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STUDENTS' MISCONCEPTIONS ON RADICALS BASED ON LEARNING STYLES

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Abstract

The aim of this research are describing students' misconceptions on radicals reviewed from learning styles. Because by knowing the learning style of students, we can repair the teaching method or the learning environment such that the misconceptions are less appear in the future.The method of the research is qualitative research. The data taken on 9th – 26th of February 2018 on grade X with 35 students.The result of the research showed that student with accommodator learning style found misconception happen on radicals definition; student with assimilator learning style found misconception happen on radicals definition and operation, especially addition/subtraction; student with diverger learning style happen misconception on radicals definition and operation, especially addition/subtraction and multiplication/division; student with converger learning style happen misconception on radicals definition and operation, especially addition/subtraction and multiplication/division. Then, the causes of misconception in radicals are: First, generalization of variable definition; Second, application of wrong radicals operation; Third, deletion of the root and square of number inside the root; Fourth, application of wrong concept through limitation or requirement that is applied on the radicals test. By knowing the misconception of students on radicals based on learning styles, every teacher must pay attention to each learning styles of students such that misconception decreases and make a meaningful learning.
Keywords: Misconception, Radicals, Learning Style

BACKGROUND

The concept is defined as an abstract idea that can be used to classify a set of objects (Depdiknas in Kesumawati, 2008). While one's interpretation of certain concepts within the framework already existing in his mind is called conception (Berg in Handjojo, 2004). There are two kinds of conception, they are preconception and misconception. Preconception is a conception based on formal experiences in everyday life, whereas misconception is a wrong conception caused by previous learning.

Misconception or wrong conception is wrong understanding and ideas that are inconsistent with the concepts of experts. Misconceptions can be long-lasting and difficult to repair even during formal education. This suggests a fact that learning is a complex process in an interaction of learners 'beliefs, experiences, and learners' knowledge. (Kusnick, 2002).

Learning is an example of communication between teachers and students. Mulyana (2007) states that communication is done to share knowledge and experience. As part of communication, learning must meet all the effective communication prerequisites for material delivery (Naim, 2011: 112; Day, 2011). Effective communication can occur when there is a shared understanding between the message giver and the person receiving the message (Rohim, 2009). At the time of learning, students' understanding is different and sometimes missteps so that student have misunderstandings.

The benefit of studying misconceptions as mentioned by Shen (2013) is to help reduce misconceptions that occur in students. By studying misconceptions, teachers can find out the wrong student concepts and correct them so that misconceptions do not recur in the future. The second benefit is to help teachers to anticipate misconceptions among students. Teachers can develop learning strategies that can help the learning process run better.

Misconceptions occur because of differences in student perceptions formed when students obtain new information. Students reason and combine information with prior knowledge using their own unique way of learning style. In the learning process, it is important for teachers to know the learning style of each student for the success of learning. So the misconception can be reduced

or even eliminated. Because as mentioned earlier, learning uses communication that depends on our ability to understand each other.

Problems of misconceptions are still common with high misconception rates (Lucariello, 2014; Chan & Ismail, 2013; Ozkan, 2011). Some examples of radicals misconceptions which are discussed in the journal about the misconception of the radicals:

1. $\sqrt{(-6)^2} = \pm 6$ or $\sqrt{(-6)^2} = -6$

   Such an answer has not been exact because the student made the properties $\sqrt{a^2} = a$ is right for all conditions. Students forget the requirement that the number inside the root sign should not be negative. The desired answer is 6, corresponding to the nature of the radicals

   $$\sqrt{a^2} = |a| = \begin{cases} a, if\ a \geq 0 \\ -a, if\ a < 0 \end{cases}$$

2. $\sqrt{4^2 - 4} = 4\sqrt{1^2 - 1}$

   This answer is not correct because there are errors in factorizing and rooting numbers. Students answer like this because they still remember the algebra operation so that the desired answer has not been fulfilled. The easiest way is to do the number operation inside the root sign first and get results $\sqrt{12}$ $=\sqrt{4(4-1)} = 2\sqrt{3}$. Alternative ways that can be used is to factorize as follows

   $$\sqrt{4(4-1)} = 2\sqrt{3}$$

3. $\sqrt{(-4)(-4)} = \sqrt{(-4)}\sqrt{(-4)}$

   This answer is almost the same as the number 1, ie students forget the requirement of the number in the root sign should not be negative so justify the property $\sqrt{a} \cdot \sqrt{a} = \sqrt{a \cdot a}$ for all conditions. So, the right answer by multiplying number inside the root then by rooting.

