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# Students' mathematical connection ability reviewed from learning style on Auditory, Intellectually, Repetition learning model

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Abstract

The aims of this study are to (1) comprehensively analyze the achievement of learning completeness of students' mathematical connection ability with the AIR learning model, (2) to find out the improvement in mathematical connection ability with the AIR learning model, (3) to comprehensively analyze the students' mathematical connection ability with the AIR and DL learning model. , (4) to analyze the difference in the proportion of completeness on the students' mathematical connection with the AIR and DL learning model, (5) to describe students' mathematical connection ability on the AIR learning model based on learning style. This research used descriptive quantitative method and class 7 SMP Negeri 16 Semarang for the academic year 2019/2020 became the population of this research. The results showed that (1) the students' mathematical connection ability on the AIR learning model achieved learning completeness, (2) There was an improvement in the mathematical connection ability of the class on the AIR learning model, (3) the students' mathematical connection ability on AIR learning was better than DL, (4) the proportion of completeness on the test results of students' mathematical connection ability on the AIR learning was better than DL, (5) the mathematical connection ability reviewed from learning styles was (a) students with the visual learning style met all mathematical connection indicators (b) students with the auditory learning style met three mathematical connection indicators (c) students with the kinesthetic learning style met three mathematical connection indicators.



## 1. Introduction

Education has an important role in human life. Good education aims to build society as well as can educate the nation's life (RI Law No. 20 of 2003). To educate the nation's life, the government makes every effort such as developing the learning curriculum in the school. One of the important lessons is mathematics education. Based on the 2013 Permendiknas (Minister of National Education Regulation), mathematics subjects need to be given to all students starting from elementary school to equip the students with the ability to think logically, analytically, systematically, critically, and creatively, and the ability to work together.

Mathematics is universal knowledge that underlies the development of modern technology. Mathematics learning in the 2013 Curriculum emphasizes modern pedagogical dimension in learning, namely using a scientific approach which includes observing, asking, reasoning, trying, forming networks for all lessons (Permendikbud (the regulation of the minister of education andculture) No.65 of 2013). In addition, in the 2013 curriculum, the students are motivated to check new information with those already in memory (Permendikbud No. 81A 2013). Furthermore, NCTM (2000) formulates mathematics learning objectives, they are learning to communicate mathematically, learning to reason mathematically, learning

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to solve mathematical problems, learning to connect mathematical ideas, and learning to represent mathematical ideas. Based on these descriptions, the mathematical connection ability is one of the goals that must be achieved when learning mathematics in the class.

The mathematical connection ability is the ability to connect mathematical concepts to both mathematical concepts (in mathematics) and to link mathematical concepts to other fields (outside mathematics), which includes connection between mathematical topics, connection with other disciplines, and connection with everyday life (Dewi, 2013: 284). If the students can connect mathematical concepts, then the students' understanding will be deeper and last longer. Mathematical connection is fuctioned to emphasize that mathematics is taught in a cohesive manner and is related between procedures and ideas that will be created. NCTM states that generally there are two types of connections, namely the modeling connection between problem situations that may arise in the real world or in the disciplines other than mathematics and mathematical representation; and a mathematical connection between two equivalent representations and between corresponding processes (Karniasih, 2014: 55-56). Based on this description, good mathematical connection ability is needed to link principles in learning mathematics and principles outside mathematics to solve problems, especially math problems.

According to the results of interview conducted by the researcher with Mrs. Sri Rejeki, S.Pd., M.Pd, a Mathematics teacher at SMP Negeri 16 Semarang, it was found that the learning process in the class on the set material was still not optimal. The students still had difficulty in solving problems related to writing daily life problems into the form of a Mathematical model. Moreover, the students also had difficulty in connecting between object and concept in Mathematics as well as had difficulty in determining what formulas will be used if they faced with problems related to everyday life problems. The students’ difficulties mentioned above were the elements of a mathematical connection. Thus, from the results of the interview it can be stated that the students' mathematical connection ability was not optimal. Furthermore, the results of the national exam at SMP Negeri 16 Semarang in the 2018/2019 academic year showed that SMP Negeri 16 Semarang only received an average score of 63.34 in Mathematics (Puspendik, 2018).

