

# Understanding of the Students of Mathematics Education in Solving Linear Algebra Problems

## Knowledge of the Students of Mathematics Education in Solving Linear Algebra Problems

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### ABSTRACT

This study aims to describe the instrumental understanding and relational understanding of Mathematics Education students in solving linear algebra problems. This research was conducted in the Department of Mathematics Education, FKIP, University of Borneo Tarakan. The research subjects were students of the 4th semester of the Mathematics Education Department using the purposive sampling technique. The research design used is a qualitative case study type research with data collection using tests and interviews with the expectation that the data obtained can fully reveal and answer the research formulation about students' instrumental understanding and relational understanding in solving Linear Algebra problems. The data were analyzed qualitatively by reducing, presenting, and concluding, as well as triangulating the data that had been obtained. From this research, it was found that the instrumental understanding of subject-01 and subject-02 was able to know the method to determine the solution of linear algebra problems. In contrast, the relational experience of subject-01 and subject-02 did not know the concepts related to other problems and could not click linear algebra problems. With other problems. For instrumental understanding, subject-03 cannot see the method for determining the solution of linear algebra problems. For relational experience, subject-03 does not know the concepts related to other issues and cannot relate linear algebra problems to other problems.

**Keywords:** *Instrumental Understanding, Relational Understanding, Problem-Solving, Linear Algebra*

### 1. PRELIMINARY

One field of study that has a vital role in education is Mathematics because, in its implementation, mathematics lessons are given at every level of education. One of the mathematics lessons at the college level is the Linear Algebra course. Linear algebra is a mathematics field that studies linear systems, matrices, vector spaces, and linear transformations. Students are trained to think logically and critically in solving problems with abstract objects through learning or problem-solving in Algebra courses.

Students' ability to solve problems is needed in their lives, both at the college and in the family environment. Armed with the problem-solving skills obtained from learning Linear Algebra, students are expected to face and solve their life problems. Learners can apply

previously acquired knowledge into new, unfamiliar situations is the essence of learning to solve problems.

Understanding becomes an essential thing to achieve the desired learning goals in solving Linear Algebra problems. Learning linear algebra requires the ability to count and requires the ability to think and reason in solving a problem [1]. These two things will emerge when accompanied by a good understanding. When you can provide meaning or description after studying a particular subject or use previous knowledge to apply to other cases, performance will appear. Therefore, understanding is the ability of students to define something to give meaning when they understand it.

There are various types of understanding that experts have defined. One of them has been categorized by Richard R. Skemp. Two types of understanding:

instrumental understanding and relational understanding [2]. The instrumental version is the understanding of students when they can use specific procedures or methods in solving problems without knowing the reasons for using these procedures. Meanwhile, the relational experience understands students when they can provide grounds for using specific techniques or methods in solving problems.

Based on the observations of researchers as a teacher of the Linear Algebra course at the Faculty of Teacher Training and Education, the University of Borneo Tarakan, it was found that the average value of the PTS (Mid-Semester Assessment) exam was still low, even the score was still below 50. When working on questions, students made many mistakes in writing symbols or numbers. Also, not careful in working on the problems so that the final result's expected answer is wrong. After being observed when students were working on assignments, most of the answers given were only the result of cheating from other student friends. Sometimes, the solution in doing the problem is wrong, but the final answer is correct. Based on these things, it is not clear that the students' understanding of the studied material is not clear.

This is in line with previous research which analyzed students' ability to solve at the University of Borneo Tarakan of Linear Algebra, [3] showed that the students' difficulty in learning linear algebra is very significant where 88.63 percent of students are unable to articulate symbols or notations, 88.11 percent of students find it challenging to use symbols or notations or mathematical concepts and logical reasoning, 88.38 percent of students find it challenging to understand symbols or notations used in logical reasoning, and 91.77 percent of students find it difficult to verify whether symbols or notations or the mathematical concept used has been implemented correctly or not and uses logical reasoning. This illustrates that it is tough for students to study linear algebra. This is because students' comprehension and the resolution of linear algebra issues are very slow compared with other materials.

