How Are High IQ Students Thinking in Making Mathematical Connections in Solving Mathematics Problem?: A Case of Gender Difference

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Abstract: The study aims to describe male and female high IQ students thinking of making mathematical connections. The qualitative-explorative research was conducted with two students of 12th grade who have high IQ. There were male and female students. The data was collected through interviews and analyzed by data reduction, data display, and conclusion drawing/verification. The results of this research are that a male high IQ student did processing of thinking consist of some steps. First, he accepted information by reading mathematical problems, doing attention and rehearsal, then recall and recognition some information on mathematical concepts. He manipulated the information by making the connection between mathematical concepts and principles in solving the mathematical problem. He created six different ways to find the solution. The six ways were Pythagoras Theorem (first way), tangent rules, sinus rules, Pythagoras Theorem (second way), wide triangle, and scale. A female high IQ student actually made connections relatively similar to the male student. She could use similar steps but she created five different ways to find the solutions. The five ways were sinus rules, Pythagoras Theorem, tangent rules, triangular area, and scale. The male and female students are also different in recalling information at the time-solving problems using Pythagoras Theorem and triangular area.

1 INTRODUCTION

The mathematical connections can be interpreted as the connections between mathematical concepts, principals, topics; the relation between mathematics and other disciplines, and the link between mathematics and real-life context problems (NCTM, 1989; Goos, Gloria, Colleen, 2007; NCTM, 2000). The mathematical connections is the implication of mathematics as a single unity. Thus, in order for the students to be successful to learn mathematics, they have to be given opportunities to see the connection, either between mathematical concepts principles, concepts, and branches. The mathematical connections is one of the skilled processes in mathematical learning. Kemendikbud (2014) explains the importance of mathematical connections in mathematical learning which is included in the 2013 Curriculum.

In order to create a mathematical connection, it needs a process of thinking. Thinking is a process which produces mental representation through the transformation of information to help in formulating and solving a problem as well as taking a decision (Ruggiero, 1984; Solso, 2001). One of the widely used thinking theories is Information Processing Model. According to this theory, the processing of information in memory is including the process of encoding, storage, and retrieval. Encoding is the process of inserting information to the memory, storage is the retention of information from time to time, and retrieval is recalling information for the memory (Santrock, 2010; Slavin, 2011). The differences of student's individual which is commonly becoming the research focus on the education discipline are intelligence and gender. Intelligence is the skill to act with aims, solve the problems, think rationally, adapt to the environment, and learn from daily life (Santrock, 2010; Stemberg, 2008; Winkel, 2009). Intelligence Quotient (IQ) is a score received from an intelligence test tool which describes the level of someone's intelligence. A student is said to have high IQ if he/she is on the superior or very superior level. Meanwhile, gender is

a trait attached to the male or female which is influenced by the conditions of social and cultural. The male individual has masculine traits while the female individual has feminine traits (WHO, 2015; Showelter, 1989) The gender difference has a high influence on the differences in the students' thinking process of creating mathematical connections.

The research result (Deary, Strand, Smith, and Femandes, 2007) stated that there is a significant positive correlation between IQ and students' learning achievements. (Zhu 2007)reported that there are differences of abilities between male and female in solving mathematical problems which are located on the abilities of spatial, verbal, and quantitative. Sugiman and Ruspiani (Sugiman, 2010; Ruspiani, 2000) respectively reported their research about the low ability of mathematical connection among junior and senior high school students which will imply on the low students' ability to solve mathematical problems and their result. The research (Sugiman, 2010; Ruspiani, 2000) had not describe the students' thinking process in making the mathematical connection. Thus, it needs further research to get the description about students' thinking process of creating mathematical connections. In order for classical learning to be successful, the individual differences also need attention. So, this research will relate to mathematical connections, IQ, and gender. The goal of this research is to describe the thinking process of high IQ male and female students in making the mathematical connections. The type of this research is explorative with a qualitative approach. The subject is focused on high IQ students because they have the potential to make a good mathematical connection..

2 METHOD

This research uses an explorative type of research with the qualitative approach. The subjects of this research are two students of 12th grade in state senior high school 1 Banjarmasin which consists of 1 high IQ female and 1 male student. Both subjects have relatively the same IQ level and mathematical ability. The students' IQ is measured by a psychologist. Meanwhile, their mathematical ability is measured using tests and based on their report score. In this research, both subjects IQ are the same, which is 123 (superior).

