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Mathematical Literacy Skills: In Terms of Gender Differences

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ABSTRACT

Good mathematical literacy skills will hopefully help maximize the tasks and role of the prospective teacher in activities. Mathematical literacy focus on students' ability to analyse, justify, and communicate ideas effectively, formulate, solve and interpret mathematical problems in a variety of forms and situations. The purpose of this study is to describe the mathematical literacy skills of the prospective teacher in term of gender differences. This research used a qualitative approach with a case study. Subjects of this study were taken from two male students and two female students of the mathematics education prospective teacher who have followed Community Service Program (CSP) in literacy. Data were collected through methods think a loud and interviews. Four prospective teachers were asked to fill mathematical literacy test and video taken during solving this test. Students are required to convey loud what he was thinking when solving problems. After students get the solution, researchers grouped the students' answers and results think aloud. Furthermore, the data are grouped and analysed according to indicators of mathematical literacy skills. Male students have well of each indicator in mathematical literacy skills (the first indicator to the sixth indicator). Female students have good of mathematical literacy skills (the first indicator, the second indicator, the third indicator, the fourth indicator and the sixth indicator), except for the fifth indicators that are enough.

INTRODUCTION

Mathematics literacy is the knowledge to know and applies basic mathematics in our everyday living. The concepts of mathematical literacy and connections to the real world are not totally different but in fact complementary. Mathematical literacy will provide learners with awareness and understanding of the role that mathematics plays in the modern world. Fundamental mathematical capabilities underlying mathematical process related to the mathematical literacy as the main potential effect of the three mathematical processes; formulate, employ and interpret when solving some PISA-like tasks, although in general case these abilities have not maximally activated yet. Mathematical literacy focus on students' ability to analyse, justify, and communicate ideas effectively, formulate, solve and interpret mathematical problems in a variety of forms and situations. Many factors must be considered in the study of mathematical literacy, among others: the willingness, ability, and specific intelligence, readiness of teacher and students, curriculum, and methods presented, a factor that is not less important is the gender factor. A gender difference necessarily leads to differences in physiology and affects the psychological differences in learning. So male and female students' certainly have a lot of differences in mathematics learning. The purpose of this study is to describe the mathematical literacy skills of prospective students' in term of gender differences.

MATHEMATICAL LITERACY

Literacy is traditionally understood as the ability to read, write, and use arithmetic. The modern term's meaning has been expanded to include the ability to use language, numbers, images, computers, and other basic means to understand, communicate, gain useful knowledge and use the dominant symbol systems of a culture. The concept of literacy is expanding in OECD countries to include skills to access knowledge through technology and ability to assess complex contexts. Fletcher-Campbell et al say that literacy is a complex concept that is required to get this capability is also a complicated process. The general idea of literacy would be absorbed in other fields, and one of the areas that absorb is mathematics so that the term mathematical literacy. In PISA 2015 draft mathematics framework stated that mathematical literacy is an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to engage in mathematics, in ways that meet the needs of that individual's life as a constructive, concerned, and reflective citizen. Mathematics is a common human activity, increasing in importance in a rapidly advancing, technological society. A greater proficiency in using mathematics increases the opportunities available to individuals. Students need to become mathematically literate in order to explore problem-solving situations, accommodate changing conditions, and actively create new knowledge in striving for self-fulfilment'. Definition of mathematical literacy in Cambridge Advance Learner's Dictionary defined as follows: 1) able to read and write, and 2) having knowledge of a particular subject, or a particular type of knowledge. Therefore, mathematical literacy is seen as the knowledge and skills needed to get through life in the aspect of financial, social, economic, culture and modern civilization. The PISA framework for mathematical literacy is organised into three broad components: the situations and contexts in which problems are located and that are used as sources of stimulus material; the mathematical content to which different problems and questions relate, and which are organised by certain overarching ideas; and the mathematical competencies that must be activated to connect the real world (in which problems are generated) with mathematics, and then used to solve the problems. The three components are shown in Figure 1.

