ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 12, Issue, 03, pp. 54563-54566, March, 2022
https://doi.org/10.37118/ijdr.24084.03.2022

RESEARCH ARTICLE OPEN ACCESS

MISCONCEPTION ANALYSIS OF ALGEBRAIC FORMS USING THREE TIER TESTS FOR CLASS VII STUDENTS

Asdar[1], Badrullah Bakri Badru[2*] and Husnul Khatimah Rusyid[3]

[1&3]Department of Mathematics at the Faculty of Mathematics and Natural Sciences, Makassar State University (UNM); [2]Human Resources Development Agency (BPSDM) of South Sulawesi Province

ARTICLE INFO

Article History:
Received 14th January, 2022
Received in revised form
21st January, 2022
Accepted 19th February, 2022
Published online 28th March, 2022

Key Words:
Misconceptions, Algebra, Describe types, Factors, Experienced

****Corresponding author: Badrullah Bakri Badru***

ABSTRACT

This research is a descriptive research that aims to determine students who have misconception, describe types, and factors that cause these misconceptions. The data were collected through diagnostic test of the form three tier test which was supported by interview data. The research subjects were 21 grade VII-9 students and then 5 students were selected to be interviewed based on the tendency of misconception experienced. Based on the research result, can be concluded that the percentage of grade VII-9 who have misconception on algebraic forms was 59.81% with moderate categories. Further, there are 67 types of student's misconception on 4 indicators of algebraic forms. Furthermore, the factors that cause misconception which came from students, namely the existence of preconception students', incomplete reasons, and intuition.

Citation: ***Asdar, Badrullah Bakri Badru, Husnul Khatimah Rusyid.*** "Misconception analysis of Algebraic forms using three Tier tests for class VII students", *International Journal of Development Research*, 12, (03), 54563-54566.

INTRODUCTION

Conceptual error or misconception is a misunderstanding or misinterpretation of a meaning (Ojose, 2015). Pesman (2005) and Gurel (2015) also add that misconceptions are incorrect and flawed conceptual understandings that can hinder learning. Therefore, the existence of misconceptions in students will affect the knowledge and understanding of students, especially in the process of problem solving and mathematical representation. According to Suparno (2005), the causes of misconceptions in students are students themselves, teachers, textbooks, contexts, and learning methods. In addition, there are characteristics of the material in certain subjects that are difficult for students to understand so that students try to interpret or create their own concepts which are sometimes not in accordance with the actual concept, giving rise to wrong concepts in students' minds. Misconceptions can occur in mathematics, especially algebra. Algebra material is a prerequisite for understanding mathematical concepts at the next level of material. Concepts in algebraic material will often be found at higher levels and math problems related to everyday life. Therefore, students must be able to understand the basic concepts of correct algebra so as not to experience difficulties or misconceptions in advanced material. One tool for detecting student misconceptions is the three tier test. Three-tier diagnostic test is more accurate in determining students' misconceptions and distinguishing them from students who do not understand the concept (Dindar, 2011; Gurel, 2015). The three-tier diagnostic test consists of a multiple choice test in the first tier, the second tier consists of the reasons for the answers in the first tier, and the third tier consists of a scale of the level of student confidence in the two answers given or using a certainty of response index (CRI) (Adadan, 2012). Several studies show that there are misconceptions that occur in students in algebraic concepts (Herutomo and Saputro, 2014; Utami, 2017; Asbar, 2017; Sahin and Soylu, 2011; Lucariello, Tine, and Ganley, 2014). Sahin and Soylu (2011) in their research revealed that there were misconceptions that occurred in the concept of variables which are the basic components of algebraic equations. Lucariello, Tine, and Ganley (2014) revealed that the most common misconception is students' belief that variables are labels for objects. This research was conducted with the aim of providing an overview of the misconceptions experienced by students in algebraic form material, describing the types of misconceptions experienced, and knowing the factors that cause these misconceptions. The types of misconceptions referred to in this study are grouping misconceptions based on the characteristics inherent in students' misconceptions of understanding the concept of algebraic material. Meanwhile, the factors that cause misconceptions are focused on students' internal factors which include students' associative thinking, humanistic thinking, incomplete reasoning, wrong intuition, and student abilities.

