Gender perspectives on mathematical connection ability in PACE learning model

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Abstract. The purpose of this research was to proving effectivenes PACE learning model and analyze the ability of students' mathematical connections in terms of gender. This type of research is mixed methods. The quantitative research design used is true experimental design. This research was conducted in one of the High Schools in Banyumas in the academic year 2018/2019. Two sample groups (experiment group and control group) were selected randomly. An experiment group was taught by using PACE learning model, while the other group (control group) was taught by using Problem Based Learning Model. The purposive sampling technique consists of 6 subjects were chosen, 3 male and 3 female students. Data collection techniques through tests and interviews. Data analysis through the stages of data reduction, data presentation and drawing conclusions. The results showed that female subjects fulfilled indicators of the relationship between topics in mathematics and indicators of mathematical relationships in other fields, as well as indicators of mathematical relationships in everyday life one subject did not fulfill; male subjects meet indicators of the relationship between topics in mathematics and indicators of mathematical relationships in everyday life, as well as indicators that connect mathematics in other fields that are not fulfilled by one subject

1. Introduction
Mathematical concepts and procedures obtained can be used in mathematics and in other fields [1], and then, mathematics is a very important science and has a role in the development of the world. Other fields in question such as physics, chemistry, biology and others. Based on the National Council of Teachers Mathematics [2] that there are 5 standards of mathematical ability that students must achieve in learning, these abilities are problem solving, reasoning and proof, communication, connections, and representation. According to [3], mathematics consists of various topics that are interrelated with one another so that connection is called mathematical connection.

According to [4] also stated that the connection of mathematics aims to make students able to connect between material with one another. With the ability of students to connect or associate mathematical ideas, students' understanding of mathematics becomes deeper and lasts longer. Based on this description, mathematical connections are very important because with the ability of mathematical connections students can understand and connect their ideas, making it easy to connect mathematics between topics and with other material or with everyday life.

However, the importance of mathematical connection ability in Indonesia is not in accordance with the level of connection ability possessed by students. Mathematical connection skills are abilities that include connections between mathematical topics, connections with other disciplines, and connections with everyday life [5]. Mathematical connections according to [6] need to be developed because they
can increase the understanding of concepts and the application of concepts in everyday life so that students do not experience difficulties in learning mathematical concepts.

One learning model that is thought to stimulate the realization of mathematical connection abilities is the PACE learning model. PACE is a learning model that consists of the stages of Activity, Cooperative learning, Exercise and Project. According to [7], that PACE models are highly motivating students to push their knowledge. At the activity stage students are given an assignment sheet, useful to find concepts that are being learned and to review concepts that have been learned previously. PACE learning is a learning model where students are actively involved in groups. As in the cooperative learning stage, students gather in groups and discuss each other about a problem related to the material being studied. In this discussion process students exchange opinions with each other. The next stage is exercise, at this stage students are given practice exercises, so that students can better understand the material that has been learned. The last stage is the project, at this stage students are given project assignments that are completed in groups. Students choose their own problems and solve them in the form of reports and presentations. The problem chosen by students is related to daily life.

In learning, there are many factors that affect student learning processes, factors that are no less important are gender. The study by [8] found that female students outperformed their male counterparts. But the results by [9] showed that understanding the concept of male students was better than female students. From the diversity of research results that are considered different in terms of gender, researchers want to focus on mathematical connections when viewed from students' gender differences and to find differences in each aspect. By looking at this background the purpose of this study is to analyze the mathematical connection ability of class X students in mathematics learning in terms of gender differences.

2. Research Methods

This research is a mixture of quantitative and qualitative research. The quantitative research design used is true experimental design. According to [10] there are two forms of true experimental design, namely posttest only control design and pretest group design. In this study using posttest only control design, in this design there are two groups, namely the experimental class and the control class. The experimental class group was students who were treated by the PACE learning model and the control group was students who were treated by the Problem Based Learning (PBL) model. While qualitative research uses purposive sampling technique. Purposive sampling technique where sampling by selecting the person or place that most helps us in understanding our phenomenon [11]. Through a purposive sampling technique, 6 research subjects were selected from the experimental class group, which consisted of 3 men and 3 women.