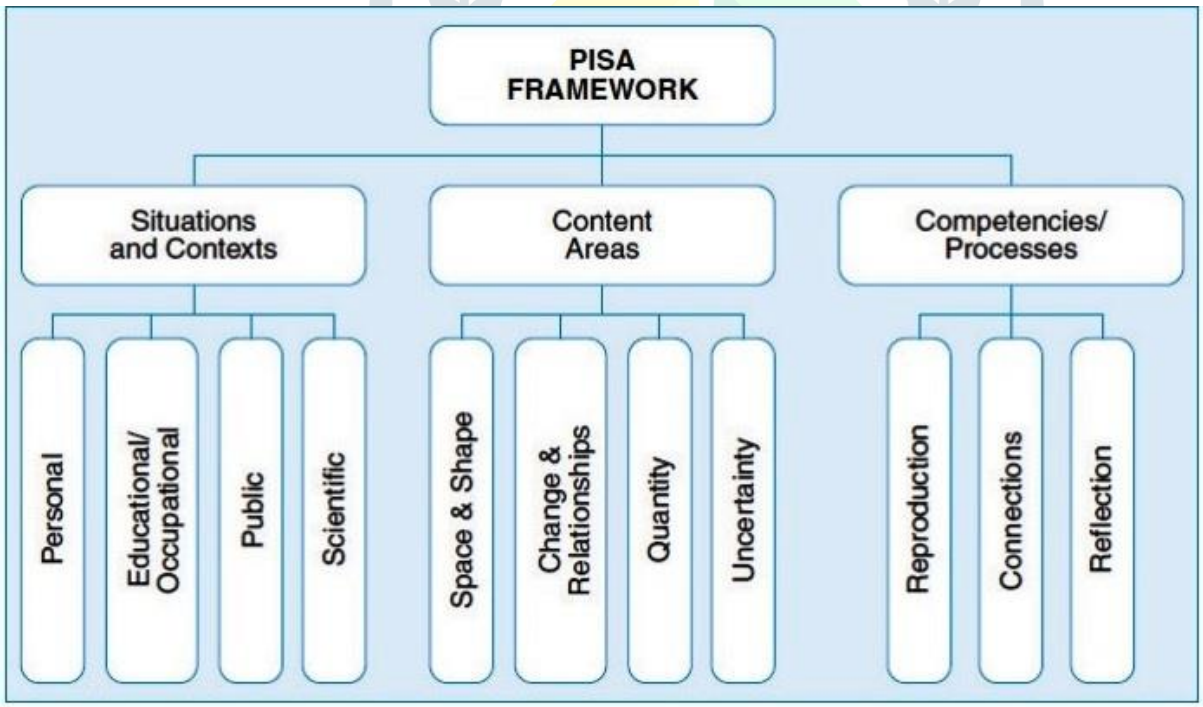


FIGURE 1. The component of the mathematical literacy framework

An important aspect of mathematical literacy is engagement with mathematics: using and doing mathematics in a variety of situations. Students were shown written materials that described various situations that students could conceivably confront, and the which required them to apply reviews their mathematical

knowledge, understanding or skill to analyse and deal with the situation. Four situations are defined in the PISA mathematical literacy framework: personal, educational/occupational, public and scientific. The situations differ in terms of how each problem directly affects students' lives; that is, the proximity of the connection between the student and the problem context. The PISA framework defines mathematical content in terms of four broad knowledge domains, referred to as 'overarching ideas', which reflect historically established branches of mathematical thinking and underpin mathematical curricula in education systems throughout the world. Together, these broad content areas cover the range of mathematics that 15-year-old students need as a foundation for life and for further extending their horizon in mathematics. The four overarching ideas are as follows:

- Space and shape, which draws on the curriculum of geometry. Looking for similarities and differences, recognizing shapes in different representations and different dimensions, understanding the properties of objects and their relative positions, and the relationship between visual representations (both two- and three dimensional) and real objects.
- Change and relationships, which relates most closely to the curriculum area of algebra. Recognizing relationships between variables and thinking about relationships in a variety of forms including symbolic, algebraic, graphical, tabular and geometric.
- Quantity, understanding of relative size, recognition of numerical patterns, and the use of numbers to represent quantities and quantifiable attributes of real world objects (counting and measuring).
- Uncertainty, solving problems related to data and chance, which generally correspond to statistics and probability in school curricula.

The competencies needed for mathematics literacy are described in the work of Program for International Students Assessment (PISA) under the auspices of OECD that is: Mathematics Thinking and Reasoning: Posing questions characteristic of mathematics; knowing the kind of answers that mathematics offers; distinguishing among different kinds of statements; understanding and handling the extent and limits of mathematical concepts. Mathematical Argumentation: Knowing what proofs are; knowing how proofs differ from other forms of mathematical reasoning; following and assessing chains of arguments; having a feel for heuristics; creating and expressing mathematical arguments. Mathematical Communication: Expressing oneself in a variety of ways in oral, written, and other visual forms; understanding someone else's work. Modelling: Structuring the field to be modelled; translating reality into mathematical structures; interpreting mathematical models in terms of context or reality; working with models; validating models; reflecting, analysing, and offering critiques of models or solutions; reflecting on the modelling process. Problem Posing and Solving: Posing, formulating, defining, and solving problems in a variety of ways. Representation: Decoding, encoding, translating, distinguishing between, and interpreting different forms of representations of mathematical objects and situations as well as understanding the relationship between different representations. Symbols: Using symbolic, formal, and technical language and operations. Tools and Technology: Using aids and tools, including technology when appropriate.

