Improving Pedagogical Competences of Prospective Science Teachers to Develop Learning Materials through Jigsaw Cooperative Model

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Abstract. The problems faced by prospective science teachers are low competence to develop learning materials based on scientific approach. The research aims to improve the pedagogical competences of prospective science teachers to develop science learning materials that includes Lesson Plan and Student Worksheet. The research method used is the classroom action research which conducted in two cycles. The subjects of this study are the students of the sixth semester who enroll of Microteaching course in the academic year 2016/2017. The subjects are 58 students. Implementation of this research was carried out using Jigsaw cooperative type, where each group member is responsible for presenting the subject matter related to the development of learning materials based on scientific approach. The instruments used were: 1) Instrument of assessment of Lesson Plan and 2) Instrument of assessment of student worksheet. Data analysis technique used was descriptive statistical analysis. The results show that the science teacher competence to develop the learning material has increased from cycle I to cycle II. The results show that 89.63 % of prospective science teachers have a good competence to develop lesson plan and 89.05 % based scientific approach to develop Student Worksheet based on 2013 curriculum. This finding shows that jigsaw is able to increase the ability or the competency to produce learning tools based scientific approach.

1. Introduction
The curriculum applied in Science Education Study Program refers to the achievement of graduate competence of science education graduate. Competence of graduates can not be separated from the competence of teachers as the candidates this profession. There are four aspects that belong to the competence of teachers, namely pedagogical competence, personal competence, professional competence, and social competence. Pedagogical competency is the ability of understanding students, designing and conducting learning process, understanding the evaluation of learning outcomes, and development of students to show their own potential [1].

Teacher competence is defined by Koster & Dengerink that is the combination of knowledge, skills, attitudes, values and personal characteristics, empowering the teacher to act professionally and appropriately in a situation, deploying them in a coherent way [2]. Therefore, as an institution which
produce science teachers, it is necessary to prepare students competence of science teacher candidates in developing learning materials.

Research to measure teacher competence in making learning tools ever done by [3] at SMPN 3 Tirta Pekalongan, Indonesia. This study is based on the findings that the competence of teachers in the school in preparing the lesson plan has not been aligned with the application in class with 65.58%. These results became the foundation for conducting classroom action research to obtain an increase in teacher competence in preparing Lesson Plan. The low competence of teachers in preparing the lesson plans was also found by [4].

Some efforts are made to improve the competence of prospective science teachers in planning, implementing and evaluating the learning, among others through microteaching course. The subject is a course that provides early debriefing to students doing micro teaching practice.

Studying about the competency which is discussed above is a narrative material and requires cooperation to evaluate each individual ability to develop learning tools. One of the learning models considered to enable students and build individual and social knowledge is Jigsaw type cooperative learning model.

Cooperative learning opposites with conventionial learning. This learning give opportunity to students to be actively in their own learning. Cooperative learning activities involve the interaction students of that promote the development of language and concept also content. This strategy is preferred than reading technique. However this strategy is an effective way to achieve the best conclusion by reading [5]. As known that study about produce learning tools need the ability of reading. The prospective teacher must read the basic competency and then develop it.

Furthermore, model jigsaw is an effective approach to developing dependency and cooperation. However, there are some disadvantages of this model that influence the participation of learners in group work negatively. To use this teaching method effectively, some technique need to be considered. When cooperative tasks are assigned to group members not sufficiently challenging to require joint effort, group members can see their respective contributions. In addition, it is important that the main content selected for group work is divided into sub-categories for the same responsibilities of group members [6].

2. Method
This research is classroom action research, by following Kemmis and Taggart's procedures of planning, action, observation, and reflection. Starting from the plan then held the action and observation finally the result is reflected.

As the research subjects are student of Science Education Program for academic year 2016/2017 who took course of practice recognition field I. The number of research subjects are 58 people

Data collected were the data of prospective science teacher competency to develop learning tools, including assessment of lesson plan and worksheet by all members in the Jigsaw group. Finally, the data were analyzed qualitatively using the descriptive statistic.

