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PROFESSIONAL TEACHER PROGRAM EXPERIENCE: TEACHERS' KNOWLEDGE ON OVERCOMING STUDENTS' MISCONCEPTION

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ABSTRACT

This study aims to describe the teachers' knowledge about students in dealing with misconceptions experienced by the student on integral material based on the experience of teachers participating in the teacher professional program (PPG). This research is qualitative research that involved two subjects who were mathematics teachers of SMA Negeri 11 Ambon. Subjects were given a chance to identify the student's misconceptions. The data is collected through observation and interviews. Based on the research results obtained information that S1 has good knowledge in diagnosing misconceptions when use three tiers test, providing treatment when the student got a different answer, and ensuring that misconceptions do not occur in student with made peer instruction in front of the class, and have a good understanding of concepts about means of constant on indefinite integral. S2 cannot diagnose misconception and S2 cannot explain the different answers when the student solves the problem using a different method. Thus, it can be stated that teachers who have the PPG experience have a better knowledge of knowing and addressing the misconceptions experienced by the student.

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INTRODUCTION

Mathematics teachers play an essential role in improving the quality of mathematics learning in schools (Marchis, 2011; Moller, Mickelson, Stearns, Banerjee, & Bottia, 2013; Mutodi & Ngirande, 2014). Based on UNESCO data in 2016, Global Education Monitoring (GEM) shows that the quality of education in Indonesia ranks 10th out of 14 developing countries; besides that, Indonesia the last rank for the quality of teachers from 14 countries (United Nations Educational, 2016). Based on the GEM data above, it appears that the quality of Indonesian mathematics teachers has not been as expected because it is at the last of 14 developing countries. One of the indicators measured is based on teacher quality when managing the class into the learning process. The management capability is related to Pedagogical Content Knowledge (PCK) (Hill, Ball, & Schilling, 2008). Furthermore, there are three domains in PCK, namely teachers' knowledge related to the content, pedagogics, and students.

There are three main advantages of PCK based on several previous studies including, 1) can improve student learning outcomes (Cueto, León, Sorto, & Miranda, 2017; Gess-Newsome et al., 2019; Kleickmann et al., 2013) 2) can improve the ability to manage classes better (Van Driel & Berry, 2010; Venkat & Adler, 2014) 3) can enrich students' understanding and experience in the learning process (Hauk, Toney, Jackson, Nair, & Tsay, 2014; Lannin et al., 2013). Based on these descriptions, it can be stated that PCK has a direct influence on improving the quality of mathematics learning.

Based on early observation of the school, there is information that the teacher does not follow up with students ' learning results if they do not meet the target achievement. It is also justified by the students who are taught, they feel they are not given understanding and explanation when finding difficulties in resolving problems after the learning process. Teachers sometimes do not provide follow-up assessments in the form of guidance related to misconceptions that occur to students (J. Jeremy Winters & Dovie L. Kimmins, 2018; Kusmaryono, Basir, & Saputro, 2020; Ma'rufi, Budayasa, & Juniati, 2017). In contrast, misconceptions that occur can result in subsequent misconceptions (Kusuma, Subanti, & Usodo, 2018; Nassir, Abdullah, Ahmad, Tarmuji, & Idris, 2017; Sari & Sukisman, 2009) and make students difficult and construct new knowledge.

The material deemed difficult for students is integral. Based on several previous studies found that the lack of students in solving problems on integral material is an error in understanding basic concepts (Amelia & Yadrika, 2019; Grundmeier, Hansen, & Sousa, 2006; Makgakga & Makwakwa, 2016). For this reason, integral material can use to identify misconceptions that occur in students.

There are many researchers found that teachers' knowledge about the student is very important to identify students' misconception (An & Wu, 2012; Ausubel, Novak, & Hanesian, 1968; Sadler et al., 2013; Shulman, 1986). However, until now there have been no specific research results showing PCK advantages of aspects of classroom skills based on the teacher's knowledge of the misconceptions experienced by the student. One of the programs conducted by the Government in improving the quality of teachers is the professional teacher Program (PPG) which provides teachers or prospective teachers the opportunity to improve the ability of teachers PCK related to evaluation and monitoring based on Permendikbud No. 76 in 2013 and the mandate of UU No. 14 in 2005 stating that teachers are professional educators who have participated in PPG. Therefore, researchers are interested in describing the teacher's knowledge in the classroom when identifying student misconceptions, the treatment is given when students experience misconceptions, and the actions taken to ensure that students are not subjected to misconceptions on integral material based on the teacher experience following PPG.

