Journal of Physics: Conference Series

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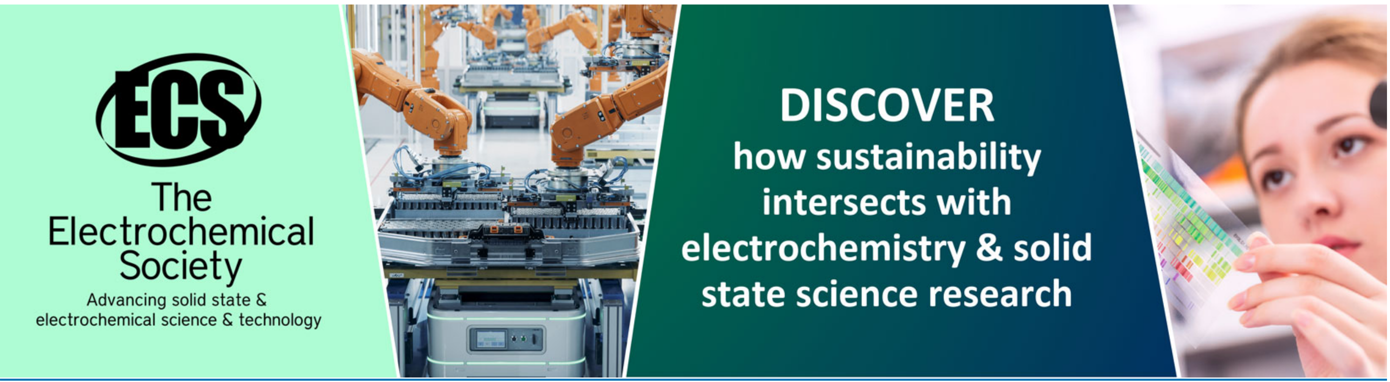

Mathematical Proficiency Profile of Prospective Mathematics Teacher Students

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Abstract. Abstract This study aims to look at the profile or category of prospective mathematics teacher students in terms of their mathematical ability. This research is important because it will provide data for lecturers and study programs to develop learning models and the curriculum development process. This research is a kind of qualitative research with a grounded theory approach, and involves 23 prospective mathematics teacher students as respondents. The respondent's profile description is guided by a mathematical rubric proficiency and a set of written questions, questionnaires and interviews. The results of this study were obtained two categories of mathematical proficiency of prospective mathematics teacher students, namely the average category and the advanced category. Based on the indicators of each aspect of mathematical proficiency, it was found that in general the presentation of average category was still above 60% and the percentage of advanced category was still below 40%.

1. Introduction

The expertise or skills of a teacher are obtained through the education process obtained from Educational Personnel Education Institutions (LPTK). In LPTK prospective teachers are printed according to their fields, namely mathematics education, biology education, physics education, PKN (civics) education, chemistry education and other education courses that are in line with subjects in schools.

Prospective mathematics teachers will be printed as professional mathematics teachers. [1] said that a professional mathematics teacher is a teacher who mastered pedagogic science and its mathematical content. This is in line with the Law on teachers that teachers must have skills. In this case, mathematics teachers are required to be proficient in mathematics. The term is proficient in mathematics known as Mathematical Proficiency. Mathematical skills, according to [2] consist of (1) conceptual understanding; (2) Procedural fluency; (3) strategic competence; (4) adaptive reasoning; and (5) productive disposition. These five skills must be possessed by a mathematics teacher when they want to teach mathematics to their students. The five skills are unity that cannot be separated from one another. Knowing the math skills profile of prospective mathematics teachers is important. This serves as an indicator of an LPTK institution in producing graduates who will be deployed to the field to become mathematics teachers.

In most of the LPTK, mathematics education study programs have a vision of producing professional mathematics teachers. In line with this vision, they should know the profile of students who will be graduated from their institutions with good mathematical proficiency skills. If you know the profile of students who will graduate, it will be a feedback for the institution and lecturers to be able to develop learning models and curriculum in order to improve students' mathematical proficiency abilities.