3. Result and Discussion

3.1 Research result
Competence of prospective science teacher students in developing learning tools, that is, they are competent to develop lesson plan and worksheet. The device assessment process begins with Jigsaw type cooperative learning. Each Jigsaw cooperative group consists of seven members. Each member is responsible for each of their expertise: 1) a scientific approach; 2) discovery learning and inquiry learning model; 3) problem based learning and project-based learning model; 4) Development
of lesson plan; 5) Development of worksheet. After the group of experts met, then they went back to the original group to explain each of the material that is his responsibility.

Further, the task given to original group is produce lesson plan. Each group obtain one basic competency which is gained from the matter from grade VII to IX. Each group was asked to develop learning model, method, and learning strategy adjusted with the characteristic of matter and learner. However, this product are measured as the asessment to gain the score of the competency of prospective science teacher to develop the learning tools as the result of discussion in jigsaw.

This study measures the competence of prospective science teachers to make lesson plan and worksheet. The following data on the competence of science teacher candidate in terms of developing learning materials.

Table 1 Competence of Science Teacher Prospective in Developing Lesson Plan Based on Scientific Approach

| No. | Components of the Lesson Plans | Average | Category | Percentage (%) |
|-----|--------------------------------|---------|----------|----------------|
|     |                                | Cycle I | Cycle II | Cycle I | Cycle II | Cycle I | Cycle II |
| 1.  | Subject Identity               | 3.14    | 3.94     | high    | high     | 78.5    | 98.5  |
| 2.  | Core Competencies and Basic competencies | 3.36 | 3.76     | high    | high     | 84.1    | 94.0  |
| 3.  | Formulation of Indicators      | 2.96    | 3.57     | medium  | high     | 73.9    | 89.4  |
| 4.  | Formulation of Learning Objectives | 2.41 | 3.59     | medium  | high     | 60.33   | 89.92 |
| 5.  | Selection of Teaching Materials | 2.57    | 3.50     | medium  | high     | 64.19   | 87.56 |
| 6.  | Selection of Learning Resources | 2.71    | 3.61     | medium  | high     | 67.75   | 90.25 |
| 7.  | Selection of Learning Media    | 2.68    | 3.59     | medium  | high     | 66.94   | 89.69 |
| 8.  | Learning model                 | 2.70    | 3.47     | medium  | high     | 67.62   | 86.75 |
| 9.  | Learning methods               | 2.57    | 3.30     | medium  | high     | 64.33   | 82.58 |
| 10. | Learning Scenarios based on scientific approach | 2.63 | 3.54     | medium  | high     | 65.70   | 88.50 |
| 11. | Learning Assessment Plan       | 2.55    | 3.55     | medium  | high     | 63.75   | 88.8  |

| Average | 2.71 | 3.55 | Medium | High | 68.83 | 89.63 |

Table 1 shows that there is an increase of competence of science teacher candidate in developing Lesson plan from cycle I to cycle II that is from 68.83% to 89.63%.

Table 2 presents the pedagogical competencies of prospective science teachers to develop worksheet in cycle I and cycle II. From the table it is known that the quality of worksheets developed by prospective teachers has increased from cycle I to cycle II. These worksheets are developed based on the learning model used in lesson plan.
Table 2 Pedagogical Competencies of Prospective Science Teacher to Develop Worksheet Based on Scientific Approach

