Mathematics learning disabilities of the slow learner students on pythagorean theorem

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Abstract. This research was aimed to analyze mathematics learning disabilities of the slow learner on Pythagorean Theorem. This research was an exploratory study with qualitative approach. The subjects of this research were 2 of the 8th grade’s slow learner students of two inclusive schools in even semester of the 2017/2018 academic year. Data collection was done using test and interview method. Based on the data analysis, the results showed that the subjects had mathematics learning disabilities on Pythagorean Theorem that was categorized in (1) procedural memory deficit: the subject could not do the procedure properly and still had difficulty in operating the algebraic form, (2) semantic memory deficit: disability in learning arithmetic facts, disability in using the principle (3) visuospatial deficit: the subjects were still confused when the triangle was rotated.

1. Introduction
Education for all is an education implementation that accommodates all individual to receive a right education service. Slow learner is one of the students with special needs that requires special education services at inclusion school. Inclusive education aims to reduce bad prejudice, discrimination, intolerant, because students with special needs deserve to get a proper education in accordance with their special needs [1].

Slow learner student has no physical distinction with other regular students. Their learning progress is slower than the average progress of the students in their age, in which their IQ tests scores show between the score of 70 and 90. Slow learners are children who have the intelligence is classified as dissability, but unable to cope with academic tasks [2].These students have slower rate than the average students, but they are still capable of achieving a moderate degree of academic success. They are not considered mentally retarded because they are physically like regular students although they have lower IQ than the average students[3]. The characteristics of slow learner are weak memory, limited cognitive capacity, lack and distraction of concentration, and inability to express ideas[4].

The special education services is required because the slow learner must face some learning problems, such as: (1) difficulty understanding abstract concepts; (2) has a limited vocabulary; (3) has a low learning motivation; (4) takes a longer time to understand a lesson than a normal student; and (5) need repetition in the explanation of the lesson. The obstacles of the slow learner will appear after following the learning process [5].

Students with slow learning have many difficulties and constraints in academics, especially mathematics. Mathematics is useful in everyday life [6]. We can handle the money, analyze the data, calculate the time and the distance because of mathematics. Mathematics learning that taught in every
education level can be a foundation of mathematics skills for solving real life problems[6]. Most math problems are quite difficult to understand by slow learner [7].

Mathematics learning at an inclusive school that includes slow learner students will be different from regular school. Teaching mathematics for slow learner student should use effective learning strategies, probably by using appropriate learning models and many learning aids. Teaching mathematics in inclusive classroom requires a different curriculum to suit the needs of the slow learner [4]. Inclusive school program is designed to serve difficulties of children with special needs [1]. Learning disability is the condition in which students have learning disorders so that students cannot learn properly with certain obstacles in achieving the results of the study. Students with learning disabilities tend to struggle with bad conceptual understanding of basic mathematics skills, deficits in working memory, difficulty coordinating measures problem-solving, and lack of ability to using the skills to solve the problem of calculation and the word [8]. Most students generally encounter difficulties in geometry in senior secondary school mathematics lesson [9].

Geometry is a branch of mathematics that studies about shapes, spaces, compositions and properties, measurement, and connections between the material elements [10]. Geometry is closely related to our daily lives because many problems in daily life associated with geometry require the application of the geometry concept to solve. Geometry is used to build spatial ability, visualization, intuition of students and to accomplish some practical problems [11]. Most students experience difficulty in learning geometry, and slow learners do too. Based on the observation in the class and the teacher’s interview, the slow leaner students experience difficulty in geometry. Most students face difficulty in learning a Pythagorean Theorem when determine the hypotenuse and make an algebra operation [12]. This research is aimed to analyze mathematics learning disabilities of the slow learner on Pythagorean Theorem based on Geary’s mathematics learning disability theory.

2. Methods
This research was an exploratory study with qualitative approach. The subjects of this research were 2 of the 8th grade’s slow learner students of an inclusive schools in even semester of the 2017/2018 academic year in Islam Diponegoro Junior High School Surakarta and Modern Islamic School Junior High School Surakarta. The subjects were selected by purposive sampling and had received a lesson about Pythagorean Theorem.

Researcher gave the subjects a test and interview to get information about their mathematics learning disabilities. The subjects were given a test about Pythagorean Theorem and interviewed. The test consists of 2 items of question. By using an interview, the students could express their thoughts interactively. The indicators of mathematics learning disabilities used 3 types in accordance with Geary namely (1) procedural memory deficit, (2) semantic memory deficit, and (3) visuospatial deficit [13]. This research used four procedures of data analysis that consisted of data collection, presenting data, data reduction, conclusion.

3. Result and Discussion
Slow learner students are students who have low IQ and have lower thinking skill than their friends, so that they need more time to learn. Slow learners are those children that have weak performance in school and cannot receive specific instructions and they perform slower in understanding specific concepts that normal people understand easily[14].

Students with mathematics disabilities often face difficulties at application of three areas of knowledge that consists of factual, conceptual knowledge, and procedural, which can affect achievement in geometry classes of secondary-level significantly [15]. Geary classify the types of mathematics learning disabilities into three namely (1) procedural memory deficit, (2) semantic memory deficit, and (3) visuospatial deficit.

The subjects were a male slow learner students from Islam Diponegoro Junior High School and a female slow learner students from Modern Islamic School Junior High School. The two subjects were AH and DL. Researcher gathered informations from test and interview. The test was about
Pythagorean Theorem. The interview was task-based interview that conducted after giving the test. One of the problems was using a right triangle with the usual position that requires the ability to operate algebraic form by finding another triangle’s leg if it was known the hypotenuse and the leg. Another problem, the triangle was rotated so that the hypotenuse is in the bottom and looked for another leg. The problems and the student’s answer presented in Table 1.

| Item | Problem | Student’s Answer |
|------|---------|------------------|
| 1    | Determine CB ! | ![](image1.png) | $\sqrt{5^2 - 3^2} = \sqrt{16} = 4$ |
| 2    | Determine x ! | ![](image2.png) | $x = \sqrt{8^2 - 4^2} = \sqrt{32}$ |

Table 1. Problems and Student’s Answer

Research interviewed the subjects after gave a test. The citation of the transcript of the interview as follows (R as researcher):

*R*: What is sought in this problem? From the formula you have written, is it correct?