METHOD

This research is a qualitative descriptive that aims to describe the phenomenon obtained naturally (Moleong, 2009; Nana, 2010). The research aims to to describe the teacher's knowledge related to students in overcoming students' misconceptions on integral material in terms of the teacher's experience. The subjects were two mathematics teachers who taught at SMA Negeri 11 Ambon, which was distinguished by their experience in participating in PPG. Data obtained by giving problem-solving tests to two different classes where the two subjects taught. The subject consisted of two teachers consisting of one teacher who had participated in PPG, which was later called S1, and one teacher who had not yet participated in PPG, which later was called S2. Both subjects were allowed to determine the misconceptions experienced by student. Then subject was allowed to give treatment to student who experienced misconceptions to correct erroneous concepts, then proceed with the process of confirming to

students that no misconceptions occurred. After the whole process carried out, further in-depth interviews conducted related to the activities that have been carried out in overcoming misconceptions experienced by student. To make it clear, we can see in figure 1.

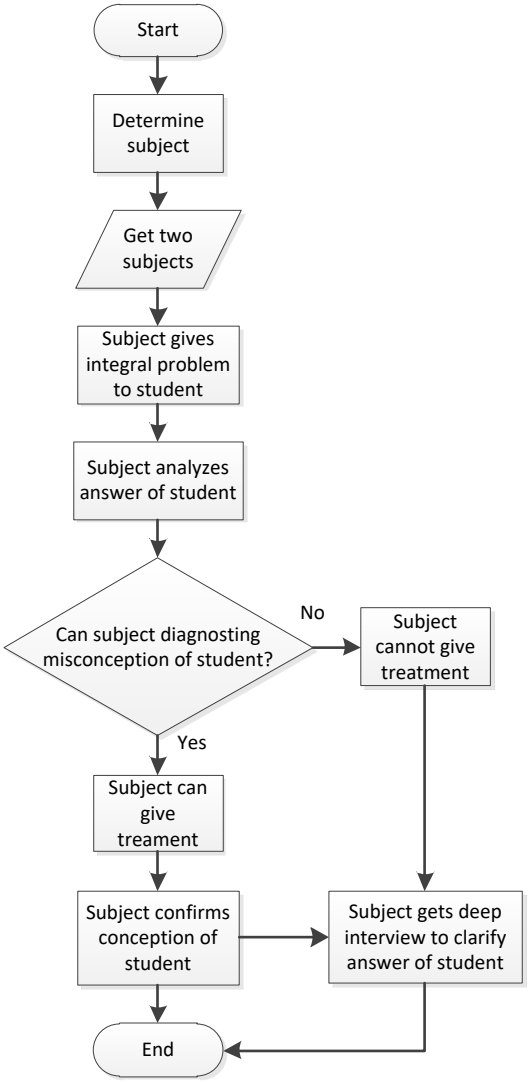

Figure 1. Flowchart of research step

Data analysis techniques consist of 1) analyzing field data in the form of student's work, 2) transcribing the results of interviews, 3) conducting data reduction 4) presenting data in the form of illustrations of diagnostic, treatment, and confirmation processes 5) concluding. The data analysis collection technique is in line with the opinions Miles et al., (1994) that qualitative data analysis techniques are based on collection and reduction data, presentation, and conclusions.

RESULT AND DISCUSSION

S1's process analysis when overcoming misconceptions experienced by student

After student complete the given integral problem, S1 analyzes the results of student's work, and it indicated by student experiencing errors when solving indeterminate integral problems that require substitution and partial methods. Student answer quickly even with wrong answers.

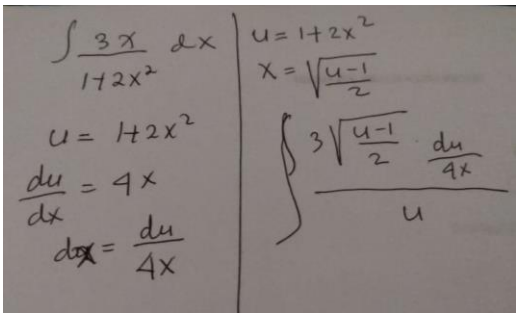

Figure 2. Student's answer (problem I)

Based on figure 2, students can not solve the given problem even though they are sure of the method used. When S1 interviewed related to understanding student's concepts in solving problems, it appears that student cannot understand the concepts well. The S1 interview excerpts are as follows.