3. Results and Discussion

The study of classical completeness test was conducted to test that 75% of students had achieved minimal completeness. The test results show that of 34 students who took the mathematical connection ability test in the experimental class there were 5 students who did not complete and from 34 students who took the mathematical connection ability test in the control class there were 12 students who did not complete. Classical completeness test with the proportion test of one party in the experimental class is \( z_{hitung} = 1,386 \geq z_{(0.5-\alpha)} = 0.64 \). The test results show that students in the experimental class with PACE learning have achieved classical completeness. Research is also supported by the similarity test of two averages and the similarity test of two proportions. Based on the test the right party is obtained \( t_{hitung} = 2,319 > t_{table} = 1.99 \). Therefore the average mathematical connection ability test with PACE learning is more than the average mathematical connection ability test with PBL learning. While based on the similarity test two proportions were obtained \( z_{hitung} = 1.96 \) dan diperoleh \( z_{(0.5-\alpha)} = 1.64 \) so that the proportion of students completing class using PACE learning is more than the proportion of students completing class using Problem Based Learning. In line with [7] it also stated that PACE learning is better than direct learning also stated that PACE learning is better than direct learning.
Mistakes according to Newman in [12], consist of reading errors, misunderstanding, transformation errors, process skill errors, and writing error answers. The mathematical connection ability test consists of 6 items with connection indicators between mathematical topics found in numbers 1 and 2, connections with other disciplines are in numbers 3 and 5, and connections with everyday life are in numbers 4 and 6. After making data analysis of test results and interviews with 6 subjects consisting of 3 women and 3 men, the following results were obtained. The results of the analysis of mathematical connection ability in terms of gender in subjects S-1, S-2, and S-3, can be summarized in a summary table of mathematical connection abilities of female subjects.

| Indikator                          | Butir  | S-1   | S-2   | S-3   |
|-----------------------------------|--------|-------|-------|-------|
| Relationships between topics in mathematics | 1      | able  | able  | able  |
| Mathematical relations in other fields | 2      | able  | able  | less able |
| Relationship of mathematics with everyday life | 3      | able  | less able | less able |
|                                    | 4      | able  | able  | less able |
|                                    | 5      | able  | able  | unable  |
|                                    | 6      | less able | less able | less able |

The results of the analysis of mathematical connection ability in terms of gender in subjects S-4, S-5, and S-6, can be summarized in a summary table of mathematical connection abilities of male subjects.

| Indikator                          | Butir  | S-4   | S-5   | S-6   |
|-----------------------------------|--------|-------|-------|-------|
| Relationships between topics in mathematics | 1      | able  | able  | less able |
| Mathematical relations in other fields | 2      | able  | able  | able  |
|                                    | 3      | able  | less able | less able |
|                                    | 5      | able  | less able | unable  |
|                                    | 4      | able  | able  | able  |
|                                    | 6      | less able | less able | able  |

Subject S-1 made a mistake at number 6 in process skills and an encoding error. Based on [13] that encoding error is working out the problem solution but students could not express solution in an acceptable written form. S-1 is less precise in calculations, in this case the subtraction operation, which results in the final answer being wrong. Subject S-2 made a mistake at number 3. The error occurred at the process skills stage which is not careful in the calculation and the answer finally becomes less precise so that when drawing conclusions become wrong. In addition, S-2 also made a mistake at number 6. The error made occurred at the transformation stage, which is not appropriate in modeling, but there was also an error in process skills, which was inaccurate in the calculation and the answer finally became less precise. Subject 2 also made a mistake in encoding that is not writing conclusions from problems of daily life.

