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Deskripsi Kemampuan Koneksi Matematis Siswa Kelas X Pada Materi Sistem Persamaan Linear Tiga Variabel

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ABSTRAK

Koneksi matematis merupakan salah satu dari 5 standar kemampuan dasar yang wajib dimiliki siswa dalam proses pembelajaran matematika. Banyak kajian-kajian yang menyatakan pentingnya pengembangan kemampuan ini bagi siswa. Oleh karena itu penelitian ini bertujuan untuk mengetahui bagaimana kemampuan koneksi matematis siswa Kelas X Ilmu-Ilmu Sosial (IIS). Untuk mendeskripsikan kemampuan koneksi matematis siswa Subjek penelitian ini adalah 34 siswa kelas X ilmu-ilmu sosial (IIS) SMA N 2 Banjarmasin. Hasil pekerjaan siswa dibagi dalam 3 kategori yakni, tinggi, sedang dan rendah. Selanjutnya dipilih 1 siswa dari masing-masing kategori dengan pertimbangan hasil pekerjaan subjek dapat mewakili hasil pekerjaan setiap kategori. Selanjutnya ketiga subjek terpilih diberikan soal tes. Dari hasil tes yang dilakukan kepada 3 orang siswa sebagai sampel, didapat bahwa subjek dengan kategori kemampuan rendah dan sedang belum memenuhi ketiga indikator koneksi matematis. Berbeda dengan subjek pada kategori tinggi yang telah memenuhi indikator ketiga namun belum memenuhi indikator lainnya.

INTRODUCTION

The National Council of Teachers of Mathematics (NCTM) provides a standard process in learning mathematics. Process standards are national education standards relating to the implementation of learning in educational units to achieve graduation competency standards. One of the standard processes is a mathematical connection. Mathematical connection is the relationship between mathematical concepts related to mathematics itself and the relationship between mathematics and everyday life (Bernard & Senjayawati, 2019). Besides mathematical connections can also be defined as the relationship between internal and external information. Internal information is the initial knowledge possessed by students, while external information is new knowledge gained from outside ourselves. In relation to external information, Johnson (2010) states that mathematical material can be more easily

taught with the help of visual media or teaching aids. Because visual media and teaching aids are learning aids that can facilitate external information into the student's internal domain. When there is a relationship between external and internal information made by students, students are said to be doing mathematical connections. The idea of a mathematical connection has long been investigated by W.A. Brownell since the 1930s, but at that time the idea of mathematical connections was limited to connections to arithmetic (Obasi & Ugo, 2018). Mathematical connections are inspired because mathematics is not partitioned on a variety of separate topics, but mathematics is a unity. Besides mathematics also has links with other scientific disciplines, as well as close to the problems that occur in daily life. Without mathematical connections students must learn and remember too many separate mathematical concepts and procedures (The National Council of Teachers of Mathematics, 2000).

The National Council of Teachers of Mathematics (2000) has explained that the standard of student connections is the emphasis of learning mathematics on students' abilities which include: (1) Recognizing and using the relationship between mathematical ideas. (2) Understand how mathematical ideas are interconnected and build one idea to another to produce a unified whole. (3) recognize and apply mathematical concepts outside of mathematics. . In general (Rusmini & Surya, 2017), suggests that mathematical connection ability include: (a) Connecting conceptual and procedural knowledge; (b) Using mathematics in other topics (other curriculum areas); (c) Using mathematics in life activities; (d) See mathematics as an integrated whole; (e) Apply mathematical thinking skills and create models to solve problems in other subjects, such as music, art, psychology, science, and business; (f) Use connections between topics in mathematics, and get to know various representations for the same concept.