Misconceptions need to be studied, especially at high school levels that misconception more than junior high school (Lucariello, 2014). It aims to find out the misconception of students as well as an evaluation material for all people. Because misconceptions do not only happen to students, even students and teachers can do the same thing. (Taufiq, 2012; Saehana dan Kasim, 2011).

Various characteristics of student learning affect in understanding the concept of a material correctly. One such characteristic is student learning style. As explained by Woolfolk (2013) that the aspects that affect the effectiveness of learning methods is the learning style. According to Kolb and Kolb (2015), learning styles are divided into four types, namely convergers, divergers, assimilators, and accommodators. Both students and teachers need to recognize each other's learning styles as they can provide some benefits. The benefit of recognizing learning styles for students is that students can adapt to the conditions in the classroom. If there are students who are incompatible with a particular learning, students can still explore the material with their own learning style.

The benefit of recognizing learning styles for teachers is to choose the right methods and strategies to use in the classroom. Teachers can take advantage of different student learning styles to create meaningful learning. In addition, teachers must find their own learning style to absorb new information because education is dynamic.

Of the benefits already mentioned, learning styles have a strong enough influence to form concepts in students. Ahriani (2013) shows there are differences in learning outcomes that are influenced by learning styles. This is also in line with the research by Ozkan (2011) that there is an influence of learning styles on misconceptions that students do on research done, ie on chemistry subjects.

Given the importance of studying misconceptions in the above description and several studies showing the influence of learning styles on misconceptions, the researcher intends to see students' misconceptions on the radicals by reviewing learning styles through qualitative research entitled "Student Misconception on Rooted Material Reviewed from Learning Styles".

METHOD

The method of the research is qualitative research..Subjects of the research is 4 students of class X MIA 4 of State Senior High School 14 Surabaya. Data collected by using radicals test, learning style questionnaire, and interview. Radicals test is using to knowstudents ability in answering radicals question.Radicals test is set from previous research to know the misconception. From student's answer, researcher analyzes the most common errors happen in worksheets.

Learning style questionnaire is using to know the learning styles of students.After that, we can look if each learning style have represented or not. If not, then we look for research subject in another class. If it has represented, then we can do interview for each subjects by also looking the most common errors after analyzing.

Interview is using to show more about students' conception in answering radicals test. In this part, researcher asks subjects how they can do that and so on. Such that researcher know their understanding or what is in their mind in answering radicals test. So, we can know that the subjects is having misconception or not.

RESULT

From student's answer of radicals, researcher analyze data by dividing it on some indicators and suits it with interview result. These indicators is made to find the place of misconception on each candidate of learning style.

Below are misconception data get from student's answer and interview on each candidate and divide it on learning style, they are:

1. Accommodator Learning Style

a. Misconception on radicals definition

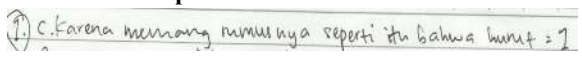

Figure 1. Student with accommodator learning style's answer for number 1

From the student's answer and the interview result, it is found that the student confused in defining the possibility of the variable of number a as negative number, zero or positive number which in it including fraction. The student understands that it is impossible for her to define the variable as a negative number, but student also understands that in a positive integer does not apply a statement on the number (1) $\sqrt{a} > a$, so student chooses the safe answer of option (c) even though in the end he ignores the statements presented by the researcher in the form of a variable as a condition applicable to all options ie statement $\sqrt{a}>a$. Therefore, it can be said that students have misconceptions on number 1

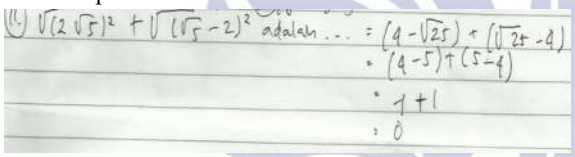

Figure 2. Student with accommodator learning style's answer for number 11

The student omits the root sign with no clear explanation. Then, the student operates the matter as if there is no root, leaving the number in the root by crossing out the rank and the root. Students do not specify or pay attention to the numbers in the root before crossed out. So students do not encounter negative numbers within the root. Then, the student has errors in solving by finding the answer -1 + 1 = 0.

