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Manipulatives Implementation For Supporting Learning Of Mathematics For Prospective Teachers

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perception was discussed. This study was focused on the implementation of the undergraduate course of manipulatives workshop at Universitas Muhammadiyah Semarang.

2. Method

This is a descriptive analytic research with the sample population were all students at the Department of Mathematics Education semesters 4 and 6 totaling 93 students. Samples were taken at random by using Purposive Random Sampling in students who have taken courses of math manipulatives workshop, totaling 36 students. Observation, interviews, and questionnaires are used as data collection techniques. Observations carried out to obtain a description in detail about the condition of the implementation of learning mathematics manipulatives workshop. Interviews with students and a lecturer of course in mathematics manipulative workshop conducted by referring to the lattice [18] to obtain information about the implementation of learning mathematics manipulative workshop.

There are eight components that are measured in the questionnaire, namely the preparation of lecture, general professional competence, specific professional competence, the ability of self-development, ability to manage the class, planning, and implementation of learning, delivery of subject material, and the way to evaluate learning outcomes. The questionnaire design refers to the guidelines provided Schwarz [19], Lucas and Baird [20], Crocker and Algina [21], Krosnick [22], and Braun et.al [23]. Four answers choices were provided in the questionnaire namely very often, often, rarely, and very rarely with the scoring for each answer is 4, 3, 2 and 1, respectively. The questionnaire results for each component is analyzed using the formula below [24]:

$$\text{Percentage of answers} = \frac{\text{Amount of respondent answers}}{\text{Ideal score answer}}$$

where ideal score = maximum score x amount of questions x amount of respondents.

Criteria for assessment questionnaire refers to the criterion of Riduwan [24]. Data were analyzed using triangulation techniques which combine and generalize the results of the data into the form of descriptive sentences detailed and candid. According to Riduwan [24], the criteria for the percentage range of 100-80, 80-61, 60-41, 40-21, and 20-0 is very good, good, fair, poor, and very poor, respectively.

3. Result And Discussion

Three students did not return the questionnaire. Perception of the 35 students who return the questionnaire is presented in Table 1.

TABLE 1. The students' perceptions of the implementation of the lectures

Assessment component	Percentage (%)	Criteria
Preparing for learning	79	Good
General professional competence	73	Good
Specific professional competence	67	Good
The ability of self-development	75	Good
Ability to manage the class	83	very good
Planning and implementation of learning	72	Good
Delivery of subject material	64	Good
The way to evaluate learning outcomes	54	Fair

Component 1. Learning plan

Results shown in Table 1 was confirmed through interviews and observations. Learning plan with a percentage of 79% and good criteria indicate that lecturers always deliver the learning objectives in each meeting. However, from the questionnaire detail, it can be shown that learning plans were always taken but not implemented in detail, learning to use the main reference book without the support of additional

references. It should be fixed on the preparation component is additional supporting books so that students can have a wider knowledge.

Component 2. General professional competence

The total scores obtained from four question is 376 with the ideal score is 512. In other words, the percentage of 73% with good criterion. This result describes that the lecturer has always encouraged students to understand mathematical concepts and cultivate an attitude of reasoning that can design appropriate manipulatives material. Students suggest that the lecturer can further grow fighting spirit and competitiveness among students.

Component 3, Specific professional competence

The data in Table 1 on components for general professional skills can also be described that the total score is 346 with an ideal score of 512. This result was confirmed in interviews and observations include the habit of thinking objectively and openly, exemplary attitudes, habits appreciate the aesthetic and religious values. Feedback from students to lecturer is, even more, emphasis on the teaching of habits in logical abstract thinking, systematic and creative.

Component 4, The ability of self-development

Components of an ability of self-development shown in Table 1 obtained a score of 388 with an ideal score of 512. Based on results of this questionnaire, interview and observation can be described that lecturers always develop themselves regarding knowledge and attitude of learning, develop appropriate skills of science and technology. Things need to be improved is the ability to develop knowledge and attitudes for further studies not yet visible in learning.

Component 5, The ability to manage the class

Based on the results shown in Table 1 questionnaires, interviews and observation, the ability of the faculty in classroom management can be described that the very good academic atmosphere is created at each meeting, and the spirit of the students to ask successfully developed. Lecturers also to train students to be responsible and respectful to others. Student feedback given to the lecturers for improvement is the ability of lecturers to train students to critical thinking skills need to be pursued more intensively.

Component 6. Planning and implementation of learning

Table 1 shows that the planning and implementing learning was done well. These results have been confirmed by interviews and observations. Planning and implementation of learning can be described that the learning plan is created for each meeting, learning executed sequentially from the material of manipulative design, lesson plan of manipulative and the practice of manipulative making.

Component 7. Delivery of subject material.

Good criterion with the percentage of 64% as shown in Table 1 indicate that the material is delivered with an efficient, clear, and students actively participate in the practice of manipulative making. However, from interviews and observations, there is an important note to be addressed in the limited time of the meeting led to some of the material cannot be delivered, the time for discussion in completing the task students are not provided with sufficient while students are always given the task group or individually. Regarding improving the delivery of content, students asked lecturers to create media that can assist students in developing the skills of manipulatives making.

Component 8. The way to evaluate learning outcomes

Lecturer considered sufficient (54%) regarding learning outcomes evaluation design that includes assessment, reporting and practice the use of manipulative. Group work given by lecturer led to an objective assessment was difficult to carry. Assessment of learning outcomes for the task presented that can be represented by one member, causing some students are not able to assess the results of their own learning.

The very good value in classroom management component indicated that the lecturer could create a pleasant lecturing atmosphere so that students do not get bored with the learning process. In other words, in the learning process, the lecturer always fosters the student's spirit to understand the material well. While fair in the evaluation component indicates that only some groups are evaluated by lecturers so that students who are not evaluated could not find out their mistake in judging themselves. In addition to assessments by the lecturer does not involve students so less objective assessment. Overall assessment component has reached a good category, with an average acquisition value for the eight components amounted to 70.87% and included a good category.

Through the evaluation of the work on the effectiveness of using math manipulatives, the author found many works that supported the use of virtual [25,26,27], pictorial [28,29], and concrete [30,31] manipulatives. For decades, many authors have been demonstrating the good impact of using pictorial and concrete math manipulatives for their students. The works that are more coeval have extended these findings to virtual manipulatives. Although some works have reported unimportant when using math manipulatives, it appears that these results are related with the method used of instructional. The lecturer who adheres the best practice recommendations for manipulative used tends to undergo positive outcomes.

4. Conclusions

As a conclusion, this study showed that the learning process for a workshop of mathematics manipulatives course had done well by the lecturer. This creates a great opportunity for students at the University as a prospective teacher develop their implicit conceptions about the teaching and learning of mathematics. This learning process can lead to increased confidence by obtaining a new learning experience. This learning process is the mechanism driving change belief-systems for students who use manipulatives to reveal the conception of teaching and learning mathematics. It can also help teacher monitor the process of reflection and to help students understand abstract concepts into concrete.

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