Based on the description above, to improve students' mathematical connection ability in Mathematics learning on set material, it is necessary to carry out learning that provides opportunities for the students to develop their mathematical connection ability. Anintya et al., (2017: 2) reveal that one of the strategies in teaching is to know students' learning style. In addition, Moussa (2014: 9) states that learning style have been shown to play an important role in the learning process. This is because everyone has their own learning style that determines how students interact with their learning environment. According to De Porter & Hernacki (2015: 110), learning style is a person’s way of receiving, absorbing, and processing information. De Porter & Hernacki (2015: 112) divide learning style into three types, they are visual, auditory, and kinesthetic learning style. While, Hasrul's research (2009: 8) argue that learning style is a person's modality that is "built up" since humans are born. When teachers are able to recognize students’ learning style, it will be easier to direct the students in the learning. Besides, Moussa (2014: 19) states that understanding students’ characteristics in each dimension will not only improve teaching, but the whole learning process.

The teachers can innovate in implementing learning model in the classroom, good management from a teacher can foster student’s interest and motivation in following ongoing learning. An example of classroom management is by applying learning model, one example is the Auditory, Intellectually, Repetition (AIR) learning model. One model that is thought can motivate, encourage, and support the achievement of students' mathematical connection ability in learning is Auditory, Intellectually, Repetition (AIR). The AIR learning model is a learning model that emphasizes three aspects, namely auditory, intellectually, and repetition. First, auditory implies that in the learning process, the students use the five senses in terms of listening, giving opinion, and responding the results of discussion. Second, intellectually implies that the ability to think needs to be trained through the process of reasoning, creating, solving problem, building, and applying. Third, repetition implies that learning requires repetition to make the concepts taught are easily and deeply accepted and understood through questions, assignments, or quizzes (Latifah & Agoestanto, 2015).

In addition, there are several stages in the syntax of the AIR learning model that must be carried out so that the learning objectives can be achieved, including the delivering stage, the training stage, and the conveying results stage (Dave, 2002). At the delivering stage, the teacher provides contextual problems that stimulate the students to guess. While, in the training stage, the teacher directs and facilitates the students to engage in intellectual activities that are packaged in group discussion (3-4 students). Here, the students have the opportunity to express opinions, gather information, problems (auditory and intellectually). Then, at the delivering the results stage, the students are asked to conclude and list new knowledge obtained through work from the problem individually (repetition). Therefore, by using the AIR model, it is also expected that it can improve students' mathematical connection ability. Based on these descriptions, the researcher conducted a study entitled Students' Mathematical Connection Ability Reviewed from Learning Style on Auditory, Intellectually, Repetition (AIR) Learning Model.

Furthermore, this study aims to (1) comprehensively analyze the completeness achievement of the students, (2) to find out the improvement in mathematical connection ability with the AIR learning model, (3) to comprehensively analyze the students' mathematical connection ability with the AIR is better than DL learning model. , (4) to analyze the difference in the proportion of completeness on the students' mathematical connection with the AIR and DL learning model, (5) to describe students' mathematical connection ability with the AIR learning model based on learning style.

## 2. Methods

This research used quantitative method followed by descriptive. According to Creswell (2014: 626), "Quantitative research is an inquiry approach that is useful for describing trends and explaining the relationship among variables found in the literature". While, the research design used experimental design. According to Creswell (2014: 21), "Experimental designs (also called intervention studies or group comparison studies) are procedures in quantitative research in which the investigator determines whether an activity or materials make a difference in results for participants".

There are three types of experimental designs, namely Pre Experimental, True Experimental, and Quasi Experimental. This study used True Experimental in the form of a Pretest-Posttest Control Design.

The population used in this study was class 7 students of SMP Negeri 16 Semarang in the academic year 2019/2020. The population in this study was taken based on the following considerations (1) the students get the material based on the same curriculum, (2) the students who become the object of this study sit at the same class level, and (3) the placement of the students is not based on rank.

Sampling in this study was determined by simple random sampling technique, namely, the sampling technique that was carried out without paying attention to the existing strata in the population (Sugiyono, 2016: 118). The sample chosen from the 8 classes was class 7 G as the experimental class and class 7 F as the control class.