Various competencies are called into play as the mathematician process is employed. Each of these competencies can be processed at different levels of mastery. The PISA mathematical literacy framework discusses and groups the competencies into three clusters: the reproduction cluster (which involves the reproduction of practice knowledge); the connections cluster (which builds on the reproduction cluster by applying problem solving to situations that are not routine but still familiar); and the reflection cluster (which involves reflecting on the process needed or used to solve a problem). Descriptions of the degree of mathematical literacy typical of students in each level are also developed. For PISA 2003, scales based on the four broad content categories were developed. Descriptions for the six proficiency levels reported for the overall PISA mathematics scale in 2003, 2006 and 2009 are presented. These form the basis for the PISA 2012 mathematics scale. The finalized 2012 scale will be used to report the PISA 2015 outcomes. As mathematical literacy is a minor domain in 2015, only the overall proficiency scale is reported. A basic competency in mathematics in mathematics literacy is shown in Table 1.

TABLE 1. A Basic competency of mathematics in mathematical literacy

Number	Indicator of Mathematical Skill Involved
1	Make a mathematical model itself, such as creating mathematical equations, making number patterns and the like.
2	Writing the answers like making calculations with coherently.
3	Make/Utilizing the model images, tables, graphs, and the like to help find the answers.
4	Choose and compare strategies for finding answers
5	Reasoning by linking information on the matter with the experience that already exists.
6	Use and manipulate formulas or specific mathematical procedure for answers.

METHOD

This study used a qualitative approach with a case study. The data is collected through interviews and participant. The study involved four prospective teachers, there are two female and two male prospective teachers in mathematics education of faculty education and teacher training who have followed Community Service Program (CSP) in literacy. Four prospective teachers were asked to fill mathematical literacy test and video taken during solving this test. Students are required to convey loud what he was thinking when solving problems. After students get the solution, researchers grouped the students' answers and results think aloud. After finishes fill these instruments, they will interview. The material of the mathematical literacy instrument is geometry. There is two main type of instruments will be used, main and auxiliary instruments. The main instruments are the researchers themselves who act as planners, data collectors, data analysis, interpreters, and reporters of research results. The auxiliary instruments used in this study are test of mathematical literacy and video recorder. Qualitative data analysis is the effort made by working with the data, organize data, sorted them into units that can be managed, synthesize, search and find patterns, find what is important and what is learned, and decide what can be narrated to others, activities in qualitative data analysis performed interactively and runs continuously until complete, so that the data is already saturated. Activities in the data analysis, namely data reduction, data presentation, and verification/conclusion.The indicator of mathematical literacy skills to review the categorization presented in Table 2 as follows:

TABLE 2. The category of mathematical literacy skills

Category of mathematical literacy skills	indicator
Good	The fluency answer, the right calculation, and the development of the idea/ideas to the maximum.
Enough	The fluency answer, the right calculation, and the development of the idea/ideas is not maximized.
Less	The fluency answer, the calculation is not right, and the development of the idea is not maximized.

RESULTS AND DISCUSSION

Here are presented results of research on the mathematical literacy skill of students' in term of gender difference along with the discussion of the findings of this research.

Subject 1 (S1) At this stage of understanding the problem, the process of mathematical literacy that will be revealed is to read an open problem, observing the open problem, identify the problem, collect the relevant information, and to associate information with prior knowledge. S1 understand the problem very easily. S1 able to create a mathematical model by show the length and width of the field, and the length and width of the stage. Another characteristic of the S1 is likely to ease in processing information and have good skills in mathematics literacy. Besides the S1 can easily be aware ofthe mistake and correct it. So it can be concluded that the S1have no trouble at this stage of understanding the problem. The passage of statement S1that meets the first indicators of mathematical literacy skills are as follows:

S11.2: *already, I've understood it before I do, so that needs to be underlined is the size of the field, a large stage and a lot of pilgrims.*

On the stage of the planning and implementing the plan, the process of mathematical literacy that will be disclosed is strategies used S1 to solve the problem. S1 has the ability to present and complete the known information through drawings and then manage them so they can be the result of the maximum estimated for the number of recitation pilgrims. So it can be concluded that the S1 is able good in third, fourth and fifth mathematical literacy indicators. The excerpts of the statement S1 associated are as follows:

S11.4: To work on the problems that I've never been like this, but I often make similar questions regarding the parking area on the coursework on campus. Q: What strategies do you use in the completion that you have created? S11.6: I illustrate with draw what I think. Q: Why use this strategy? S11.7: Because I think by draw is more suitable for solving problems in this form. S11.9: I think of the location of the stage, the location of equipment support, the distance pilgrims with a stage, the distance of pilgrims male and female pilgrims and the distances between the pilgrims. Q: How do you solve the problem? S11.10: Not difficult, just imagining what it takes to set a field to be used efficiently.

