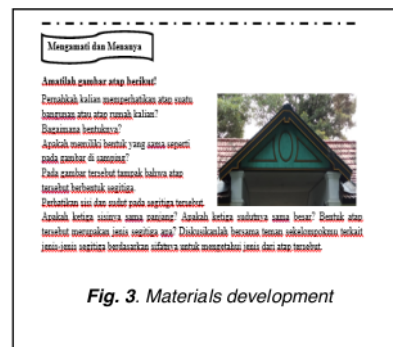


Fig. 3. Materials development

TABLE 7
THE RESULT OF NORMALITY TEST
Shapiro-Wilk

	Statistic	Df	sig
Kompetensi	.969	31	.399


a. Lilliefors Significance Correction.

TABLE 8
THE RESULT OF ONE-SAMPLE TEST

Test Value = 66.67			
	t	df	Sig. (2-tailed)
Competenc	3.952	30	.000
e			Mean Difference
			5.00742

In addition to developing the material, pre-service teachers can also develop practice questions of the type of High Order Thinking Skills that are associated with culture. Examples of problem development are presented in Fig. 4.

1. Perhatikan gambar berikut!



Ani mengamati suatu relief dengan motif hiasan berbentuk bunga pada Candi Borobudur seperti pada gambar. Pada relief tersebut membentuk lingkaran dan dianggap titik tengah pada bunga merupakan titik pusat lingkaran. Jika ditarik garis dari titik pusat ke lingkaran terluar berukuran 7 cm, berapakah keliling relief (hingga lingkaran terluar) tersebut? (Petunjuk : buatlah model lingkaran yang terbentuk)

Fig. 4. Example of developing questions

Components of learning activities are at high criteria. mathematics pre-service teachers can make apperceptions associated with culture. The stages of the chosen method or strategy are seen in the learning steps. The learning steps reflect the student-centered learning. Examples of learning steps developed are presented in Fig. 5.




Fig. 5. Example of developing learning activities

The component of the assessment is in the medium criteria. It shows that students can adequately develop assessment tools and scoring guidelines according to the indicators. Before hypothesis testing, data must be tested for normality first. The results of the normality test using SPSS are presented in TABLE 7.

Based on TABLE 7, known that the value of sig. is 0.399. Because the the value of sig. is is more than 0.05, at the 5% significance level, concluded that the data normally distributed. Furthermore, hypothesis testing is done using the one-sample test. TABLE 8 present the results of the one-sample test. The results of the one-sample test in Table 8 show that the the value of sig. is less than 0.05 so it can be concluded that learning with Lesson study is effective improving the competencies of mathematics pre-service teacher in developing lesson plan based-on ethnomathematic. The results of this study corroborate Perry & Lewis's opinion, which states that lesson study can deepen content knowledge, and increase pedagogical comprehension [26]. The success of lesson study also occurs in research conducted by Utami et al., an increase in the quality of the process and student learning outcomes through lesson study [27]. The effectiveness of the implementation of lesson study is due to proper planning of learning in the Plan phase. It is because the lesson plan is arranged jointly by the lesson study team so that in the team the lecturers sharing ideas. The lesson study statement makes lecturers more prepared in planning learning also expressed by Vitantri in the results of his research, lesson study makes planning learning more mature to make lecturers better prepared to teach [28]. Do or implementation stage determines the implementation of lesson study. In this research, implementation of learning was carried out by the planned lesson plan at the Plan stage. At this stage, one lecturer as a model lecturer while the other lecturer observes the learning process. The task of making ethnomathematics-based lesson plans chosen by the study team made students more active in asking questions. Increasing student activity through lesson study also occurred in Nurhasanah's research. [29] The reflection phase also provided an essential role in the success of lesson study in this research. Reflection makes the lecturer aware of the advantages and disadvantages in the learning process so that it becomes a consideration in preparing the next lesson plan. In this study, the task of students to make a lesson plan will be more effective when they go directly to the field to see the culture that exists in Borobudur temple, Prambanan temple, and Yogyakarta palace rather than just looking through photos or videos.

4 CONCLUSION

The conclusion in this study is that lesson study can improve the competency of mathematics teacher candidates in developing ethnomathematics-based lesson plans. In this study, all the lesson study stages began from planning learning (Plan), implementation (Do), and reflection (See) were carried out correctly. The results of this study indicate that the three lesson study stages, namely Plan, Do, and See if implemented properly can be used to improve the quality of learning

ACKNOWLEDGMENT

The authors wish to thank The Ministry of Technology Research and Higher Education of Republic Indonesia. This work was supported in part by a grant from Hibah Penelitian

Kerjasama Antar Perguruan Tinggi (PKPT) .

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