Subject S-3, namely a woman made a mistake in item number 2. The mistake was in the process skills stage, which was not thorough in the calculation and the answer finally became less precise. So that when drawing conclusions become wrong. Subject S-3 also made mistakes at numbers 3 and 6. Error at number 3 occurred at the comprehension stage, which is the lack of understanding of what
was actually asked about the problem, so that at the transformation stage the completion step was still lacking. In addition, S-3 subjects also made mistakes at the process skills stage where they were encoding errors. As for number 6, the error in the comprehension stage is the lack of information about what is actually asked about the problem, so that at the transformation stage the resolution step is less and less precise in modeling. S-3 also made mistakes at the process skills stage where they were not careful in calculation and encoding error.

Subject S-3 made a mistake at number 4 in the encoding error stage that is not writing the conclusion of the problem on the problem and made a mistake at number 5 in the comprehension stage, which is less than what was actually asked about the problem, so that at the transformation stage the completion step is still lacking. In addition, S-3 subjects also made mistakes at the process skills stage where they were not careful in their calculations and encoding error. The mistake made by S-3 subjects is not knowing what was actually asked in the problem, besides it is difficult to determine the strategy used, the inability to change the problem into a mathematical model makes mistakes in calculations and conclusions.

The S-4 subject made a mistake at number 6 in the transformation and encoding stage. S-4 subject is not appropriate in modeling and the conclusion is also wrong S-5 subject made mistake at number 3 in the transformation stage, the completion step is still lacking. In addition, S-5 subjects also made mistakes at the process skills stage where they were not careful in calculation and the answer finally became encoding error. Subject S-5 also made a mistake at number 6 in the comprehension stage, which is not understanding what was actually asked about the problem, so that at the transformation stage the completion step was less and also less precise in modeling. S-5 made a mistake at the process skills stage where it was not thorough in calculation and encoding error.

Subject S-6 made a mistake at number 1 in the transformation stage, the completion step was less and also less precise in choosing the concept used. S-6 also makes mistakes at the process skills stage where they are encoding error. In addition, S-6 subjects made mistakes at number 3 in the process skills stage where they were not careful in their calculations and encoding error. Subject S-6 also made a mistake at number 5 in the comprehension stage where S-6 did not understand what was actually asked by the problem. In addition, S-6 also made a mistake at the transformation stage where it could not choose the concept used. So Subject 6 was making mistakes at the process skills stage and encoding error.

Based on the explanation of the errors of each subject, it was found that female and male subjects made mistakes in the stages of comprehension error, transformation error, process skill error and encoding error. This is in line with research conducted by [14] where based on the newman category, the location of the student error stage in working on HOTS type questions on Trigonometry material is at the stages of comprehension, transformation, process skills and encoding. Whereas female subjects made more mistakes in the comprehension, process skill and encoding stages than male subjects. Female subjects made fewer mistakes at the transformation stage compared to male subjects. This is in line with research conducted by [14] where female gender presentations made fewer transformation stages than male gender and female gender made mistakes at the stage of comprehension, process skills and encoding more than male gender. According to [15] the errors are often done in the stage of transformation and process skills.

4. Conclusion
The PACE model is effective in developing students' mathematical connections. Therefore this study uses the PACE model to analyze the ability of mathematical connections between female students and male students. PACE learning consists of Activity, Cooperative learning, Exercise and Project. Female subjects are able to meet the indicators of relationship between topics in mathematics and indicators of mathematical relationships in other fields, as well as indicators of mathematical relationships in daily life, one subject cannot fulfill, male subjects are able to meet the indicators of relationship between topics in mathematics and indicators of mathematical relationships in everyday life, as well as indicators connecting mathematics in other fields one subject cannot fulfill. Therefore based on error
analysis female subjects made fewer mistakes at the transformation stage compared to male subjects. But female subjects made more mistakes at the comprehension, process skill and encoding stages than male subjects.

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