2. Assimilator Learning Style

a. Misconception on radicals definition

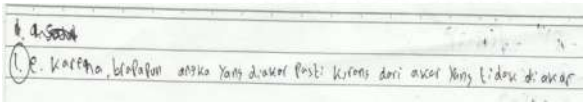

Figure 3. Student with assimilator learning style's answer for number 1

The understanding of students with this assimilator learning style states that the exact number of burning numbers is smaller than the number within the root. In fact, not all roots of positive numbers must be smaller than the original number, for example $\frac{1}{4}$

$$\sqrt{\frac{1}{4}} = \frac{1}{2}$$

then $\sqrt{\frac{1}{4}}$ no smaller than $\frac{1}{4}$. Thus, the conception of student is inconsistent with the given example.

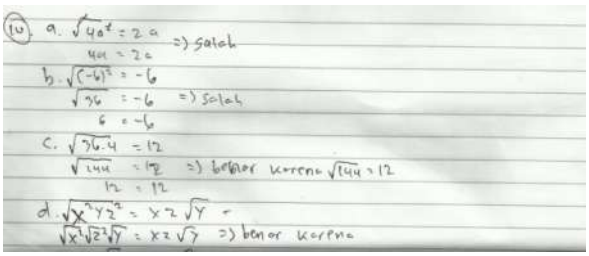

Figure 4. Student with assimilator learning style's answer for number 10

Students with an assimilator learning style have errors by crossing out roots with rank. Scraping of roots and ranks is only valid if it is certain that the value of a variable is a positive number.

The results of the interviews show the opinions of students who can make it misinterpretation of the abstract object of each variable and can be positive or negative. The incorrect definition of variables in the root will result in a less correct answer, meaning it is not applicable to all circumstances. Whereas here the researcher does not provide a range of the variable number. Therefore, researchers assess students misconception in the form of roots because of errors in defining variables in the number of roots.

b. Misconception on radicals operation

- Addition or substraction

Figure 5. Student with assimilator learning style's answer for number 12

Students assume that the number in the root is separated so that $\sqrt{4x^2 - y^2}$ in the simplification, each number can be rooted first so that the answer appears $\sqrt{4x^2}$-$\sqrt{y^2}$. This is supported data at the time of the interview the student replied that the root can be separated. Students separate the number reduction operations as they separate the multiplication or division operations. Students do so to make calculations easier. However, what students do is wrong. Thus, the end result is also less precise. The conception that the student considers true does not fit the concept of properties in addition or subtraction operations.

3. Diverger Learning Style

a. Misconception on radicals definition

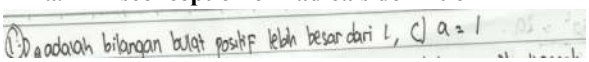

Figure 6. Student with diverger learning style's answer for number 1

From the answers and the results of interviews with students shows that students are confused by what is asked on the matter. The answer of this student tries to get out of the requirement of the statement of number (1) so that he can freely select and define *a* and searched options according to his thinking. Therefore, the conception of students on problem number (1) is not in accordance with the concept of the radicals and the terms given to the problem so that misconception arises.

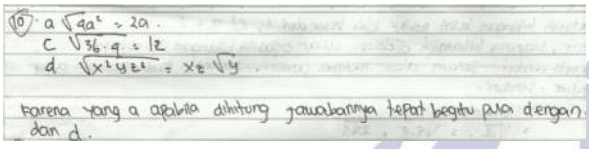

Figure 7. Student with diverger learning style's answer for number 10

Students directly direct the variable regardless if the value of the variable is negative. The student loses the possibility of the variable *a* being negative, ie the root result $\sqrt{a^2} = -a \, , if \; a < 0$, so that in the options (a) and (d) do not occur to them the root result is negative if the variable is defined less than zero / negative. This is increasingly apparent when students consider the option statement (d) on question 10 to be true. The answer from the student during the interview shows that he lost the concept of the number variable in the root is the number of the rank of two. Students are confused between the nature of the numbers within the roots that simultaneously also apply the properties of the squared numbers.

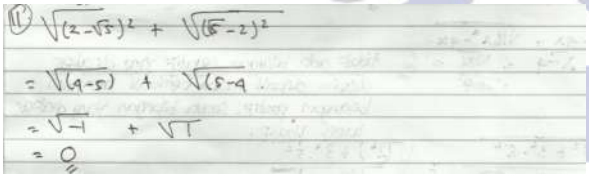

Figure 8. Student with diverger learning style's answer for number 11

Students experience errors in summing the negative roots of one and the root one. The student keeps writing the root but is wrong in the translation of the number within the root. So she get results $\sqrt{-1} + \sqrt{1}$. The focus of the researcher is not on the error of elaboration of the number within the root, but rather the next step. When $\sqrt{-1} + \sqrt{1} = 0$, the researcher thinks that the student does not pay attention to the root and the number that is in it. After the interview, the researcher assumes that the number in the root must be positive. Thus, the student performs the addition operation to remove the negative sign within the root. Thus, students experience a misconception that is a false generalization of a concept.