From the seven connection capabilities that have been described, it can be concluded that there are actually three indicator verbs on the intended connection capability. The indicator verbs are seeing / recognizing, connecting, and using / applying (Plucker & Beghetto, 2014). Meanwhile, there are four components that can be connected mathematically, namely: conceptual and procedural knowledge, topics in mathematics, topics / lessons outside mathematics, and activities of daily life. It is assumed that there are three aspects related to mathematical connections. The three aspects in question are: (1) unifying themes, (2) mathematical processes, and (3) mathematical connectors (Hemdriana, Slamet, & Sumarmo, 2014).

The ability of mathematical connections is very important possessed by students, especially in learning mathematics. The importance of these mathematical connections in general can be summarized as follows: (1) Mathematical connections can provide opportunities for students to be able to understand mathematics in depth, more thoroughly and more meaningfully; (2) Mathematical connections are very useful for students as tools in problem solving and (3) Mathematical connections can provide learning experiences that can increase learning independence, foster trust, and higher awareness about the benefits of mathematics (Harahap, 2017). The teacher's role in developing students' mathematical connection skills according to Efriani, Hapizah, & Putri (2019) are: Choose learning topics that can be connected to subjects other than mathematics; Building a classroom climate that encourages students to pursue mathematical ideas in addition to solving problems faced; The teacher can also improve students' mathematical understanding by using other disciplines as a source of problems; Gives access to various mathematical tools.

Thus, the formulation of the problem in this study is how the mathematical connection ability of class X Social Sciences (IIS) students is viewed from the indicators of students' mathematical connection ability. The purpose of this study is to determine the

ability of students 'mathematical connections in terms of indicators of students' mathematical connection abilities.

METHOD

This type of research is qualitative by using descriptive, so that research can describe the phenomenon of students' mathematical connection ability descriptively (Creswell, 2012). The research will be carried out at SMA Negeri 2 Banjarmasin. School classes consist of 13 classes for each class consisting of 6 classes majoring in Mathematics and Natural Sciences (MIA) 6 classes Department of Social Sciences (IIS) and 1 class majoring in Language. The subjects of this study were all students of class X IIS SMA Negeri 2 Banjarmasin. Sampling in this study was conducted by purposive sampling technique. Where all subjects are classified into 3 groups of ability low, medium and high, then selected 1 person from each group. Thus obtained 3 students as a sample each 1 student for each group. Classification of all subjects and take 1 subject from each group for decisions taken by the teacher who teaches in the class.

Table 1. Subject Coding

Subject Ability Level	**Subject Code**
Hight	KT
Average	KS
Low	KR

Data collection techniques used in this study were tests. The test is in the form of an essay test (description) of 1 item in which the question is used to find out how the students' mathematical connection ability is viewed from the mathematical connection indicator. The indicators used to see how students' mathematical connection ability can be seen as in the following table:

Table 2. Indicators of Mathematical Connection Ability

Indicator Code	Indicators of Student Mathematical Connection Capabilities	Description of Student Abilities based on Indicators
(1)	Recognize and use relationships between mathematical ideas.	• Linking conceptual and procedural knowledge, • Using connections between topics in mathematics • Get to know various representations for the same concept
(2)	Understand how mathematical ideas are interconnected and build one idea with another to produce a complete understanding	• Apply mathematical thinking skills and create models to solve problems
(3)	Recognize and apply mathematical concepts outside of mathematics.	• Using mathematics in life activities

The questions used as test instruments in this study are as follows:
A restaurant that sells Meatballs, Chicken Noodles with a choice of drinks in the form of Ice Tea gives special offers to their customers, which are as follows:

PAKET CERIA :
2 Mangkok Bakso, 1 Mangkok Mie Ayam, 2 Gelas Teh Es = Rp. 35.000
PAKET BAHAGIA :
1 Mangkok Bakso, 2 Mangkok Mie Ayam, 3 Gelas Teh Es = Rp. 37.000
PAKET KEHAUSAN :
1 Mangkok Bakso, 1 Mangkok Mie Ayam, 4 Gelas Teh Es = Rp. 31.000

Question:

a) Make a table that can describe the package provided by the restaurant!
b) If someone only buys 1 bowl of meatballs, 1 cup of Chicken Noodle and 2 cups of ice tea without buying through a package, determine how much money that person has to pay!