| NO | Components of the Lesson Plans | Average Category | Percentage |
|----|--------------------------------|------------------|------------|
|    |                                | CYCLE I | CYCLE II | CYCLE I | CYCLE II | CYCLE I | CYCLE II |
| 1  | Student Worksheet Format (LKPD) | 3.26     | 3.65     | high    | high    | 81.53   | 91.14    |
| 2  | The contents of the learner’s Worksheet based on scientific approach: | | | | | |
|    | A. Inquiry                     | 3.15     | 3.54     | high    | high    | 78.85   | 88.50    |
|    | B. Discovery Learning          | 3.30     | 3.70     | high    | high    | 82.60   | 92.50    |
|    | C. PjBL                        | 1.87     | 3.09     | less    | high    | 46.87   | 77.17    |
|    | D. PBL                         | 3.09     | 3.67     | high    | high    | 77.42   | 91.67    |
| 3  | Language                       | 3.46     | 3.66     | high    | high    | 86.50   | 91.62    |
| 4  | Benefits / Usage of Learners Worksheet | 3.40  | 3.69     | high    | high    | 85.00   | 92.25    |

Average 3.09 3.56 high high 77.26 89.05

At Table 2 it appears that the competence of students to develop worksheet based on scientific approach tailored to the model of learning planned in Lesson plan. In general, worksheet developed by students has improved quality from cycle I to cycle II by using various learning models.

3.2 Discussion

Microteaching course was begin with the delivering of matter about make learning tools based on scientific approach. The matters discussed in group were: scientific approach, inquiry learning, problem based learning (PBL), discovery learning, and project based learning (PjBL). Otherwise, the prospective science teacher also discussed about the development of lesson plan, formulating indicator or purpose of learning refers to basic competency and development of worksheet.

The learning proces in the classroom used jigsaw type. The groups in jigsaw were consisted of five original groups and they were choosen according to the academic ability and gender. Each students in group had responsible to make different learning tools adjusted with the type of learning model then they works together in other groups. This groups were called expert group. After they works together in expert group, they then went back to discuss in original group and evaluate the results. After each prospective teacher produce learning tool, they then strated to do peer teaching and other students gave evaluation. All this activities were conducted in cycle I.

At the process of cycle I, it is found some weaknesses. The first, many groups did not apply scientific approach in their teaching although in lesson plan is written. The second, some groups did not use media in their teaching. The third, the students had not used the assesment of affective and only focus on cognitive.

The competency to make a lesson plan in general, the lesson plans component made by the fixed group refer to the lesson plan based scientific approach, but there are still some disadvantages. Some
weaknesses encountered include: 1) the low competence of students in formulating the appropriate indicators of competence; 2) the low ability of students in formulating learning objectives that contain aspects of Audience, Behavior, Condition, and Degree; 3) the type of assessment used only focused on the assessment of cognitive aspects.

The weakness above must be a priority on the next cycle. This is in accordance with the results of the development of the professional teacher competency in preparing Lesson plan and worksheet conducted by [7] that teachers should be able to develop a clear lesson plan that describes what students expect to know, contains behavioral objectives, which are tailored to the learning objectives and character of the students. Student assessment is also seen from skills not only from cognitive or knowledge [8], [9], [10], [11].

The results of the reflection analysis conducted in cycle I become the reference to improve the action in cycle II. The evaluation of the implementation of learning in cycle II, it appears that the lesson plan is in accordance with scientific approach. Finally, the evaluation of competency of teacher candidates in developing learning tools has been in accordance with the expected.

Similar results have also been conducted by [12] who has conducted a professional competence assessment of biology teacher of Senior High School in Makassar in the aspects of mastery of teaching materials, preparation of teaching programs, implementation of teaching programs, and assess the results and teaching and learning process. Overall the average score of professional competence of Biology teachers in Makassar is 80.34 with very high category. The results of implementation of jigsaw type cooperative are giving information about the effectiveness of cooperative model to increase the prospective teacher competence, giving feed back to the lecturer to give debriefing of competence. In addition, the prospective of science teacher should design lesson plan and worksheet adjusted with model of learning and scientific approach which require the activity of students.

4. Conclusion
Based on the results of research and discussion, it can be concluded that there is an increase in student competence results in developing learning tools in cycle I to cycle II on Jigsaw. The increasing of prospective science teacher pedagogical competencies to provide lesson plan and worksheet give advantages to do field recognition practice at school.

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