P : How do you ensure that your students occurred misconceptions in solving these problems?
S1 : First, I give a variety of questions related to the integral material as a whole. Then I discovered the fact that students indicated difficulty in determining the method used in solving integral problems.
P : What method do you mean?
S1 : Substitution and partial methods
P : What is your reason?
S1 : Students are entirely focused on the problem. The method used is related to the relationship of elements in the problem. For example, if there are one element and the result of the derivation of another element of the same term, then it uses the substitution method, and if the elements in the problem are not related, then it uses a partial method.

Furthermore, S1 tries to dig deeper into students who have indicated misconceptions by asking to solve other problems. The same thing still happens when asked by S1 to solve the same problem using two methods. The results of student work are as follows.

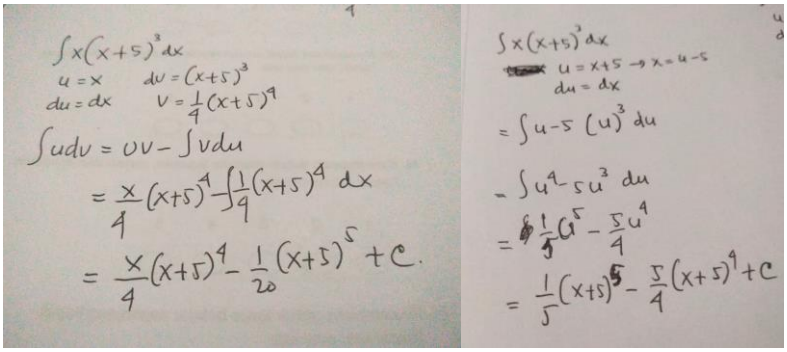

Figure 3. Student's answer (problem II)

Based on Figure 3 above, student can solve the given problem using two methods even though the student's answers are more inclined to the answers using partial methods. It supports the results of interviews conducted with the following S1.

P : How does your student answer when asked about the truth of the two methods he uses?

S1 : When I ask a similar question, my student states that the correct answer is a partial method even though he is conceptually convinced that the substitution method used is appropriate.

P : What methods do you use to ensure that your students experiencing misconception?

S1 : I used a three-tiers test

P : What do you know about that?

S1 : Basically, the misconception is related to understanding and belief; the location of the difference between not knowing the concept and the misconception is belief. When students answer wrong and believe the answer is correct, the student experiences misconceptions. About the three-tiers test, it is a test that presents the final answer, then the reason for this is the completion of the reason and then continued with the level of confidence at each step. If more than half of the overall completion steps are believed, then the answer is believed to be correct by students even though the reality is not absolute.

Based on the above interview excerpt shows that S1 can diagnose misconceptions experienced by students related to the completion of the given problem. S1 uses a three-tier test to ensure that students experience misconceptions. It is in line with the opinion of (Peşman & Eryılmaz, 2010), which states that a valid and measurable way to determine students' misconceptions is to use a three-tiers test. The problem solving given can use two different methods, namely substitution and partial, although, at a glance, the answers are different when simplified. It obtained the same final answer. So it is not appropriate if the method used depends on the relationship between the given item problem.

S1 explains the substitution and partial methods. S1 gives another example and then works on a simple form. S1's explanation related to misconceptions experienced by students is as follows.

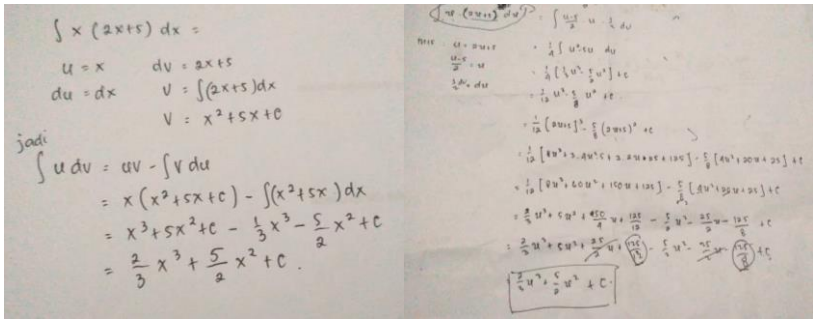

Figure 4. S1's explaining (problem III)

Based on Figure 4, S1 shows student that the same problem can be solved using the substitution and partial method because when described and simplified, the same final answer will be obtained so that it indirectly denies the student's previous statement that similar questions can only be solved by a particular method. In this case, the partial method. The following fragment of the interview confirms that.