LITERATURE REVIEW

Concept, Conception And Preconception: Ausubel defines the concept as objects, events, situations, or properties that have critical attributes that can be accepted and represent a culture through a sign or symbol (objects, events, situation, or properties that posses common critical attributes and are designated in any given culture by some accepted sign or symbol) (Halomoan, 2008). Each student's understanding of a concept is called a conception, where each student has a different conception of a concept. According to Suparno (2005), preconception is an initial concept of a material before students take formal lessons under the guidance of the teacher. The initial concepts that students already have often contain misconceptions.

Misconception: Misconceptions or misconceptions are the initial conceptions of students which sometimes do not match or even contradict the conceptions accepted by experts. The type of misconception that is most often found is not a wrong understanding during the learning process, but an initial conception (preconception) that is brought by students during the learning process (Maulini, 2016). There are several factors that cause misconceptions. Suparno (2005). states that in general there are five groups of sources that cause misconceptions in students, namely (1) students, (2) teachers, (3) textbooks, (4) context, and (5) teaching methods.

Three Tier Test: The misconceptions that occur in students need to be known, corrected, or eliminated, so a diagnostic tool is needed to identify misconceptions. One way that can be used to identify misconceptions is a diagnostic test in the form of a three-tier diagnostic test instrument. The three-tier test that was perfected and developed by Haki Pesman and Ali Eryilmaz was able to distinguish between misconceptions and not knowing the concept (Pesman, 2010). The criteria for misconceptions and not understanding the concept can be seen in the following table:

Table 1. Criteria for Grouping Student Understanding

Numb	Tier 1	Tier 2	Tier 3	Category
1	true	true	convinced	Understand (Understand the concept)
2	true	true	not sure	don't understand the concept
3	true	fals	convinced	Misconceptions (false positives)
4	true	fals	not sure	don't understand the concept
5	fals	true	convinced	Misconceptions (false positives)
6	fals	true	not sure	don't understand the concept
7	fals	fals	convinced	Misconceptions (false positives)
8	fals	fals	not sure	don't understand the concept

One of the advantages of the three-tier test is that it is very effective in assessing student understanding compared to conventional multiple-choice tests because the three-tier test is able to distinguish alternative conceptions from lack of knowledge through level analysis. The three-tier test is more efficiently used to assess students' understanding when compared to the two-tier test. Three-tier tests can provide information to teachers about students' previous knowledge and understanding as well as their understanding of concepts after taking the test (Dindar, 2011).

Real Errors in Algebra Material: Based on research conducted by Herutomo and Saputro (2014), it shows that there are a number of misunderstandings experienced by students in algebraic concepts. Students' errors in the concept of variables include misunderstanding letters as labels, not understanding variables as something whose value is unknown and as a generalization of numbers, conjoining addition and multiplication operations, misinterpretation of total meaning, and errors in forming algebraic equations. The research conducted by Utami (2017) also revealed that the algebraic concept errors experienced by students were related to the concepts of addition and subtraction of algebraic forms, the concept of variables, as well as multiplication and division of algebraic forms. Students assume that algebraic addition can be solved by adding up the coefficients and constants, such as 5x+7=12x,2x-5=-3x. In addition, students also consider addition operations as multiplication operations, such as x+5=5x.

RESEARCH METHODS

The type of research used is descriptive research with a quantitative-qualitative approach (mix methods), the research was carried out in grades VII-9 in one of the junior high schools(Arifuddin et al., 2020; Badrullah et al., 2016; Said et al., 2011). The subjects in this study consisted of 21 students and were then selected to be 5 informants to conduct interviews based on the misconception tendencies experienced. The instrument used is a three-tier test and interview guidelines that have been validated by two experts. The data collection technique in this study is the test method to see the percentage of students' misconceptions, the interview method is used to explore the data on the factors causing students' misconceptions in order to clarify the test result data, not all of which can be explained through the analysis of students' written test answers and documentation is used to complete the data. -data from interviews and field notes, namely photographs and sound recordings. Data collection in this study began with the provision of a three-tier test instrument which was then analyzed using the total score. The test results data are described based on the criteria for grouping the level of student understanding.