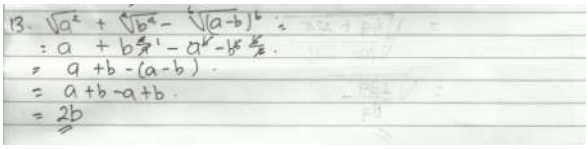

Figure 9. Student with diverger learning style's answer for number 13

Students do not pay attention to variable values. The condition given by the researcher is $a<0<b$, this means that *a* is negative and *b* is positive. Thus, for the work of the two variables must be different. If not, then the desired result does not match the answer key. Student conception that the root of a variable can be obtained by direct roots regardless of the value of the variable is not in accordance with the concept of radicals definition.

b. Misconception on radicals operation

- Addition or Substraction

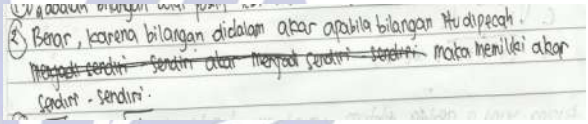

Figure 10. Student with diverger learning style's answer for number 2

Students justify the operation of the numbers inside the root can be broken down according to Figure 10. Whereas for question number 2 the number operation is addition, which should be done before it is rooted. Therefore, student answers are wrong. Thus, students experience misconceptions. The misconception in understanding the nature of the operation of the numbers in this root makes the student with the diverger's learning style answer the number 2 with the statement that the number in the root (the addition / subtraction operation in the root) can be broken down so that it has its own root. Students assume in doing the addition / subtraction operation within the root may by simplifying the radicals by issuing the sign (+) as a sum and (-) as a sign of subtraction from within the root, so that the numbers separated with each have roots. At the interview with the students, the researcher reiterated to the student the answer to this number (2), and the student once again replied b that the number inside the root when broken down has its own root. This statement is a misconception of the radicals

Figure 11. Student with diverger learning style's answer for number 12

Students separate the number reduction operations as they separate the multiplication operations or

divisions according to Figure 11. Students assume the numbers in the roots can be split so that $\sqrt{4x^2 - y^2}$ in simplification, each number can be rooted first so that the answer appears $\sqrt{4x^2}$-$\sqrt{y^2}$. Although the student on the worksheet does not write the separation of numbers, but at one interview he answered the number in the root can be broken.

Students do so to facilitate calculations but in fact what they do does not fit the concept of addition or subtraction of radicals.

- Multiplication or Division

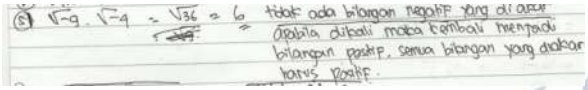

Figure 12. Student with diverger learning style's answer for number 5

Students justify multiplication because if multiplied directly the result is positive according to Figure 12. Can be seen from the statement of students who write that there are no negative numbers that are rooted. Thus, students multiply both numbers so that the number in the root is positive.

At the time of the interview the students answered the number can be multiplied. The student's conception is not in accordance with the concept that the number in the root must be positive so that if the number in the root is negative then it can not be operated.

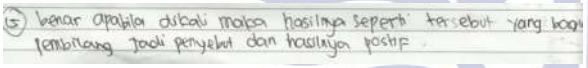

Figure 13. Student with diverger learning style's answer for number 15

The student justifies the multiplication because if it is multiplied directly the result is positive as the student's statement in Figure 13. Thus, the student forces to multiply both numbers so that the number in the root is positive.

Researchers find students experiencing misconceptions on indicators justifying the property $\sqrt{a} \cdot \sqrt{b} = \sqrt{a \cdot b}$ for all real number, whereas the problem is presented in the form of a number not in the form of a variable. It should not be separated because the number requirements inside the root can not be negative. Therefore, the process must be operated first so that there will be positive numbers and then rooted.