With the pocket money you have now, if you multiply it to 3 times: Can you buy 3 bowls of meatballs and 3 cups of Iced Tea?

RESULTS AND DISCUSSION

Analysis of the Mathematical Connection Ability of Low Ability Students

The first analysis is performed on the first indicator of mathematical connections, namely recognizing and using the relationship between mathematical ideas. To see students' abilities on this indicator, researchers used question points (a), (b) and (c).

At point (a) KR students are considered capable and meet the indicators (1). This can be seen from the answers of students who have been able to make a table as a form of representation of a given problem. In addition to tables, other forms of representation are also able to form students, namely in the form of algebraic models of a given problem (Maulyda, Hidayanto, & Rahardjo, 2019). This is what is shown in the image below:

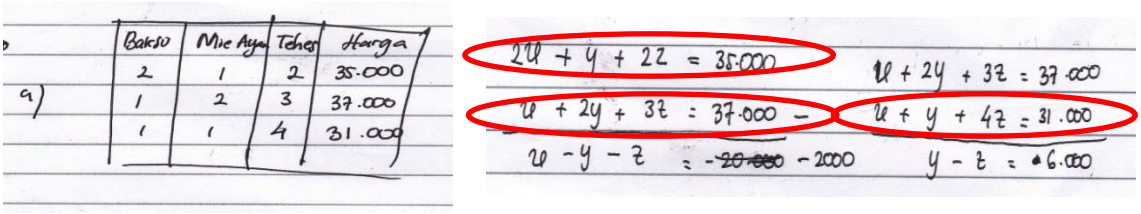

Figure 1. Students' Low Ability to Show Indicators Answers (1)

Unfortunately, indicator (1) is not fulfilled in points (b) and (c). this happens because students are still not able to connect conceptual and procedural knowledge properly, and there is still no visible use of connections between topics in mathematics. This finding is in line with research (Rohendi & Dulpaja, 2013). This is due to a misconception in working on the elimination method to solve the system problem of three-variable linear equations. These errors indicate students are less able to carry out the process of manipulating concepts that result in students being less able to connect mathematical ideas that exist in themselves (Maulyda & Khairunnisa, 2019). Due to a concept error in the elimination workmanship procedure, so students cannot find solutions to the problems given. This can be seen from the students' answers as shown below:

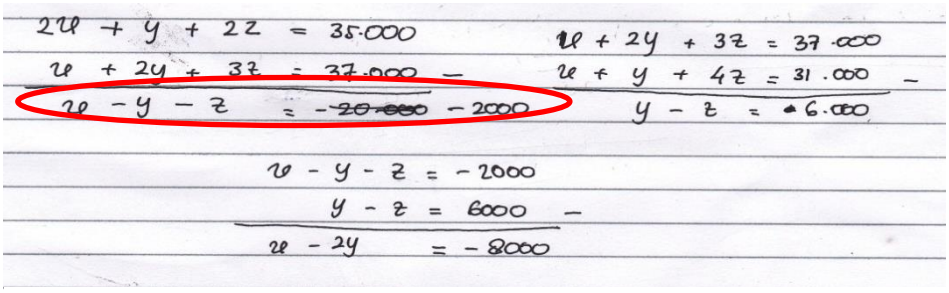

Figure 2. Students' Low Ability to Show Indicators Answers (1)

This finding is different from the results of the study (Tello, 2010) & (Ferdianto, 2019). In that study, Tello explained that one way that students do not fail in solving story problems is to represent problems in the form of images or mathematical symbols. But this does not apply to KR students.