After determining the sample, the selection of the subject was carried out using purposive sampling technique. According to Sugiyono (2016: 124), purposive sampling is a technique of sampling data sources with certain considerations. The subjects selected for qualitative research were six people from the experimental class who had previously been given a learning style questionnaire instrument. Students were grouped based on the learning style category so that it was obtained by the categories of visual, auditory, and kinesthetic learning style. From each category of learning styles, two students were chosen by considering the students' mathematical connection ability. The students' mathematical connection ability can be seen from the scores obtained by each student at the posttest.

The mathematical connection ability test instrument consists of 4 items, each of which contains 1 mathematical connection indicator in this study. The stages as well as the indicators are (1) connecting between mathematical concept or principle in the same topic, (2) connecting among topics in mathematics, (3) connecting mathematics with other science, and (4) connecting mathematics with everyday life. The results of the test are then analyzed quantitatively starting with the normality and homogeneity test, then testing the hypothesis.

The hypotheses testing in this study is as follow: 1) the students' mathematical connection ability with the AIR model achieves learning completeness, 2) there is an improvement in the students' mathematical connection ability on AIR learning, 3) the students' mathematical connection ability with the AIR learning model is better than the students' mathematical connection ability with the DL learning model, and 4) The proportion of the completeness on the test results of the students 'mathematical connection ability on AIR learning model is higher than the proportion of the completeness on the test results of the students' mathematical connection ability on the DL model learning.

Interview is conducted on the research subject related to posttest and questionnaires that have been carried out, with the aim of determining students' mathematical connection ability based on learning style. The guideline of interview becomes a reference for questions that can be developed and adapted to the subject being interviewed.

Moreover, triangulation of sources and techniques is used to determine the validity on both data Furthermore, the students' mathematical connection ability is described based on the learning style on the AIR learning model.

## 3. Results & Discussions

### *3.1. Mathematical Connection Capability*

#### *3.1.1. Hypothesis Testing 1*

a. The Average of Achievement Test

The average score of posttest on the mathematical connection ability used a predetermined minimum completeness criteria (KKM), namely 70. To determine the average achievement, the right-hand t-test was conducted with $\mu_0 = 69{,}5$. From the results of calculation using Microsoft Excel, the value of $t_{count} = 9{,}53$ and $t_{table}$. Then $t_{count} \geq t_{table}$ so that $H_0$ is rejected and $H_1$ is accepted. Therefore, it means that the average of students' mathematical connection ability on AIR learning is more than the limit of KKM.

b. Classical Completeness Test

Classical completeness test is carried out to measure the students' mathematical connection ability that is reviewed from learning style on the AIR learning model which the can achieve classical learning completeness in accordance with the predetermined minimum completeness criteria (KKM). The predetermined classical minimum completeness criteria (KKM) is 75%. This completeness test used the one-sided proportion test (right) with $\pi_0 = 0{,}745$. From the results of calculation using Microsoft Excel obtained $z_{count} = 2{,}86$. With a significant level of 0.05, it was obtained $z_{table} = z_{0{,}5-\alpha} = 1{,}64$. Because $z_{count} = 2{,}86$ and $z_{table} = 1{,}64$. It was clearly that $z_{count} > z_{table}$ so that $H_0$ was rejected and $H_1$ was accepted. Therefore, it meant that the percentage of students' mathematical connection ability in the AIR learning model achieved the classical completeness.

#### *3.1.2. Hypothesis Testing 2*

Calculation was made using the Paired Sample T Test with the help of the SPSS software first with the criteria $H_0$ was accepted if the significance $> 0{,}05$ and vice versa. Based on the results of calculation, the value of $sig = 0{,}000 < 0{,}05$, which meant that $H_0$ was rejected and $H_1$ was accepted. Then, it meant that there were difference and improvement between the pretest and posttest scores of mathematical connection ability on the AIR learning model.

After the difference in average was known, a normalized gain test according to Hake (1998: 65) was conducted by the researcher. From the results of calculation, it was obtained $\langle g \rangle = 0{,}75$. The normalized Gain criterion of $0{,}75$ was in the interval $\langle g \rangle \geq 0{,}7$, which meant that the improvement in students' mathematical connection ability on AIR learning was in the high category.

#### *3.1.3. Hypothesis Testing 3*

In this hypothesis the difference test on the two average was carried out which aimed to determine whether the average of mathematical connection ability with the application of the AIR learning model was higher than the average of mathematical connection ability with the application of DL learning model.