Several previous studies have examined various efforts to improve students' mathematical skills. Examples are the results of research conducted by [3] that students' mathematical skills can be developed through problem posing learning models and research results of [4] that mathematical skills can be developed through collaborative lecture strategies. However, from these studies, no one has done more in-depth research on the profile that is distressed in the mathematical abilities of prospective mathematics teachers. So this research wants to reveal the mathematical profile of students of mathematics education study program at FKIP.

2. Method

This research wants to reveal the profile or level of mathematical proficiency of prospective teacher students in the Mathematics Education Study Program FKIP. This research is qualitative in nature with an approach in grounded theory designs. According to [5] grounded theory designs are systematic qualitative procedures that researchers use to bring up general explanations based on participants' views that explain the processes, actions, or interactions between participants. Research with grounded theory designs can identify those involving researchers or students by interviewing them to find specific themes or categories. Grounded theory designs produce a theory when existing theories and participants do not address the problem.

Subjects in this study were 23 FKIP mathematics prospective teacher students who were studying in semester 7. All of the students were given questions to measure their mathematical abilities then were interviewed to reveal the state of their mathematical proficiency. During the interview, students were videotaped for the triangulation process. In this research, research instruments are needed. The instruments in this study were in the form of mathematical proficiency rubric, a set of description questions that had been adapted to mathematical proficiency indicators, and questionnaires and interview guides. Mathematical proficiency rubric is compiled based on existing theories related to mathematical proficiency, then discussed with experts to obtain content validity. The questions used as instruments in this study were first validated by experts after being read out.

3. Results and Discussion

The profile of mathematical proficiency of FKIP mathematics prospective teacher students in this study was analyzed based on the mathematical proficiency rubric. In this rubric, five aspects are analyzed as a strand in mathematical proficiency. The five aspects are aspects of concept understanding, aspects of procedural accuracy, aspects of problem solving strategies, aspects of mathematical reasoning, and aspects of productive disposition attitudes. The five aspects are then described by indicators to make it easier to see the profile. Then to see the profile itself determined in rubric as follows in Table 1.

This rubric is then used as a reference in determining the mathematical profile of prospective mathematics teacher students in this study. Furthermore, the results of this study will be described by referring to each aspect and indicators in each of its aspects.

3.1 Aspect of Concept Understanding

3.1.1. Use of Early Knowledge

Based on the findings of 23 respondents, there are 6 students or 22% of average categories and 17 students or 78% of advanced categories. It appears that the students categorized as advanced have been able to write the square formula and the area of the circle formula. Then they are able to find the area of a square and the area of a circle, and the results are used to determine the area of the shaded area. Whereas in students still make mistakes in calculation and writing numbers in formulas. This indicates that he is not appropriate to use his initial knowledge to solve the problems he faces. These findings indicate that there is a relationship between the ownership of initial knowledge with understanding mathematical concepts. The same thing has been done in research [6] on an exploration of growth in mathematical understanding of grade 10 learners by recommending that in order for learners to naturally grow in understanding, they must use prior and ongoing knowledge. Furthermore, [7] has done the same thing with the result that ownership of initial knowledge is one indicator for students who have an understanding behavior in mathematical concepts.

Prior knowledge has a very strong influence on success in mathematics. Early ability in mathematics is a good force in predicting for future achievement compared to reading and attention skills.

Table 1. Mathematical Proficiency Rubric of Mathematics Prospective Teacher Students