Furthermore, in indicator (2) students have actually been able to make algebraic models of the problems given, unfortunately, students immediately apply them to be solved, so that they do not clearly see the form of the problem modeling given. But if part of the solution is taken by students trying to do, can be found algebraic modeling done by students, as in the following picture:

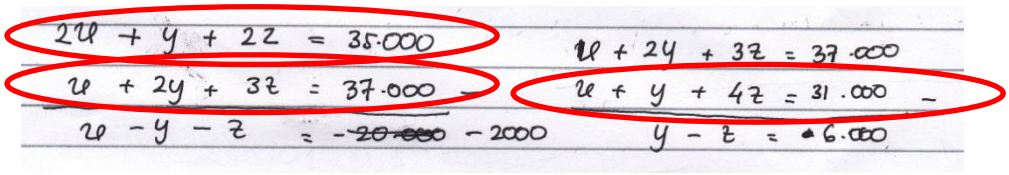

Figure 3. Students' Low Ability to Show Indicators Answers (2)

In the picture, it appears that the red circle label indicates the desired algebraic model of the problem. Thus, it cannot be said whether KR students have truly been able to meet the indicator (2). Finally, for indicator (3), the researcher looks at whether or not students meet this indicator seen in the question points (b) and (c). This is because, both problems contain real problems related to mathematical concepts to solve them. In this indicator KR students have not been able to fulfill it, this is because students have not been able to find a solution to the problem given. This finding is in line with the results of the study (Bertolin, 2018) but different from the results of the study (Siregar & Surya, 2017). In that study, it was explained that students with low ability were also able to connect concepts that had been learned in finding solutions to a problem. In point problem (b) students cannot solve the problem of finding the amount of money to be paid by a customer who wants to buy 1 bowl of meatballs, 1 cup of chicken noodles and 2 cups of iced tea. This can be seen from the answers of students who have not been able to find the value of the three variables in the problem of linear three-variable equations system, as in the following figure:

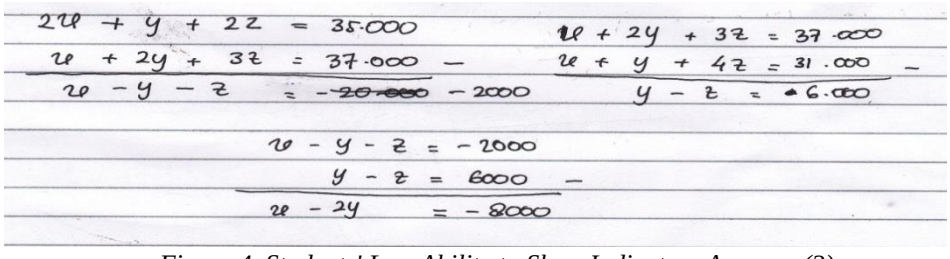

Figure 4. Students' Low Ability to Show Indicators Answers (3)

Then, in problem (c), students have not been able to associate the problems given with their daily lives. This can be seen from the answers of students who do not seem to want to solve the given problem. According to Bhinnety (2012) one of the causes of lack of interest in working on problems by students is the memory of the material to solve problems is very weak. Students who forget mathematical formulas tend to avoid math problems. The description of student answers are as follows:

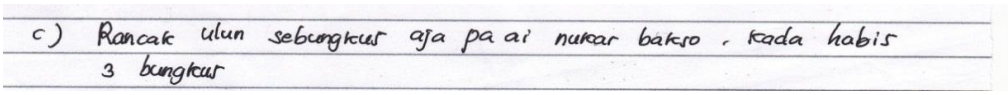

Figure 5. Students' Low Ability to Show Indicators Answers (3)

In Indonesian, these words mean "I usually pack just one pack if you buy meatballs, it doesn't run out if it's three packs". Many factors can influence this, but it seems that this is more due to students not being able to find the unit price of the items in question (b) so that KR students give up on working on point problems (c).