Research on understanding the concept of Linear Algebra in the Elementary Linear Algebra Course, getting the results of the understanding ability of students majoring in mathematics education at UIN Alauddin Makassar class of 2016 in solving elementary linear algebra problems in terms of indicators of mathematical understanding ability, students are quite capable of hands: (1) understanding can restate a concept, (2) presenting the image in various forms of mathematical representation, (3) using, utilizing and selecting specific procedures, and (4) applying concepts/algorithms to problem-solving [4]. However, the indicators of giving examples and not examples of students are classified as incapable.

Therefore, related to the facts and problems of understanding Mathematics Education students in solving problems in the Linear Algebra course at the FKIP Borneo Tarakan University and the research results from Mufidah, the researcher intends to see the understanding of Mathematics Education students when viewed from the student's instrumental knowledge and relational experience. This research is expected to be used as evaluation material in teaching Linear Algebra courses at the FKIP, University of Borneo Tarakan. The purpose of this study is to describe the instrumental understanding and relational understanding of students majoring in Mathematics Education FKIP Borneo Tarakan University in solving linear algebra problems. The study results are expected to provide benefits for Mathematics Education students to provide knowledge when answering linear algebra issues so that when students answer linear algebra problems, they can find out the reasons for giving answers. Meanwhile, for teaching lecturers in the Linear Algebra course, this study's results are expected to provide knowledge about students' abilities in answering Linear Algebra problems so that lecturers can provide innovations in understanding Linear Algebra material to students.

## **2. METHOD**

This research is qualitative research with a case study research type. Said that case study research is suitable when researchers want to answer descriptive or explanatory questions [5]. This research focuses intensively on one particular object, which studies it as a case. Case study data can be obtained from all parties concerned in the study; in other words, in this study, data was collected from various sources but is limited in the cases to be studied.

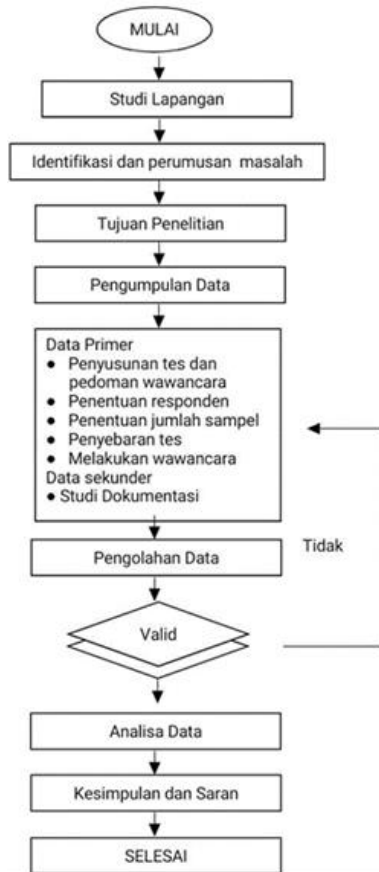


Figure 1 Flowchart Study

The data collection method used in this research is the first test by giving questions related to the Linear Algebra course, the second is the interview to explore students' reasons when answering the tests that have been given.

This research population was Semester 4 Class A1 Mathematics Education FKIP University of Borneo Tarakan totaling 30 people. While the research subjects were selected using purposive sampling, selected three people. These subjects consisted of one student with the highest score, one student with moderate grades, and one student who had the lowest score on the assignment or the Linear Algebra test.

The data analysis technique in this study is explained as follows after obtaining data from the test results then conducting interviews whose results are compiled in the form of complete notes after being supported by the results of observation and documentation. Thus the data obtained from the results of this study are interview data and documentation data. Several steps that can be followed in processing and analyzing data presented by [6] are data reduction, display, and conclusion/verification.