Aspect	Indicator	Category	
		Average	**Advanced**
Concept Understanding	Use the prior knowledge to solve problems	Knowing the initial knowledge related to the problem	Knowing and utilizing initial knowledge to solve problems
	Can represent a concept in various forms of representation	Can represent a concept in one form of representation	Can represent a concept of more than two representations
	Can associate one concept with other concepts	Can associate a concept with other concepts	Can associate one concept with other concepts
Accuracy of procedure	Know the procedure to solve the problem	Know the procedure to solve the problem	Know the procedure to solve the problem
	Use the procedure correctly	Can use known procedures in solving problems	Can use precisely the known procedures to solve problems
Problem solving strategy	Have a variety of strategies in solving problems	Have one strategy in solving a problem	Having more than one strategy in solving a problem
	Can choose the right strategy in solving problems	Have their own strategy to solve a problem	Have and can use strategies to solve problems
Have mathematics reasoning	Create pattern	Can describe the formed pattern	Can explain and make the general pattern correctly
	Can argue about the answers given	Can provide a reason for solving the problem that has been done	Can provide reasons for solving the problem provided in detail and correctly
productive disposition	Self-Confidence	Score < 279	Score 2,8-4,00
	Persistence and perseverance	Score < 279	Score 2,8-4,00
	Open-minded and flexible	Score < 279	Score 2,8-4,00
	Interest and curiosity	Score < 279	Score 2,8-4,00
	Monitor and evaluate (reflective)	Score < 279	Score 2,8-4,00

3.1.2. Can represent a concept in various representations

Based on findings in the field, there were 14 respondents or 60% of students categorized as average and 9 respondents or 40% of students categorized as advanced.

Students are only able to represent only in one representation, namely in the form of a story. Students have been able to retell concepts in the problem into stories that can help them to solve problems. Students have represented in two representations, namely image representation and story representation, so this student has been categorized as advanced.

3.1.3. Can associate one concept with other concepts

Based on the findings in the field, it was found that there were 43% of students who met the average category and 57% of students who met the advanced category. The findings were obtained after students were first tested by giving written test questions. The test examines the ability of students to relate one concept to another when solving problems. In this problem students are tested to associate the concept of a triangle if one of the 60 degree angles is known which is flanked by two sides that are the same length as the area of segment to complete or find the area of the pan.

It appears that students are able to associate triangular formulas and sector areas to solve segment problems, so that students are categorized advanced. It appears that students have not been able to associate the triangle formula needed to complete the segment.

3.2. Aspect of Procedure Accuracy

3.2.1. Know the procedure in solving problems

Based on the findings in the field, the profile of prospective mathematics teacher students for the aspect of procedure accuracy in the indicator of knowing the procedure correctly, found the average category of 0% and 100% for the advanced category. This means that all prospective teacher students know the procedure when solving problems. Students know that the procedure for solving these problems is to factor, then they do the factoring with the right steps.

3.2.2. Apply the right procedure
Based on the findings in the field, it was found that only 10% of prospective mathematics teacher students for the average category while for the advanced category it had reached 90%. This means that almost all are proficient in using procedures correctly.

Students have used the procedure appropriately using the factoring method. It is said to be correct because to solve problem number four, the procedure of quadratic formulas can be used and also completing perfect squares. By paying attention to the character of the quadratic equation in the problem, the easiest procedure is to use factoring.

3.3. Aspect of Problem Solving Strategy
3.3.1. Have various strategies in solving problems
Based on findings in the field, there are 22% of FKIP UNLA prospective mathematics teacher students are categorized average and 78% of students are advanced. From these findings, it appears that the advanced category is more dominant than the average category. It appears that students can solve it with picture strategies and story strategies or words. Students can answer the questions just by picture and can also by retelling it in the form of words.

3.3.2. Can choose the right strategy in solving problems
Based on findings in the field, there are 80% of students who are categorized average and 20% who are advanced. Students already know that to solve the problem is to use pictures, but he cannot execute or use the strategy to solve the problem that is being faced so that the student cannot finish the problem.

3.4. Aspect of Mathematics Reasoning
3.4.1. Create Pattern
Based on the findings in the field, there are 22% of FKIP mathematics prospective teacher students are categorized average, namely students have not been able to make patterns.
Students have been able to make patterns. From the pattern determined in the problem, then developed for the pattern if $n = 1$, $n = \mathrm{k}$ and $n = \mathrm{k} + 1$. Average categorized students are not able to make a pattern for $n = \mathrm{k} + 1$ while students who are proficient can already write a pattern for $n = \mathrm{k} + 1$ like in the picture.