Analysis of Mathematical Connection Capabilities of Medium Able Students

Similar to the analysis of the previous subject, the first analysis was performed on indicators (1) students' mathematical connection ability. To see students' abilities on this indicator, researchers used question points (a), (b) and (c).

At point (a) the KS student is deemed incapable and does not meet the indicator (1). This can be seen from the answers of students who did not make a table like what was asked in the problem (a). Because of this, KS students have not been able to provide multiple representations for the same problem. On the other hand, KS students have been able to provide a representation in the form of algebraic modeling, although there is no clearly visible example of a variable that corresponds to a given problem. This can be seen in the following image:

Figure 6. Student Answer Medium Capability Indicates Indicator (1)

It appears that the object given a red circle is the desired modeling of the given problem. but due to the lack of clarity in the example of variables, it cannot be seen properly whether the KS student has really made the right representation, so he is said to have not been able to meet the indicators (1). These findings are in line with (Siregar & Surya, 2017) but different (Mhlolo, Venkat, & Schäfer, 2012). In the study, moderately capable students were able to understand interconnected mathematical ideas. This finding also contradicts what was revealed by (Tello, 2010), where students have been able to model problems, but in fact they have not been able to solve the given story problems.

Similar to point (a), indicator (1) is also not fulfilled in points (b) and (c). this happens because students are still not able to connect conceptual and procedural knowledge properly, and there is still no visible use of connections between topics in mathematics. This is due to procedural errors in the elimination method to solve the problem of the three-variable linear equation system. According to Tall & Razali (1993), these errors indicate students are less able to carry out the process of manipulating concepts that result in students being less able to connect mathematical ideas that exist in themselves. Another finding by Panasuk (2010) states that students have not been able to know mathematical ideas to answer questions, one

of which is shown when students have not been able to represent mathematical ideas. Actually, KS students have been able to know what concepts are used in solving given problems, in line with the mathematical model that this student made, but due to procedural errors in the process of elimination, students could not find solutions to the problems given. This can be seen from the students' answers as shown below:

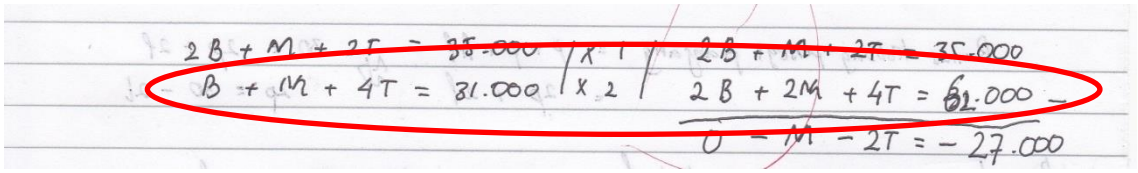

Figure 7. Student Answer Medium Capability Indicates Indicator (1)

Next, in indicator (2), KS students are able to create an algebraic model of the given problem, this looks like in indicator (1). However, because there is no clear explanation about the variables, it is rather difficult to determine whether the KS student has fulfilled the indicator (2).

Figure 8. Student Answer Medium Capability Indicates Indicator (2)

The last indicator to be analyzed is indicator (3), the researcher reviews whether students meet or not meet this indicator seen in the point questions (b) and (c). This is because, both problems contain real problems related to mathematical concepts to solve them. Similar to KR students, KS students have not been able to fulfill it. This is because students cannot find a solution to a given problem. This situation is different from the results of the study (King, 2014). According to King (2014), students with moderate abilities have been able to find solutions to a given problem. In point problem (b) students cannot solve the problem of finding the amount of money to be paid by a customer who wants to buy 1 bowl of meatballs, 1 cup of chicken noodles and 2 cups of iced tea. This can be seen from the students' answers that were wrong in finding the value of the three variables in the system problem of linear three-variable equations, as in the following figure:

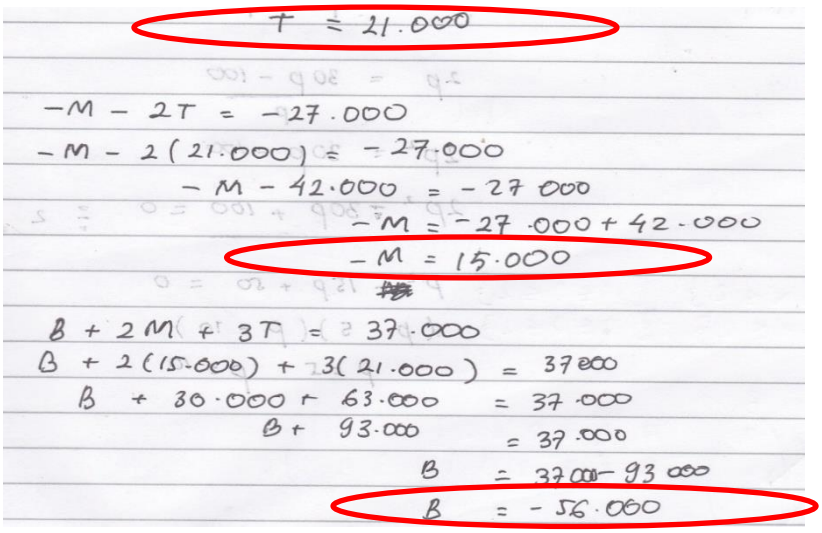

Figure 9. Student Answer Medium Capability Indicates Indicator (3)

This error occurs only because of procedural errors such as what has been disclosed in indicator (1) for point problem (b). Then, in question (c), the KS student has not been able to associate the problem given with his daily life. This can be seen from the absence of students' answers to answer point (c).

Analysis of the Mathematical Connection Capabilities of High Ability Students

Analysis of the ability of connections in KT students starts from the analysis of the indicators (1). In the questions given, this indicator can be seen from the ability of students to answer the questions points (a), (b) and (c).

In point (a), KT students are apparently still unable to meet the indicator (1). This is because KT students are still not able to make tables that correspond to the problems given. Not yet found a clear reason why students have not been able to make a table like what is asked by the problem. Therefore, it is necessary to conduct interviews with KT students to explore these reasons. This situation is different from research conducted by Haji, Abdullah, Maizora, & Yumiati (2017) & Aini (2016). According to Aini (2016), students with high abilities are able to meet the indicators (1). On the other hand, KT students have been able to make appropriate algebraic modeling as the desired representation of the given problem. this looks like in the following image:

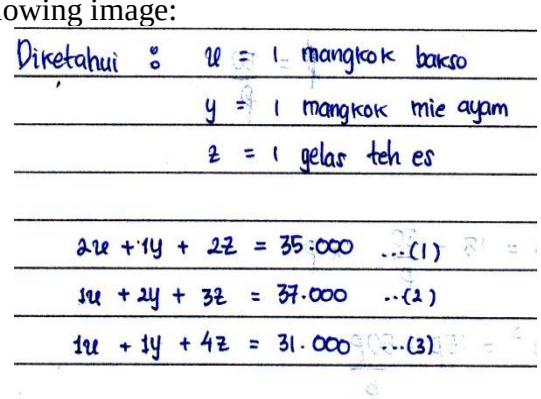

Figure 10. High Ability Student Answers Showing Indicators (1)

For indicator (1) seen in point (b), students are said to be able to fulfill indicator (1). This is because students are able to connect conceptual and procedural knowledge well, as well as the use of connections between topics in mathematics. This can be seen from the answers of students as in the following picture:

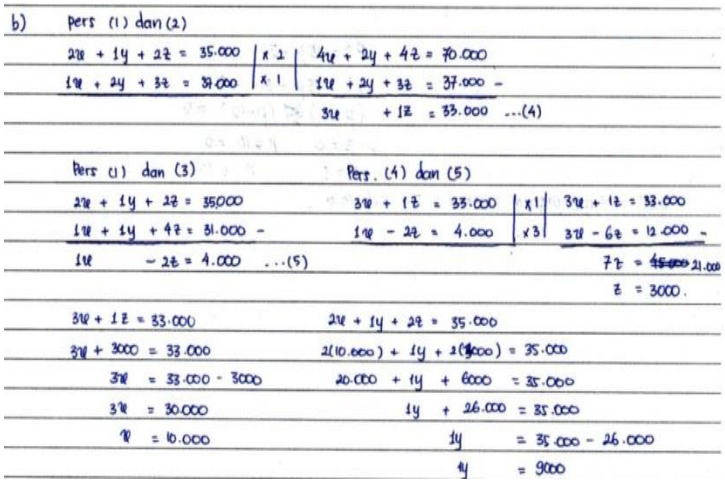

Figure 11. High Ability Student Answers Showing Indicators (1)

As seen in the picture, that students are able to use concepts and procedures in substitution and elimination well, so students can solve the problems given correctly. This finding is in line with what was conveyed by Tello (2010), Tello explained that one way that students do not fail in solving story problems is to represent problems in the form of images or mathematical symbols (Maulyda, Hidayanto, & Rahardjo, 2019). At point (c), KT students are also able to fulfill the indicator (1). This can be seen from the answers of students who have been able to connect conceptually and procedurally well where students are able to calculate the minimum amount of money needed to buy 3 bowls of meatballs and 3 cups of ice tea. From these calculations, students are also able to compare it with the allowance they have to make decisions and answer given problems. it can be seen in the following picture:

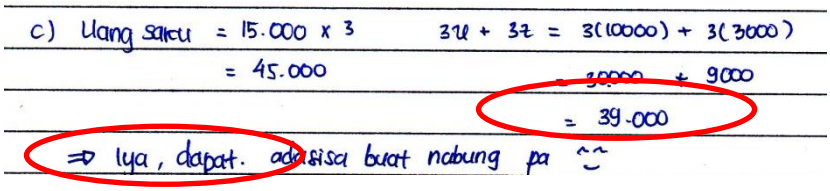

Figure 12. High Ability Student Answers Showing Indicators (1)

The next analysis is on indicator (2). KT students have been able to make algebraic models of the problems given, this looks like in indicator (1). Although there are still some writing errors in the variable instance, each variable should be interpreted as the price of the desired item. It would be nice if an interview with KT students about the actual examples of algebraic modeling that students make, so that it is better known whether the example is correct or still wrong. This is what is shown in the following image:

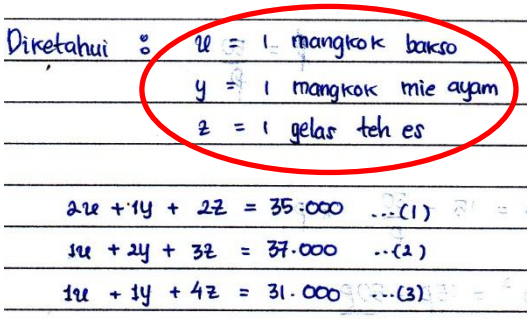

Figure 13. High Ability Student Answers Showing Indicators (2)

Therefore, based on the results of KT student answer sheets, KT students still do not meet the indicator (2). In the last indicator, indicator (3), KT students have fulfilled the indicator. This is because KT students have been able to properly solve the problems given in the problem. KT students are able to connect mathematics in everyday life or use mathematics in daily activities. This finding is in line with the results of Panasuk's (2010) study. This can be seen in students' answers to points (b) and point (c) as in the following picture:

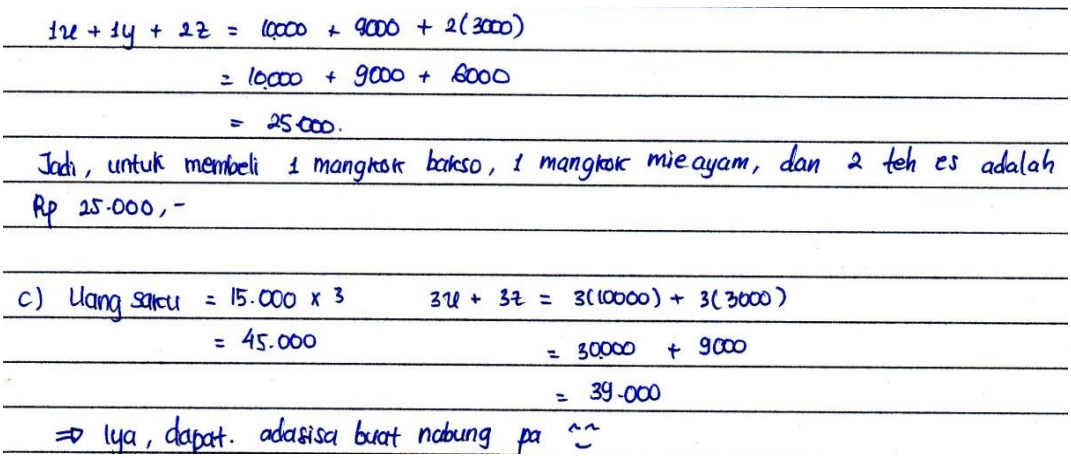

Figure 14. High Ability Student Answers Showing Indicators (3)

Based on the results of KT student answers, it appears that students have been able to correctly solve the problems given in the problem. The student is also able to compare the money he has with the money that must be paid, so he can decide whether the money he has is enough or not to buy the items requested in the problem.

CONCLUSION

Based on the results of research conducted it can be concluded that; (a) Low-ability students have not been able to meet the three indicators of mathematical connections well because of weaknesses in connecting concepts and procedures in problem solving provided. (B) middle capacity students have not been able to meet all three indicators of mathematical connections well because of weaknesses in connecting concepts and procedures in problem solving provided. (c) High-ability students have not been able to meet indicators to understand how mathematical ideas are interrelated and build one idea with another to produce a complete whole and indicators to recognize and apply mathematical concepts outside of mathematics well because of errors in the variable instance. However, he has been able to meet the indicators of recognizing and applying mathematical concepts outside of mathematics because he has been able to connect mathematics in everyday life in solving given problems.

SUGGESTION

In this study, researchers have the following suggestions: (a) For researchers, in determining how mathematical connection skills, other instruments such as interviews need to be used so that they can better see how mathematical connections are and know the reasons for each student's answer to be connected to connection skills mathematically them. (b) For teachers, it is necessary to create and implement learning scenarios that truly support the development of mathematical connection skills. In learning, students need to instill deeper concepts to be able to solve problems related to mathematical connections.

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DESCRIPTION OF MATHEMATICAL CONNECTION ABILITY OF CLASS X STUDENTS ON THE LINEAR EQUATION SYSTEM MATERIALS THREE VARIABLES

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ABSTRACT

The mathematical connection is one of the 5 basic abilities required by students in the mathematics learning process. Many studies state the importance of developing this ability for students. Therefore this study aims to find out how the mathematical connection ability of Class X students in the Social Sciences (IIS). To describe the ability of students' mathematical connections The subjects of this study were 34 students of class X social sciences (IIS) SMA N 2 Banjarmasin. Student work outcomes are divided into 3 categories namely, high, medium and low. Next 1 student is selected from each category with the consideration that the work results of the subject can represent the work of each category. Then the three selected subjects were given test questions. From the results of tests conducted on 3 students as samples, it was found that subjects with low and medium ability categories did not meet the three mathematical connection indicators. In contrast to subjects in the high category that have met the third indicator but have not met the other indicators.

Keywords: NCTM, Problem Solving, Mathematical Models, Senior High Schools

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