*DL*: length of CB. I guess the formula was right

*R*: from this picture, which one of this picture that is the hypotenuse and the leg?

*DL*: the hypotenuse is AC. the leg is AB and BC

*R*: how did you write and get this formula?

*DL*: I forgot but I have learnt. I am confused how to find the side CB.

*R*: initially, you added the number, and then suddenly subtracted the number. Why? How did you operate like this? At the beginning, you have been wrong in writing the formula.

*DL*: i thought what i’ve learnt was like this, i forgot and confused, i did not know the way. What asked in this problem is not the hypotenuse, so it must use subtraction operation like my teacher taught.

The subject DL has already made a mistake on the first step that was the writing of Pythagorean formula. Based on the interview, the subject DL tried to remember the steps as taught by the teacher. For another subject, AH, had the same conclusion as the subject DL.

The other problem was found their difficulties that presented in this citation the interview below:

*R*: what does the command from this problem?

*AH*: find the x

*R*: where is the hypotenuse?

*AH*: this AC or x.

*R*: why did you think if this was hypotenuse?

*AH*: because this is slanted

*R*: why did you write the formula like this?
AH: oh i know i missed the quadratic symbol  
R: if you thought this was right, use quadratic symbol, why did you write the formula with subtraction symbol?  
AH: because the the hypotenuse minus the side BC

The subject AH has already made a mistake on the first step that was the writing of the Pythagorean formulas that result in an error until the end of the calculation. Based on the interview, the subject AH did not know which triangle’s hypotenuse and triangle’s legs whereas on the picture was already clearly visible sign of a right angle. The subject AH presume that the hypotenuse was x. DL had the same conclusion as the subject AH.

From the result and the interview, the researcher made the analysis based on Geary Theory of mathematics learning disability. There were three types of mathematics learning disabilities that were experienced by the slow learner students.

The first aspect was procedural deficits, the subjects do many counting errors while solving simple arithmetic problem when completing the simple calculations e.g. doing wrong operation and determining the square root of a number. The subject could not do the procedure properly whereas the Pythagorean formula has only one form. The subjects still had difficulty in operating the algebraic form. The subject often make mistakes in writing of the quadratic symbols. The characteristics of procedural deficits of the slow learners with mathematics learning disability had mathematics difficulties in term working memory and conceptual knowledge. These subjects had working memory deficit, is related to the system of the language represented with articulation in the form of numbers words and counting ability. All matters involving working memory, such as the weak attention centre can interfere with the use of mathematical procedures[13]. The subject had a procedural error when faced the problem which made in the new situations. These subjects had conceptual knowledge deficit. Lacking an understanding of concepts and principles can affect procedural errors. These subjects did not comprehend the concept and the procedure very well so that they did error while solving simple problems of the test. These students had difficulties in identifying, expressing, and using a concept of the material. They experienced difficulties in using the principle correctly and the difficulty in modifying a principle.

The second aspect was semantic memory deficits, the subjects had difficulties in saving arithmetic facts for given learning. They encountered obstacles in accessing the arithmetic facts from their long term memory that necessary for doing a test. The subjects were still confused when the triangle is turned around. Thus, they could not understand which side was hypotenuse or leg. Since the subjects do not really understand about the fact, it caused the error of doing calculation procedure. One of semantic memory is distraction in the ability to retrieve basic facts from long-term memory that causes difficulties in learning arithmetic facts and retrieving those facts[13]. The slow learners have poor memory[4]. These subjects had experienced difficulty in remembering formulas and doing procedure's rule correctly. Students with learning disabilities tend to struggle with bad conceptual understanding of basic mathematics skills, deficits in working memory, difficulty coordinating measures problem-solving, and lack of ability to using the skills to solve the problem of calculation and the word[8].

The third aspect was visuospatial deficits, visuospatial systems support areas of geometry. Low visuospatial can influence the difficulty in learning maths in particular geometry. The subjects were still confused when the triangle is rotated. Thus, they could not understand which side is triangle’s hypotenuse or triangle’s leg. Slow learners have difficulties to answer correctly the rotated position of the picture of the geometry object problem[16]. When they were asked about how to find the triangle’s area on the question number 3, they said that the base is 8 and the height is 4. This was kind of mathematics difficulty/disability in visualizing and analyzing the rotated geometric figures[17]. If a shape's position are different from usual, then the students will experience difficulty to identify[18]. Tolentino stated that students usually struggling in mathematics about (a) using multiple steps to make a solution of a mathematics problem, (b) understanding and representing mathematics problems, (c) using mathematics concepts, facts, procedural strategies, and rules, (d) identifying and recognising mathematics symbols[19] that accordance with the characteristics of the slow learner.
subjects in which had weak memory, difficulty in using simple or even multiple steps procedure, difficulty in understanding a triangle’s picture when the picture was rotated.

4. Conclusions
The results can be conclude that the mathematics learning disabilities of the slow learner were they did not know the facts (triangle’s hypotenuse and triangle’s legs), did not understand the concepts of a right triangle and Pythagorean Theorem, did not understand the concept of algebra when operating Pythagorean’s form, could not understand the principles, could not perform the procedures correctly. This means that the subjects had procedural deficits, semantic memory deficits, and visuospatial deficits.

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