3.4.2. Can argue
Based on the findings in the field, there are 57% of students who are categorized as average and there are 43% of students who are categorized advanced. The ability of these students can be analyzed by answering mathematical induction problems that have been given. Students who are categorized advanced have been able to complete the proof by mathematical induction to completion.

It appears that the student cannot argue to prove that if he claims for $n = \mathrm{k}$ is true then it must prove that it is true for $n = \mathrm{k} + 1$. The student also cannot conclude from the results of his work so that the student is said to be unable to argue properly.

3.5. Aspect of Productive Disposition
Each indicator is categorized into ordinary and proficient categories. The average categorized students are usually seen from the score obtained only less than 2,80. While the score for students who are categorized as advanced is above 2,80 using a scale of 4. The score is obtained from a questionnaire with four choices of answers to one statement. The four choices of answers are strongly agree to be given score 4, agree to be given a score of 3, disagree to be given a score of 2 and strongly disagree to be given a score of 1. Then the students' answers in the questionnaire are processed using the following approach;

$$\frac{score\ obtained}{higher\ score} \times 4 = final\ score \tag{1}$$

Following is an example of a student questionnaire answer for self-confidence indicator. Based on the questionnaire's answer, the score is 13, the highest score is 4 × 6 statement = 24, then the final score is:

$$\frac{13}{24} \times 4 = 2{,}2 \tag{2}$$

Based on this score, the student is categorized as an average indicator of self-confidence in the aspect of productive disposition.

Based on Table 2 bellow, it appears that the attitude of self-confidence and interest and persistence of mathematics prospective teacher students are still categorized as usual meaning that there still needs to be an increase. In the aspect of understanding concepts, there are still more average categories compared to those categorized as advanced, so that future efforts are needed to improve the understanding of concepts in various ways that can be done. In the aspect of procedure accuracy, it can be said that more students tend to be advanced. In the aspect of problem solving strategies, advanced categories are still very few when compared with average categories. This is in line with the findings that students are still inclined to the procedure rather than to solving problems. In the aspect of mathematics reasoning, the ability to make patterns tends to be advanced, but when arguing, it is still in the average category, it is necessary to increase the ability to argue. Based on the findings in the field, the data obtained is then processed using the approach above, the data obtained as shown in Table 2 below:

Table 2 Data on the Findings of Productive Disposition Aspect

ASPECT	INDICATOR	CATEGORY	
		AVERAGE	ADVANCE
PRODUCTIVE DISPOSISION	Self-Confidence	86%	14%
	Persistence and perseverance	86%	14%
	Open-minded and flexible	64%	36%
	Interest and curiosity	27%	73%
	Monitor and evaluate (reflective)	81%	19%

In the aspect of disposition, self-confidence is still lacking, so there are more average categories than the advanced category. Persistence and perseverance are also still in the average category compared to the advanced category. Open-minded and flexible for average categories is still more compared to advanced categories. The interest and curiosity of mathematics prospective teacher students in FKIP is more categorized as advanced than the average. Monitor and evaluate (reflective) of mathematics prospective teacher students is more categorized as average than the advanced.

4. Conclusion

This study wants to categorize and describe the mathematical proficiency of mathematics prospective teacher students in FKIP. Based on the data obtained, an analysis of the data is carried out so that it can be concluded that the mathematics prospective teacher students in FKIP are categorized in two categories, namely the average category and the advanced category. There is also a breakdown of further results from these two categories. The average category still dominates rather than the advanced category. This means that in general the mathematical proficiency of mathematics prospective teacher students in FKIP still tends to be categorized as average.

Based on the results of data analysis that has been done, there are some suggestions for further research, (1) aspects of understanding students' concepts still need to be improved in representing a concept in various representations, (2) aspects of choosing a strategy need to be improved in the accuracy of using strategies in solving problems, (3) aspects of reasoning need to be improved in the ability to argue, and (4) aspects of disposition need to be improved in the attitude of self-confidence and interest and persistence in solving problems.

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