It is as shown in the S1 response as follows:

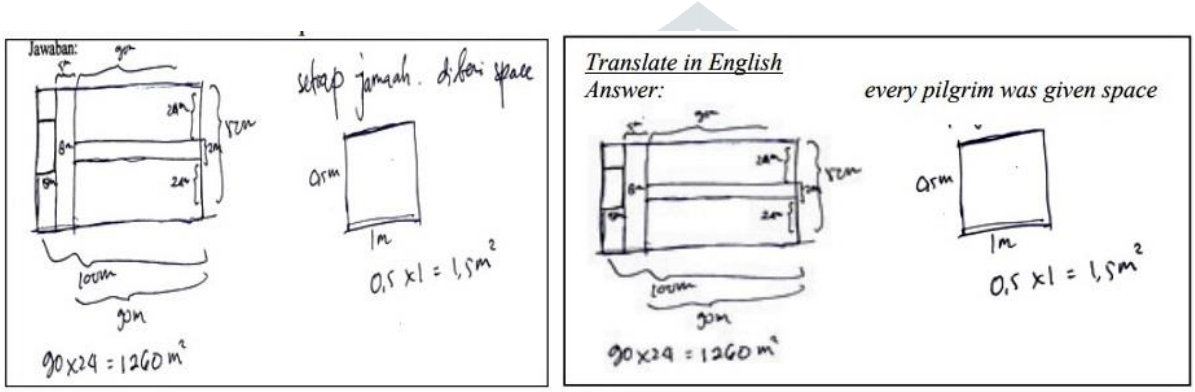


FIGURE 2. Response S1 in the planning with using drawing strategy

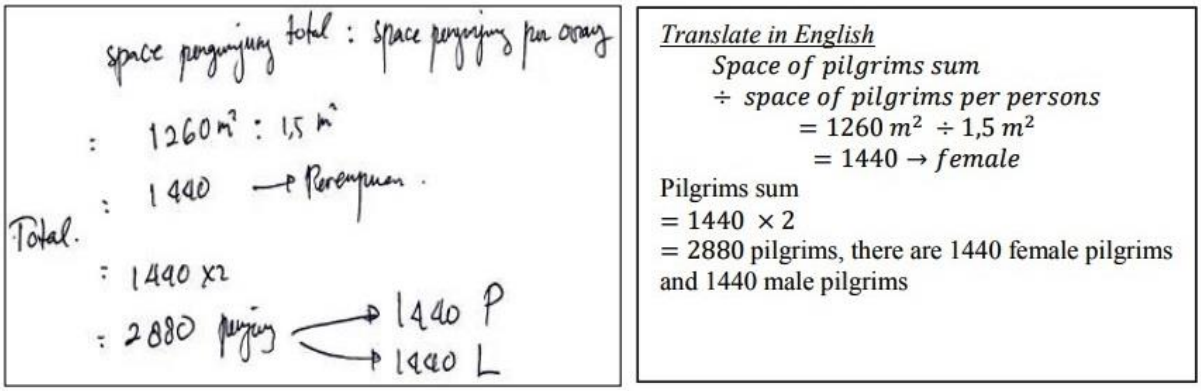


FIGURE 3. Response S1 in implementing the plan

At this stage of the evaluating process in mathematical literacy, that will be revealed is reading open problems, corrected the information obtained, and check the answers. Here are excerpts of the interview subjects' related S1 evaluation stages:

Q: Are you satisfied with your answer? S11.11: Yes, I'm sure, because I've read it and has been estimated in accordance which I believe to be true. Q: How do you check your answers! S11.12: Reread all my answers

Based on the data description, indicate that the subject S1 has been reviewing the results of his work. This is done by correcting from beginning to end, reread the question, and recheck the information and steps to resolve written.

Subject 2 (S2) At this stage of understanding the problem, S2 is able to create a mathematical model with the show the length and width ofthe field, and also length and width of the stage. Another characteristic of

the S2 is likely to ease in processing information and have good skills in the fifth indicator of the mathematical literacy. S2 can easily realize the mistake and correct it. It can be concluded that the S2 is not experiencing difficulties at the stage of understanding the problem. Here are excerpts of the interview S2 in understanding the problem:

Q: Have you read the problem? S22.1: Already, I've read it. Q: Did you understand the question? S22.2: It is, because it is clear and easy to understand, so we were told to make the layout and other stage and then count the number of pilgrims. Q: Tell me what you understand of the matter! S22.3: (S2 read about the subject again). So we like to make the event, and we must make preparations to make the place, set all layouts and then to estimate how many pilgrims can be accommodated. Q: Do you ever get the same problem with that question before? S22.4: Never, but because much simpler than this. Q: What knowledge do you need to solve the problem? S22.5: The experience that I have to manage multiple events.