RESEARCH RESULTS

Types of Misconceptions Experienced by Students: Based on the results of the three tier test analysis, data were obtained regarding the types of misconceptions experienced by students. There are 67 types of student misconceptions found in 4 indicators of algebraic material. The types of misconceptions experienced by each student are presented in Table 2:

Table 2. Combination of Student Answers on Algebraic Forms Materials Identified Having Misconceptions

Question	Category	Percentage
1	Misconceptions (false negatives)	71,42%
	Misconceptions (false negatives)	0%
2	Misconceptions (false negatives)	28,57%
	Misconceptions (false negatives)	38,09%
3	Misconceptions (false negatives)	33,33%
	Misconceptions (false negatives)	9,52%
4	Misconceptions (false negatives)	23,80%
	Misconceptions (false negatives)	4,77%
5	Misconceptions (false negatives)	33,33%
	Misconceptions (false negatives)	23,80%
6	Misconceptions (false negatives)	57,14%
	Misconceptions (false negatives)	9,52%
7	Misconceptions (false negatives)	42,85%
	Misconceptions (false negatives)	4,77%
8	Misconceptions (false negatives)	76,19%
	Misconceptions (false negatives)	4,77%
9	Misconceptions (false negatives)	61,90%
	Misconceptions (false negatives)	4,77%
10	Misconceptions (false negatives)	57,14%
	Misconceptions (false negatives)	23,80%
11	Misconceptions (false negatives)	38,09%
	Misconceptions (false negatives)	0%
12	Misconceptions (false negatives)	71,42%
	Misconceptions (false negatives)	9,52%

Based on table 2, it can be seen that the largest percentage for misconceptions (false negative) is in item number 8, which is 76.19%. Meanwhile, the largest percentage for misconceptions (false positive) is in item number 2, which is 38.09%.

Factors Causing Misconceptions in Students

The students' preconceptions or initial concepts are wrong/wrong: In the following, the results of the test and an excerpt from the interview of one of the students are presented which show

that there is a wrong/wrong preconception of students. Furthermore, a brief description of the factors that cause these misconceptions is described.

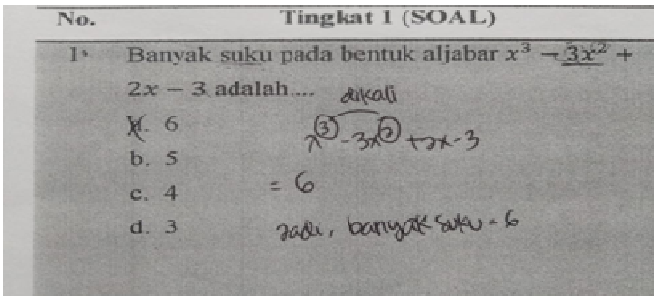

Figure 1. Display of HDS . test results

Figure 1 shows that HDS determines the number of terms in the algebraic form by multiplying the exponents of the variables. So, HDS gets a lot of terms in the problem, namely 6, from the result of multiplying the power of 3 times 2. In Transcript 1, HDS explains how to solve problem number 1, which shows that there is a wrong/wrong preconception. Students think that the term is the result of multiplying the power in algebraic form. In fact, algebraic terms are determined by the number of variables and their coefficients or constants separated by the sign of the operation of the sum or difference.

Incomplete student reasons: In the following, the results of the test and an excerpt of an interview with one of the students are presented which show the reasons for the incomplete student. Furthermore, a brief description of the factors that cause these misconceptions is described.