4. Converger Learning Style

a. Misconception on radicals definition

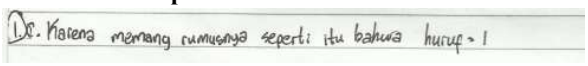

Figure 14. Student with converger learning style's answer for number 1

From the answers and interview results, students have difficulty in defining variables on the terms statement in the matter for then searched options that meet the statement $\sqrt{a}>a$ so choose $a = 1$ that still not meet the requirements on the question. Students are wrong in answering tests about the radicals not because they do not understand the concept of the radicals but have misconception of the radicals, especially on the error indicator in taking the roots.

Figure 15. Student with converger learning style's answer for number 11

The student removes the root and then squares the number in the root according to Figure 15. Thus, the student is not aware of any negative number within the root if it does not remove the root. Students work on questions with no rank so attributes are incomplete. Then this results in the failure to define the number in the root is a negative number so that it belongs to the criteria of misconception.

b. Misconception on radicals operation

- Addition or substraction

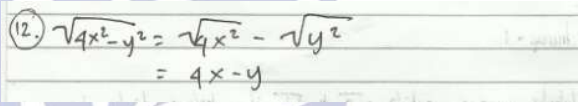

Figure 16. Student with converger learning style's answer for number 12

Students separate the number reduction operations as they separate the multiplication or division operations. Students in working on the question number (12) assume the number in the root is separated so that $\sqrt{4x^2 - y^2}$ in its simplification, each number can be rooted first so that the answer appears $\sqrt{4x^2}$-$\sqrt{y^2}$. Students do so to simplify calculations but what students actually do is wrong. The student's conception that the settlement can be separated as multiplication operations is inconsistent with the concept of addition or subtraction operation at the radicals.

- Multiplication or division

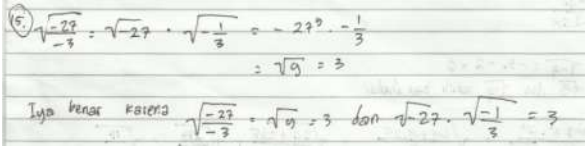

Figure 17. Student with converger learning style's answer for number 15

Students take the negative number first and then multiply. Students indirectly forget the requirement of the number within the root should not be negative. The focus of the students as if only the multiplication of two negative numbers within the root will produce a positive number. This omission makes each of them think that negative numbers can be separated so that they have their own roots.

CONCLUSION

Based on the result of this research, researcher takes conclusion in 2 things, they are:

1. Student's misconception on radicals reviewed from learning styles

   Students with accommodator learning styles found the least misconceptions among other learning styles. Students with accommodator learning style experience misconception in the definition of radicals.

   Students with assimilators learning styles have misconceptions in radicals definitions and misconceptions in radicals operations especially in addition/subtraction operations.

   Students with diverger learning styles experience misconceptions in radicals definitions and misconceptions in radicals operations especially sum / subtraction and multiplication / division operations.

   Students with converger learning styles occur misconceptions in radicals definitions and misconceptions in radicals operations especially sum / subtraction and multiplication / division operations.
2. The cause of misconception on radicals

   Misconceptions of the radicals are caused by the following. First, the generalization of the definition of the number variables. Generalizing the definition of a variable of numbers as a positive integer results in the loss of the basic essence of the concept of the radicals. Particularly in terms of attracting root results, to then be able to properly operate and root the roots.

   Second, the application of the operating properties on the wrong radicals. The workmanship of the hasty and inaccurate form of roots causes each subject to be trapped by the similarity of roots form operations. Finally they lose the essence and wrong in applying the properties of roots form operations. They can no longer distinguish the special properties of multiplication / subdivision and addition / subtraction. Furthermore, the application of these operating properties also determines their success in completing the factoring of numbers within the roots.

   Third, deleting the root sign with the square of the number within the root. In this case, especially in the matter of the form of the root with the number in the root is the number of the rank of two or squared. The deletion of the root and square marks on the numbers inside the root is considered a shortcut to be able to work on the problem quickly and correctly. An assumption that can not be used for every circumstance. The circumstances or restrictions on the radicals must be fully understood first and then apply the concept understood.

   Fourth, the application of the wrong concept to the restrictions or conditions that apply to the matter of the radicals. In addition to the properties of the radicals and the operative properties of the radicals, each subject must correctly understand the conditions or conditions to be met so that they can be applied to the working of the radicals. The inability of each subject to identify the circumstances causes them to be less precise in using the properties of the radicals and the operating properties at the radicals.

SUGGESTION

Based on the result of this research, we have suggestion as follows.

1. Pay attention to each learning style of students because misconceptions that occur in the subject of research are varied.
2. Do more in-depth research for the misconception of the radicals or misconception on other materials

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