The criteria of this test was to compare the value of $t_{count}$ with the value of $t_{table}$ with the probability value $(1 - a)$ and $a = 5\%$, and $dk = (n_1 + n_2 - 2)$. If the value of $t_{count} \geq t_{table}$ then $H_0$ was rejected. Based on the results of calculation, the value of $t_{count} = 1{,}906$ and $t_{table}$ with $dk = 32 + 32 - 2 = 62$ was $1{,}67$ so that $H_0$ was rejected. Therefore, the average of students' mathematical connection ability on the AIR learning model was more than the average of students' mathematical connection ability on the DL learning model..

*3.1.4. Hypothesis Testing 4*

In this hypothesis, a two-proportion difference test was carried out which aimed to determine whether the proportion of students who completed the mathematical connection ability with the AIR learning model was higher than the proportion of students who completed the mathematical connection ability with the DL learning model.

The criteria of this test was to compare the value of $z_{count}$ with the value of $z_{table}$ with the probability value $(0{,}5 - \alpha)$ and $\alpha = 5\%$. If the value of $z_{count} \geq z_{(0{,}5-\alpha)}$ then $H_0$ was rejected. Based on the results of the calculation, the $z_{count} = 1{,}715$ and $z_{table}$ with the probability $(0{,}5 - \alpha) = (0{,}5 - 0{,}05) = 0{,}45$ was 1,64 so that $H_0$ was rejected. So, the proportion of test results on students 'mathematical connection ability with the AIR learning model was more than the proportion of test results on students' mathematical connection ability with the DL learning model.

*3.2. The Learning Style Grouping*

The students were grouped based on the learning style category. This study used a questionnaire consisting of 30 questions which had to be chosen by the students according to their respective conditions. The questionnaire was given on September 16, 2019 to 32 experimental class students. The data obtained from filling out the learning style questionnaire were analyzed according to the learning style questionnaire assessment guideline. Based on the analysis results of filling out the learning style questionnaire in appendix 7b, there were 12 students with visual learning style, 8 students with auditory learning style, and 12 students with kinesthetic learning style.

The research subject in this study was the class 7 G students at SMP Negeri 16 Semarang who had visual, auditory, and kinesthetic learning style. Based on the analysis results of learning style questionnaire on 32 class 7 G students, then two students were selected as research subject who represented each learning style group to see the difference regarding the mathematical connection ability among the students with visual, auditory, and kinesthetic learning style. The research subject can be seen in Table 1. .

**Table 1.** Research Subject

| No | Kode | Learning Style |
|---|---|---|
| 1 | E-14 | Visual |
| 2 | E-22 | Visual |
| 3 | E-29 | Auditory |
| 4 | E-20 | Auditory |
| 5 | E-04 | Kinesthetic |
| 6 | E-12 | Kinesthetic |

*3.3. The Description of Students' Mathematical Connection Ability reviewed from Learning Style*

The analysis of the mathematical connection ability on AIR learning reviewed from learning style was carried out by analyzing the posttest results of mathematical connection ability and the results of interview. This section showed a discussion of students 'mathematical connection ability by comparing the posttest results of mathematical connection ability and the results of interview to obtain a description of students' mathematical connection ability based on learning style. The research subject was selected based on learning style, namely visual, auditory, and kinesthetic learning style.

*3.3.1. Students' Mathematical Connection Ability reviewed from Visual Learning Style*

The subjects with a visual learning style were able to meet the four existing mathematical connection ability indicators. When learning with the AIR model, the subjects with a visual learning style tended to sit, write as well as take notes on the worksheets. This is in line with Bire (2014: 171) who states that the students with visual learning style find it easier to learn their subject matter through seeing, looking at, or observing their learning object. The subjects with visual learning style also had a tendency to rarely ask the teacher for material that may not had been understood. This is in line with what Kusumawati (2018: 6) states that the students with visual learning style find it difficult to respond to friends in a discussion.

At the time of the interview, the subjects with a visual learning style only answered briefly. This is in accordance with Deporter & Hernacki (2015: 116) that one of the characteristics of the visual learning style is often answering questions briefly.