On the stage of the planning, S2 has the ability to present and complete the known information through drawings and then manage them so they can be the result of the estimated maximum for the number of pilgrims. It can be concluded that the S2 is able to good in indicators third, fourth and fifth of the mathematical literacy skills. Following the continuing quote the interview with S2 in the completion plan:

Q: What strategies do you use in the resolution that you have created? S22.6: I draw Miss. Q: Why use this strategy? S22.7: Due to my own trouble if not draw, because it's been given to know the size of the field and the stage so yes that is easy to draw. Q: Are there other strategies that can be used in solving the problem? S22.8: As for this, I do not know any better than to draw to resolve such issues.

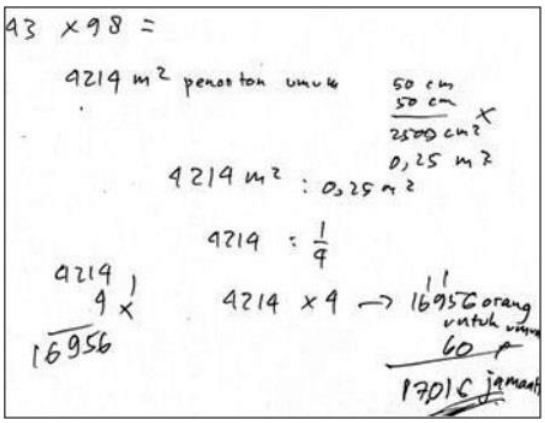
At the stage of implementing the plan, S2 did good management to solve the problems given. S2 capable in the well-sketched image for the placement of the stage. This means S2 has the ability to make/use the model images, tables, graphs, and the like to help find answers (third indicator mathematical literacy). S2 is also able to demonstrate the ability to reason or other needs in the study estimates. This means S2 has the ability to use and manipulate formulas or specific mathematical procedure for answers. It can be concluded in the problem management process S2 showing good skills in the second indicator, the indicator fifth and sixth indicators of mathematical literacy. The following are excerpts advanced Interview results with S2:

Q: Tell me the steps in the resolution that you have created! S22.9: Yes, the first drawn broad field known, then determine the position of the stage. The stage in front of the middle put itself so that visitors can see clearly also helped with the LCD on the side of the stage. Then given a red carpet on the way to the stage. Also among the pilgrims separated general and VIP pilgrims. Q: How do you solve the problem? S22.10: Not difficult, I only need to estimate the layout study needs to be efficient.

At the stage of evaluating, S2 read back about cursory and check the information that has been written. To test the truth of the completion, S2 read each step is written. Here are excerpts of the interview stage S2 associated with evaluating:

Q: Are you satisfied with your answer? S22.11: Yes, I was convinced. Q: How do you check your answers! S22.12: Reread all my answers.

It is as shown in the S2 response as follows:



Translate in English
$43 \times 98 = 4214\ m^2$ general audience
$50\ cm$
$50\ cm\ \times$
$2500\ cm^2 = 0{,}25\ m^2$

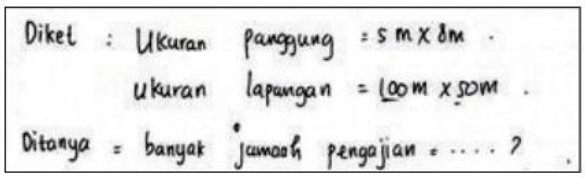
$4214\ m^2 : 0{,}25\ m^2 = 4214 : \frac{1}{4} = 4212 \times 4 \rightarrow$
16956 general pilgrims.
16956
60 +
17016 pilgrims

FIGURE 4. Response S2 in the planning and implementing the plan

Subject 3 (S3) At this stage of understanding the problem, S3 is able to create a mathematical model to show the length and width of the field and the length and width of the stage. Another characteristic of the S3 tends to be quite easy in information processing and have good skills in the fifth indicator of mathematics literacy. It can be concluded that the S3 would have no trouble at this stage of understanding the problem. Here are excerpts of the interview S3 in understanding the problem:

Q: Have you read the problem? S31.1: Already, I've read it. Q: Did you understand the question? S31.2: Already, I've understood it so I write down what I know. Q: Tell me what you understand of the matter! S31.3: (S3 read about anymore). So this is given a field with an area of 100 m x 50 m and stage with an area of 5 mx8 m. we are asked to determine the many pilgrims who can occupy the field. Q: Do you ever get the same problem with that question before? S31.4: Never. Q: What knowledge do you need to solve the problem? S31.5: Knowledge of study usually can be used to estimate properly.