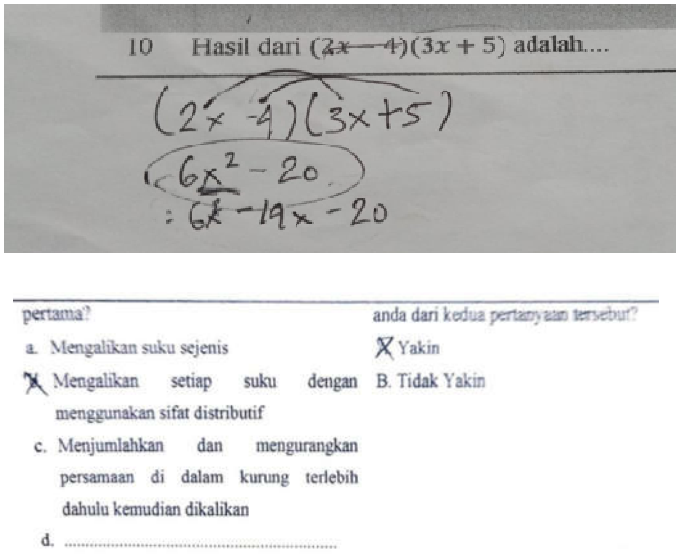

Figure 2. Display of RAS test results

Figure 2 shows that RAS performs multiplication by multiplying algebraic forms in the same position, namely (2x) (3x) =6x^2 and (-4) (5)=-20. Then RAS performs subtraction of the algebraic form to get the middle value on the question, which is 20-6 = 14. So that the solution to the problem is obtained, namely 6x^2-14x-20. The reason for choosing RAS in the second tier states that the multiplication of algebraic forms uses distributive properties. The distributive property is meant by multiplying algebraic forms in the same position. In Transcript 2, RAS explains how to complete the multiplication of algebraic forms according to the answers on the test results. This shows that RAS provides incomplete reasons for solving multiplication of algebraic forms. RAS simply solves multiplication by multiplying algebraic forms in the same position. In fact, the solution to the multiplication of algebraic forms can be done using the distributive property. The concept of the distributive property in question is the property of the operation of spreading numbers with the sum or difference of two other numbers. So, with the incomplete reason, it gives rise to the wrong concept given by the subject.

Students' Intuitive Thinking: In the following, the test results and interview excerpts of the RAS subject are presented which show that students' intuitive thinking is wrong. Furthermore, a brief description of the factors that cause these misconceptions is described.

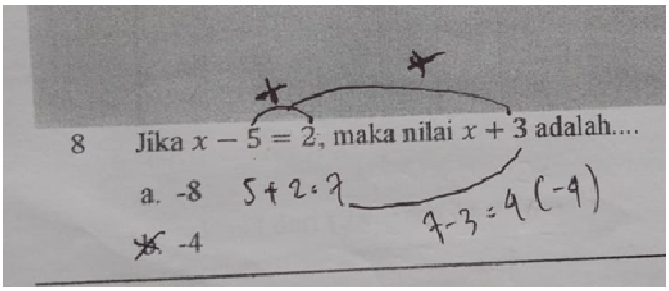

Figure 3. Display of RAS test results

In Figure 3, it can be seen that RAS solves the problem by using all the numbers contained in the algebraic equation. RAS obtains the value of x by doing algebraic addition and subtraction, namely 3-(5+2)=3-7=-4. So, RAS gets the value of x on the question, which is -4. In Transcript 3, it shows that RAS gives spontaneous thought to the question instructions and this will affect the way the subject solves the problem. Spontaneous thinking given by the RAS subject is to think that the value of x can be found using all the numbers provided. In fact, equation 1 in the problem becomes a clue to get the value of x which will be substituted in the equation of algebraic form 2, so that the answer to the question is obtained. Spontaneous thinking given by the subject can lead to conceptual errors and have an impact on the difficulties experienced by students in solving the problem.