*3.3.2. Students' Mathematical Connection Ability reviewed from Auditory Learning Style*

The subjects with auditory learning style were able to meet the indicator (1), namely connecting between the topics in mathematics. In indicator (2), the subjects had a tendency to be less able to connect between mathematical concept or principle on the same topic. In indicator (3), the subjects were able to meet the indicators, namely connecting mathematics and other sciences. In indicator (4), the subjects could meet the indicators, namely connecting mathematics with everyday life. Based on these evidences, it can be concluded that the subjects with an auditory learning style were able to meet the three existing indicators of mathematical connection ability.

When learning with the AIR model, the subjects with an auditory learning style had a tendency to frequently ask questions about the material which had not been understood either to the teacher or to their partner on a group discussion. The subjects with auditory learning style were also able to explain well when presenting the results of discussion in front of the class. This is in line with Bire (2014: 172) that the students with an auditory learning style find it easier to digest, process, and convey information by listening directly. They tended to learn or receive information by listening orally. The students with auditory learning style had the strength in their ability to hear. At the time of the interview, the subjects with an auditory learning style seemed able to explain the completion process coherently. Moreover, the students tended to find it easier to explain the answers that had been written on the answer sheet. This is in accordance with Deporter & Hernacki (2015: 118) that one of the characteristics of the auditory learning style is like to talk, like to discuss, and explain things at length.

*3.3.3. Students' Mathematical Connection Ability reviewed from Kinesthetic Learning Style*

The subjects with a kinesthetic learning style were able to meet the indicator (1), namely connecting between the topics in mathematics. In indicator (2), the subjects were able to connect between mathematical concept or principle in the same topic. In indicator (3), the subjects had a tendency to be less able to meet the indicator, namely connecting mathematics and other sciences. In indicator (4), the subjects were able to meet the indicator, namely connecting mathematics with everyday life. Based on these evidences, it can be concluded that the subjects with a kinesthetic learning style were able to meet the three existing indicators of mathematical connection ability.

At the time of learning with the AIR model, the subjects with a kinesthetic learning style had a tendency when learning process was conducted that they cannot stay still. The students liked to walk around and were very active in class because they wanted to borrow stationery from their friends. This is in line with what Kusumawati (2018: 8) that the students with a kinesthetic learning style like to move and walk when learning mathematics. At the time of the interview, the subjects with a kinesthetic learning style seemed unable to stay still for a long time and gave explanations slowly. This is consistent with Deporter & Hernacki (2015: 118) that one of the characteristics of the kinesthetic learning style is speaking slowly and not being able to sit still for long periods of time.

## 4. Conclusion

Based on the results of research and discussion, the conclusions that can be drawn regarding the students' mathematical connection ability reviewed from students' learning style on AIR learning were as follow: (1) the students' mathematical connection ability on AIR learning reached the average achievement, (2) the students' mathematical connection ability on AIR learning achieved classical completeness, (3) the students' mathematical connection ability on AIR learning had experienced improvement with a gain index was 0.75 so that the improvement was included in the high category, (4) the average of mathematical connection ability of class 7 students on AIR learning was higher than the average of mathematical connection ability of class 7 students on DL learning, (5) the proportion of completeness on the test results of mathematical connection ability of class 7 students on AIR learning was higher than the proportion of the completeness on the test results of the mathematical connection ability of class 7 students on DL learning.

In addition, the description of the subjects' mathematical connection ability reviewed from learning style obtained the following results. (1) the subjects with a visual learning style had a tendency to be able to meet the indicator of connecting between topics in mathematics, able to meet the indicator of connecting between mathematical concept or principle on the same topic, able to meet indicator of connecting mathematics and other sciences, and able to meet indicator of connecting mathematics with everyday life. From the four mathematical connection indicators, the subjects with a visual learning style were able to meet all four indicators. (2) the subjects with auditory learning style had a tendency to be able to meet indicator of connecting between topics in mathematics, were less able to meet indicator of connecting mathematical concept or principle on the same topic, able to meet indicator of connecting mathematics and other sciences, and able to meet indicators of connecting mathematics with everyday life. From the four indicators of mathematical connection, the subjects with an auditory learning style were able to meet the three indicators. (3) The subjects with a kinesthetic learning style had a tendency to be able to meet indicator of connecting between topics in mathematics, able to fulfill indicator of connecting mathematical concept or principle on the same topic, less able to meet indicator of connecting mathematics and other sciences, and able to meet indicator of linking mathematics with everyday life. From the four mathematical connection indicators, the subjects with a kinesthetic learning style were able to meet the three indicators.

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