It is as shown in the S3 response as follows:



Translate in English
Known data: the size of the stage = $5\ m \times 8m$
The size of the field = $100m \times 50m$
Asked: how many pilgrims' recitals =.....?

FIGURE 5. Response S3 in the understanding the problem.

On the stage of the planning, S3 has sufficient ability in presenting and resolving known information through drawings and then manage them so they can be the result of the approximate maximum for the number of pilgrims' recitation. It can be concluded that the S3 is good in the third and fourth indicators of mathematical literacy skills, but sufficient in the five indicators of mathematical literacy skills. The following excerpt continuation S3 interviews with the settlement plan:

Q: What strategies do you use in the resolution that you have created? S31.6: I describe what I think. Q: Why use this strategy? S31.7: Because I think the draw would be easier to solve problems in this form. Q: Are there other strategies that can be used in solving this problem? S31.8: I do not understand other strategies to resolve this matter.

It is as shown in the S3 response as follows:

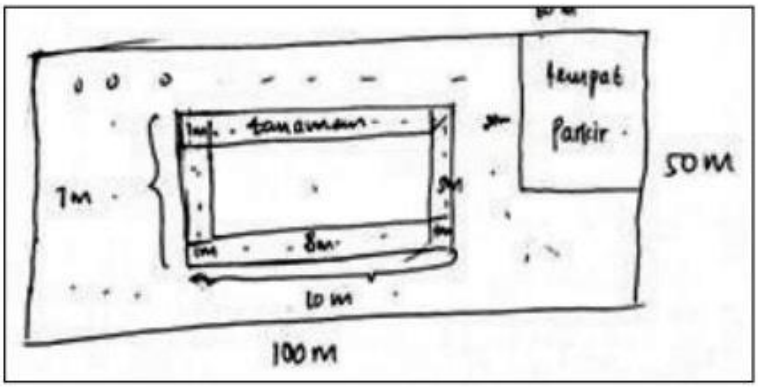
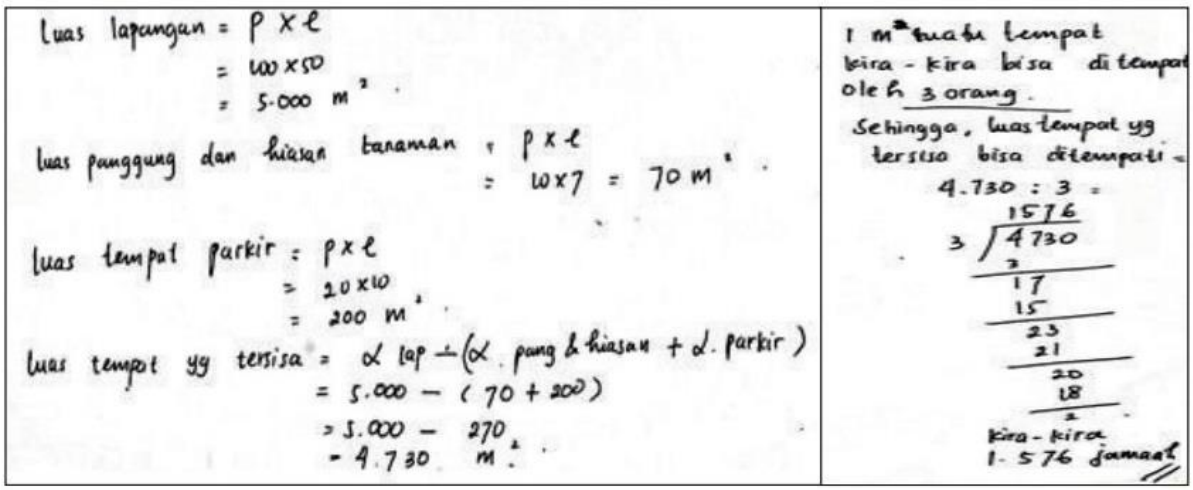


FIGURE 6. Response S3 in the planning with using drawing strategy

At the stage of implementing the plan, S3 well manage to solve the problems given. S3 was able to sketch a picture that allows for the placement of the stage, this means that S3 has the ability to make/use the model images, tables, graphs, and the like to help find answers (third indicator mathematical literacy). S3 was able to demonstrate the ability to reason or another need in the study estimate enough, this means that S3 has the ability to use and manipulate formulas or specific mathematical procedure for answers. It can be concluded in the process of managing the problem; S3 demonstrated considerable ability in the second, fifth and sixth indicators of mathematical literacy skills. The following are excerpts advanced Interview with S3 results:

Q: Tell me the steps in the resolution that you have created! S31.9: I thought the location of the stage; the stage is made such recitation Dedeh mommy is in the middle. Then given embellishments such as flowers and other in the around the stage. Then also it needed parking space. Only then will the rest of the land used for the pilgrims. Q: How do you solve that problem? S31.10: With conjecture is required anything for the study in general.