P : How do you change students' views about the understanding they have?
S1 : Actually, it is easy; the student already has prior knowledge. Students can show the previous problem by using two different methods correctly, although it is not appropriate in interpreting the selection of methods because of the questions with the model. The focus is not on choosing the method but instead on how to decipher and use the concept correctly.
P : How do your students interpret the difference in constant?
S1 : On the results of integrating students, argue that the difference in the value of a constant does not change the solution given that when a constant is operated, it will produce a constant.
P : Is it useful to change your students' understanding?
S1 : Providing direct explanation is an appropriate strategy for aligning students' understanding of the ways used in solving problems like that.

Based on the interview excerpt above shows that S1 can reinforce the concept by providing a re-explanation based on examples of the questions presented, then a statement of denial is built that students understand, so students can accept and know misconceptions related to the choice of methods used in solving integral problems. A direct explanation of misconceptions experienced by students is appropriate, and student can accept it. It is in line with (Gaigher, 2014), which states that the best way to overcome misconceptions is to provide a direct explanation related to misconceptions experienced by students.

Then S1 provides an opportunity for student who experience misconceptions to appear in front of the class and then is allowed to make their problems (submit a problem), then solve using two different methods, then finally explain to other students (peer instruction). The results of student work are presented in the following figure 5.

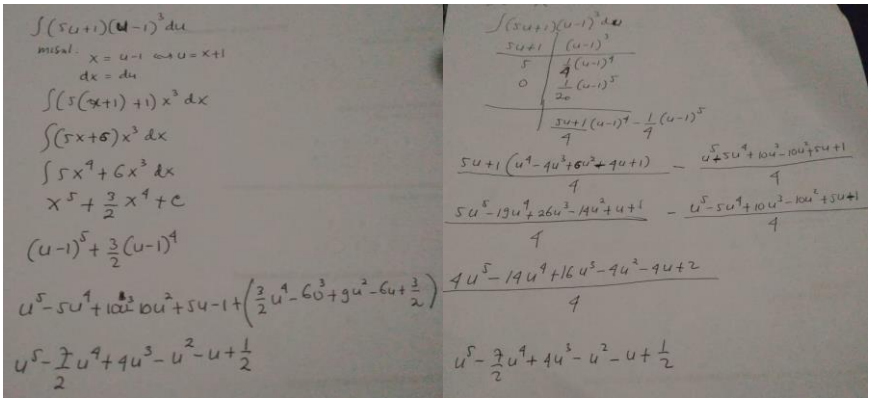

Figure 5. Student's answer in front of the class

Based on Figure 5 above shows that student can solve their questions using two different methods, namely the substitution method and the partial method. Then student is allowed to explain each stage of completion in two different methods. It indicates that student no longer understand the method of substitution and partial methods as a choice of methods but can be used simultaneously. The excerpts of interviews with S1 are as follows.

P : Why do you allow students to submit problems and solve problems in front of the class and then continue with peer instruction?

S1 : I do this to ensure that students can understand the use of substitution and partial methods and it can use together to prove the truth of each other

P : Besides making sure students don't experience misconceptions regarding the use of different methods, what else do you expect?

S1 : I hope students have meaningful experiences when explaining in front of the class, so that they provide confidence.

Based on the above interview excerpt, it can state that S1 could ensure that student no longer experience misconceptions. By providing opportunities for students to submit problems and continue peer instruction. It is in line with the view (Crouch & Mazur, 2001; Lasry, Mazur, & Watkins, 2008), which states that the way to ensure that misconceptions do not occur is to provide opportunities for student to demonstrate their understanding.

S2's analysis process in overcoming misconceptions experienced by student

After students solve the given integral problem, S2 analyzes the results of student work. There are two answers presented by students because initially, students make the wrong

substitutions with the wrong example, then students write the answers with other examples. Student seems hesitant with the answers given to get the right final answer.

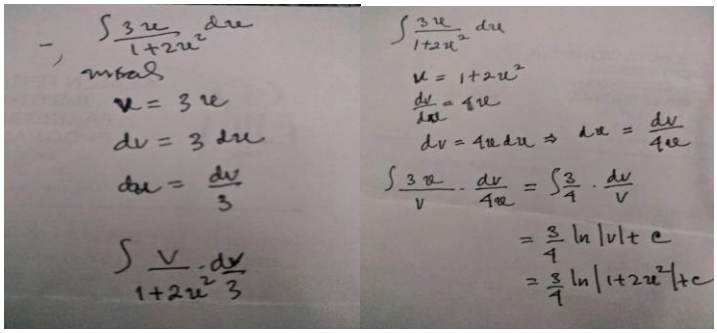

Figure 6. Student's answer (problem I)

Based on Figure 6 above, it appears that student do not master the concepts that have related to the method of settlement with substitutions. When S2 was interviewed related to understanding student's concepts, S2 stated that students seemed hesitant in solving the given problem. The S1 interview excerpts are as follows.