### 3. RESULTS AND DISCUSSION

Based on the data analysis of the Subject-01 written test results, it is known that the completion steps and completion results are given are correct. Furthermore, based on the results of the Subject-01 interview, it was found that Subject-01 was able to use formulas in simple calculations and perform algorithmic calculations, was able to link existing concepts, and be aware of the process he was doing. So that from these results, the Subject-01 written test data can be declared valid. However, Subject-01 cannot relate linear algebra problems to other problems. In this case, Subject-01 has a relatively good instrumental ability because Subject-01 has understood the information contained in the questions. Display equations should be flush left and numbered consecutively, with equation numbers in parentheses and flush right. First, use the equation editor to create the equation. Then, select the equation, and set the "Equation" Style. Press the tab key and type the equation number in parentheses.

Besides, Subject-01 has been able to use procedures or steps to work on questions correctly and correctly. However, Subject-01 did not write down what he knew when working on the problems. While the relational ability of Subject-01 is still low because it cannot find a concept that has relevance to the questions given, besides that, as previously said, Subject-01 also cannot connect linear algebra problems with other problems. However, Subject-01 has been able to estimate what steps to do first and know what concepts to apply in solving problems.

Based on the Subject-02 written test data analysis, it can be seen that the completion steps and the final results given are almost correct. Then based on the results of the Subject-02 interview, it was found that Subject-02 was sufficiently able to apply the formula in simple calculations and perform algorithmic calculations, was able to link existing concepts, and be aware of the process he was doing. Therefore, the Subject-02 written test data can be said to be valid. However, in carrying out the test, Subject-02 made several mistakes in the process steps; besides that, Subject-02 could not connect linear algebra problems with other problems and did not get concepts relevant to the questions.

In this case, Subject-02 has quite good instrumental abilities because Subject-02 has understood the information contained in the questions. Also, Subject-02 was able to use procedures or steps to solve questions correctly and correctly. However, Subject-02 did not write down what was known from the problem at the time of working. While the relational ability of Subject-02 is still low because it cannot find concepts related to the questions given, in addition to this, Subject-02 also cannot connect the relationship between linear algebra

problems with other problems. However, Subject-02 has been able to estimate the steps that should be done first and know the concepts that should be used in solving the problem.

Based on the Subject-03 written test data analysis, it was found that the completion steps and the final results obtained were wrong. After further interviewing Subject-03, it was found that Subject-03 could not understand the information contained in the questions. Even Subject-03 could not know the steps to take to answer the questions and could not connect linear algebra concepts with ideas in other fields. So it can be said that Subject-03's instrumental ability is low, and Subject-03 does not have a relational understanding.

#### 4. CONCLUSION

The instrumental ability of Subject-01 students, which includes having high power in solving linear algebra problems, is said to be high because Subject-01 has been able to understand the information contained in the questions and do it appropriately. However, Subject-01 did not write down what was known in solving the problem. Meanwhile, in understanding relational, it is still low because Subject-01 cannot connect the concept of linear algebra with material outside linear algebra. However, Subject-01 can estimate what steps should be done first and know what ideas can be applied to the problem.

The instrumental ability of Subject-02 students, which includes moderate ability to solve linear algebra problems, is said to be reasonable because Subject-02 has been able to understand the information contained in the questions. Still, only part is correct when working on test questions. Meanwhile, the relational understanding of Subject-02 is still low because it cannot relate material outside linear algebra with concepts relevant to linear algebra. However, Subject-02 can only estimate what steps to do first and know what ideas can be applied to the problem.

The instrumental ability of Subject-03 students, which includes low ability in working on linear algebra, is said to be quiet because they do not understand the information on the questions, causing Subject-03 not to be able to solve the questions. Meanwhile, the relational understanding of Subject-03 is said to have no relational knowledge because it does not know the methods or steps to solve problems and cannot connect the concept of linear algebra with problems outside linear algebra.

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