CONCLUSION

The percentage of students in grades VII-9 in one of the junior high schools who have misconceptions about algebraic forms is 59.81% (medium category). It was found that 67 types of misconceptions experienced by grade VII-9 students were found in 4 indicators which included recognizing algebraic forms of contextual problems; explain the meaning of variables, constants, terms, and similar terms; observe and determine addition and subtraction in algebraic form; and observe and determine multiplication and division in algebraic form. The factors that cause misconceptions experienced by students in grades VII-9 come from the existence of wrong/wrong preconceptions or initial concepts of students, incomplete reasons for students, and students' intuitive thinking.

REFERENCES

Adadan, E. and Savasci, F. 2012. An Analysis of 16 – 17–year– Old Students' Understanding of Solution Chemistry Concepts Using a Two-Tier Diagnostic Instrument. *International Jornal of Science Education*, *34(4), 513 – 544*.

Arifuddin, Rahyuddin and Badrullah. 2020. *Teori dan praktik metode penelitian pendidikan*. CV. Syahadah Creative Media.

Asbar. 2017. Analisis Miskonsepsi Siswa Pada Persamaan dan Pertidaksamaan Linear Satu Variabel dengan Menggunakan *Three Tier Test. Skripsi.* Jurusan Matematika Universitas Negeri Makassar.

Badrullah, Asdar and Rahyuddin. 2016. *Metode penelitian penuntun praktis bagi siswa dan mahasiswa*. Kretakupa Print.

Dindar, A., C. and Geban, O. 2011. Development of a Three-Tier Test to Assess High School Students' Understanding of Acids and Bases. *Procedia Social and Behavioral Sciences*, *15 (2011), 600 – 604.*

Gurel, D., K., Erylmaz, A. and McDermott., L., C. 2015. A Review and Comparison of Diagnostic Instruments to Identify

Student's Misconceptions in Science. *Eurasia Journal of Mathematics, Science and Technology Education*, *11(5), 989-1008*.

Herutomo, R. and Saputro, T. 2014. Analisis Kesalahan dan Miskonsepsi Siswa Kelas VIII Pada Materi Aljabar. *Jurnal Ilmu Pendidikan dan Pengajaran, 1(2):134.*

Lucariello, J., Tine, M. and Ganley, C. 2014. A Formative Assessment of Students' Algebraic Variable Misconception. *Journal of Mathematical Behavior, 33, 30-41.*

Maulini, S., Kurniawan Y. and Muliyani R. 2016. The Three Tier-Test untuk Mengungkap Kuantitas Siswa yang Miskonsepsi pada Konsep Gaya Pegas. *Jurnal Pendidikan Fisika, 1 (2): 43*.

Ojose, B. 2015. *Common Misconceptions in Mathematics Strategies to Correct Them*. United States of America: University Press of America.

Pesman, H. 2005. Development Of A Three Tier Test To Asses Ninth Grade Student's Misconceptions About Simple Electric Circuits. *Thesis* : Middle East Technical University.

Pesman, H. and Eryilmaz. 2010. Development of A Three-Tier Misconception About Simple Electric Circuit. *The Journal of Education Research.* Vol. 3 (2).

Sahin, O. and Soylu, Y. 2011. Mistakes and Misconception of Elementary School Students about The Concept of Variable. *Procedia Social and Behavioral Sciences, 15 (2011), 3322-3327.*

Said, H., Badru, B. B. and Shahid, M. 2011. Confirmatory Factor Analysis (Cfa) for testing validity and reliability instrument in the study of education. *Australian Journal of Basic and Applied Sciences*.

Sudijono, A. 2009. *Pengantar Statistik Pendidikan.* Jakarta: Rajawali Pers.

Suparno, P. 2005. *Miskonsepsi dan Perubahan Konsep dalam Pendidikan Fisika.* Jakarta: Grasindo.

Utami, R. 2017. Analisis Miskonsepsi Siswa dan Cara Mengatasinya Pada Materi Bentuk Aljabar Kelas VII-C SMP Negeri 13 Malang. *Jurnal Pendidikan Matematika, 3 (1): 37.*

****