P : How do you ensure that your students have difficulty in solving the problem?
S2 : Based on several types of questions that I gave, it appears that students have difficulty in determining which examples are used when using the substitution method
P : Are the difficulties experienced by students classified as misconceptions?
S2 : In my opinion this cannot be said to be a misconception because students look doubtful with the answers given
P : What is your reason?
S1 : Based on my understanding, misconceptions occur when students believe the answer given is correct even though it is conceptually wrong. Students look doubtful with the answers he gives because they write two different answers.

Next, S2 tries to explore further the student who indicated misconceptions by asking to solve other problems. Student, when asked by S2 to solve the same problem using two methods, studentget different answers. The results of student work are as follows.

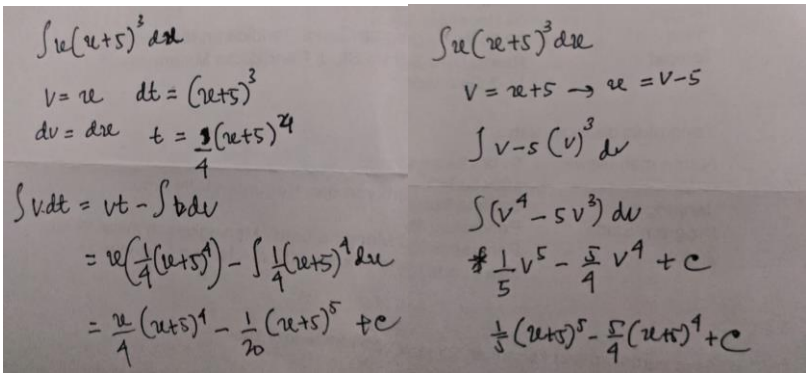

Figure 7. Student's answer (problem II)

Based on Figure 7 above, students can solve the given problem using two methods, even though student is more confident with the answers using the substitution method. It is supported by the results of interviews conducted with the following S2.

P : How does your student answer when asked about the truth of the two methods he uses?

S2 : My students feel confused when they get two different answers from the two methods used. Conceptually, students believe that the answer he gave is correct. Nevertheless, students tend to choose answers that use the substitution method.

P : What methods do you use to ensure that your students experiencing misconception?

S1 : I also have difficulty when asked to determine the correct answer because conceptually, the two methods are correct but have different final answers.

P : What will you do if students ask the truth of two different answers?

S1 : I will explain that both are conceptually correct but I do not know why things happen

Based on the above interview excerpt, it appears that S2 is not able to explain the difference in answers obtained if done using two different methods even though conceptually, both methods are appropriate. When S2 is asked if there are misconceptions experienced by students, S2 cannot determine because S2 has difficulty finding the location of differences so that different answers are obtained.

Based on the results obtained from the analysis of S1 and S2 in overcoming misconceptions experienced by students, it can be stated that there are differences in the ability to diagnose misconceptions. It is inseparable from the ability to master different concepts. S1 is more masterful of the concept when compared to S2 in explaining concepts related to substitution and partial methods. Mastery of concepts owned by teachers will facilitate teachers in diagnosing misconceptions experienced by students (Park & Oliver, 2008). Besides, teachers who have experience attending training and developing teaching

skills are better at teaching and managing classes when compared to teachers who have never attended (Duchaine, Jolivette, & Fredrick, 2011; Harris & Sass, 2011; Mulyawan, 2013; Pangestika & Alfarisa, 2015).

CONCLUSION

S1's knowledge of misconceptions that student experience is better than S2. It is seen when S1 can diagnose the student's answer by giving the three tiers test, then give the student the treatment of the misconception by allowing students to solve the problem with two different methods, as well as ensuring that students do not experience misconceptions by presenting different problems in front of the class with peer instruction. In addition, the understanding of S1 related to integral material is better when compared to S2. It is seen when S1 can show the similarity of the final answer when the problem is solved using two different ways while S2 does not do this and getting confused. Thus, it can be stated that teachers who have the PPG experience have a better knowledge of knowing and addressing the misconceptions experienced by the student.

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