It is as shown in the S3 response as follows:



Translate in English
Wide of field = $p \times l = 100 \times 50 = 5000\ m^2$
Wide of stage and plan decoration = $p \times l = 10 \times 7 = 70m^2$
Wide of parking area = $p \times l = 20 \times 10 = 200m^2$
Wide of place left = wide of field – (wide of stage and plan decoration+wide of parking area)
$= 5000 - (70 + 200) = 5000 - 270 = 4730m^2$
$1m^2$ a place could be occupied approximately 3 people. sowide remaining places can be occupied =$4730:3 = 1576$ pilgrims.
So many pilgrims approximately = 1576 pilgrims.

FIGURE 7. Response S3 in implementing the plan

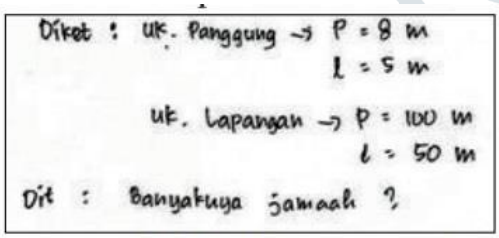
At the stage of evaluating, S3 reread and re-examine the matter cursory information that has been written. To test the validity of the settlement, S3 reread every step written. Here's more information S3:

Q: Are you satisfied with your answer? S31.11: Yes, I'm sure because I've read about and had predicted it all. Q: How do you check your answers! S31.12: Reread all my answers.

Subject 4 (S4) At this stage of understanding the problem, S4 is able to create a mathematical model to show the length and width of the field, as well as the length and width of the stage. Another characteristic of the S4 tends to be process information and have good skills in the fifth indicator of mathematics literacy. It can be concluded that the S4 is not experiencing difficulties at the stage of understanding the problem. Here are excerpts of the interview S4 in understanding the problem:

Q: Have you read the problem? S42.1: Already, I've read it. Q: Did you understand the question? S42.2: Yes, I've understood it and then I wrote the note and asked. Q: Tell me what you understand of the matter! S42.3: (S4 read about the matter again). So we are given to arrange a place for their problems. It is known wide of the field and wide of the stage. Then we set them up to get used to how the field pilgrims. Q: Do you ever get the same problem with that question before? S42.4: Not like this, just search the area, not many visitors. Q: What knowledge do you need to solve the problem? S42.5: Yes just to understand about the story.

It is as shown in the S4 response as follows:



Translate in English:
Known data: size of stage → $p = 8\ m, l = 5\ m$
Size of field → $p = 100\ m$,
$l = 50\ m$
Asked: How many pilgrims'?

FIGURE 8. Response S4 in the understanding the problems

On completion of the planning stage, S4 have sufficient ability in presenting and resolving information known through drawings and then manage them so they can be the result of the approximate maximum for the number of pilgrim's recitation. It can be concluded that the S4 enough in third, fourth and fifth indicators of mathematical literacy skills. The following excerpt continuation S4 in the interview with the settlement plan:

Q: What strategies do you use in the resolution that you have created? S42.6: Hmmm ... Draw. Q: Why use this strategy? S42.7: I think this way is easier. Q: Are there other strategies that can be used in solving the problem?

S42.8: Hmmm. Not

It is as shown in the S4 response as follows:

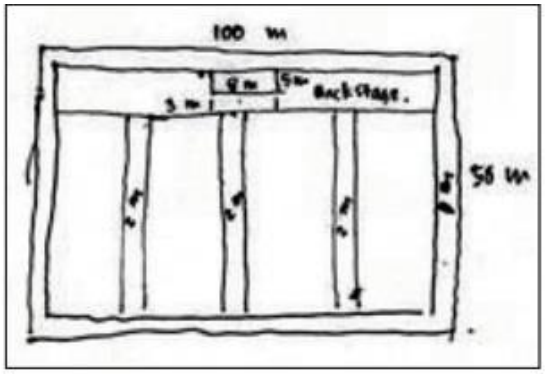


FIGURE 9. Response S4 in the planning with using drawing strategy

At the stage of implementing the plan, S4 managing well enough to solve the problems given. S4 was able to sketch a picture that allows for the placement of the stage, this means that the S4 has the ability to make/use the model images, tables, graphs, and the like to help find answers (third indicator mathematical literacy). S4 is also able to demonstrate the ability to reason or another need in the study estimated that enough. This means that the S4 has the ability to use and manipulate formulas or specific mathematical procedure for answers. It can be concluded in the process of managing the problem; S4 showed good ability in the second indicator and the indicator sixth mathematical literacy, although fifth indicator mathematical literacy skills demonstrated considerable ability. The following are excerpts advanced Interview with S4 results:

Q: Tell me the steps in the resolution that you have created! S42.9: The first time I read a matter later understand it. I wrote the note and asked. I plan sketches a picture that will be created. Then count. Q: How do you solve the problem? S42.10: Not difficult, I just need to understand the problems and plan the pitch should be

It is as shown in the S4 response as follows:

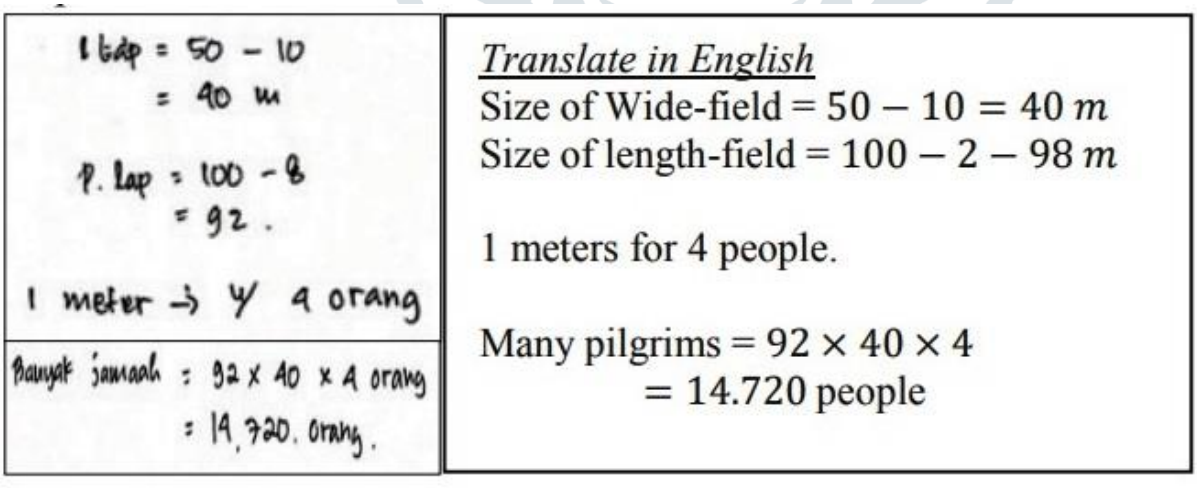


FIGURE 10. Response S4 in implementing the plan.

At the stage of evaluating, S4 reread and re-examine the matter cursory information that has been written. To test the validity of the settlement, S4 reread every step written. Here are excerpts of the interview S4:

Q: Are you confident with your answer? S42.11: Yes, I'm sure because I've set it up such. Q: How do you check your answers! S42.12: Reread all my answers.

Comparison of mathematical literacy skills of male and female students of mathematics prospective teachers are presented in Table 3. Male subject and female subjects initially perform the same steps that identify the problem. Furthermore, the male subject and a female subject began to build an idea, or ideas to solve the problem. In the process of building this notion or idea, there is a significant difference between the male subject and a female subject. The male subject in detail and develop good ideas. Subject male and female subjects sketch plan for solving problems. Furthermore, male and female subjects perform accurate calculations to solve the problem.

TABLE 3. Comparison of Mathematical literacy Skill Between Male and Female Students'

Indicator of mathematical literacy skill	Male students'		Female students'	
	S1	S2	S3	S4
First indicator	good	good	good	good
Second indicator	good	good	good	good
Third indicator	good	good	good	good
Fourth indicator	good	good	good	good
Fifth indicator	good	good	enough	enough
Sixth indicator	good	good	good	good

Factors that influence the differences in mathematical literacy skills between male students and female students as follows:

Experiences of male students are more active in social activities making it possible to know in complex real events on the ground.

Experience in testing a math problem. Male students tend to like challenges on matters of non-routine thus affecting the reasoning process of solving mathematical problems are quite complex.

CONCLUSION

Based on the results described above, it can be concluded mathematical literacy of prospective teachers in terms of the gender differences are male students of prospective teachers have good mathematical literacy skills of each indicator, the first indicator to sixth indicators mathematical literacy. While, female students of prospective teachers have good mathematical literacy skills in almost every indicator, except on fifth indicators that are in the enough category.

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