The instruments which are used in this research consists of the researcher as the main instrument, student worksheet, and interview guidance. The

analytical procedure (Miles & Huberman, 1994) model that includes data reduction, data display, and conclusion drawing/verification. The result data of this research will be explained according to the Information Processing Theory. This is the following student worksheet.

Joshua is a member of the Basketball Team of senior high school 1 Banjarmasin. One day after training, he stands on a school park corner while seeing to the flag attached to the flagpole on the school field. It was known that the distance between his toe and eyes is 170 cm. On his standing position, he saw the peak of the flagpole and formed on the elevation angle of 15o. Later, he walked straight to the flagpole for 29,5 m and saw the peak of the flagpole with the elevation angle of 45o. Determine the height of the flagpole!.

3 RESULT AND DISCUSSION

3.1 Thinking Process of High IQ Female Student

The following thinking process of high IQ female student in making the mathematical connections.

a. Female student (FS) received the information by reading the mathematical problem repeatedly (rehearsal), doing attention, trying to recognize the mathematical concepts and principles on the problem, and continued by processing information through representing her idea in form of a sketch to make it easier in understanding the problem.

b. After she understood the problems, FS make a plan and does it through recognizing and using the relation between mathematical concepts and principles, as well as using a certain calculating operation. FS sets five solving plans and then implements it. The five sets respectively are sinus rules, Pythagoras Theorem, tangent rules, triangular area, and scale.

c. FS rechecked her works by matching information on the mathematical problems with her answers. FS processes information through recognizing equivalent representation from the same concept so she concluded that the mathematical problems can be solved through three approaches: geometry, trigonometry, and algebra.

d. FS recalled information through recall and recognition. The recall is happened when

remembering, ever experienced the similar problem but more simple and can be solved only in one way. Meanwhile, recognition happens when remembering mathematical concepts and principals related to the problem-solving. FS was able to recall mathematical materials from elementary school, junior high school, and high school which was she learned. The concepts of triangular area and Pythagoras Theorem were recognized by FS since learning mathematics in elementary school.

3.2 Thinking Process of High IQ Male Student

The following thinking process of high IQ male student in making a mathematical connections.

a. Male student (MS) received the information by reading the mathematical problem repeatedly (rehearsal), doing attention, trying to recognize the mathematical concepts and principles on the problem, and continued by processing information through representing her idea in form of a sketch to make it easier in understanding the problem.

b. After he understood the problems, MS made a plan and does it through recognizing and using the relation between mathematical concepts and principles, as well as using a certain calculating operation. FS sets 6 solving plans and then implements it. The six sets respectively are Pythagoras Theorem (first and second way), tangent rules, sinus rules, triangular area, and scale. For the solving using Pythagoras Theorem, MS did it using two distinct ways. The solving using Pythagoras Theorem (first way), tangent rules, sinus rules, triangular area, and scale, is the same idea which is used by FS. However, the second way of Pythagoras Theorem is a different idea.

c. MS recheck his work by matching the information on the mathematical problems using the answer he got. MS processed the information by recognizing the equivalent representation from the same concept so it can be concluded that mathematical problem can be solved using three approached: algebra, geometry, and trigonometry.

d. FS recalled information through recall and recognition. The recall is happened when remembering, ever experienced the similar problem but more simple and can be solved only in two ways. Meanwhile, recognition happens when remembering mathematical concepts and

principals related to the problem-solving. FS was able to recall mathematical materials from junior high school and high school which he learned. MS was able to recall the junior high school and senior high school materials.

MS and FS had solved mathematical problems using various ways. It shows that they were able to create mathematical connections using many mathematical concepts and principles. This is supported by Hodgson (1995) who stated that mathematical connections as a tool to solve mathematical problems. It means that when a student can make more mathematical problems, it will be easier for him/her to solve the problems and the ways he/she solves the problems will be more varies. This is also supported by Winkel (Suhaman, 2005) who stated that high IQ students have chances that materials management will be deeper so it can improve memory achievement which is very needed when a student solves mathematical problems.

The thinking process of MS and FS as a whole is relatively the same, either when receiving, processing, and recalling information. This can happen because both students have high IQ. It is in line with Suharnan [20] who stated that there are 4 abilities which are had by high IQ students, those are a short memory, general knowledge, reasoning and problem solving, and adaptiveness.

Despite the relatively the same thinking process, but there are a few differences in terms of the numbers of solving ways and the recalled mathematical materials when solving a problem. The solving problems by MS are the same idea as 5 solving ways created by FS. However, when MS used Pythagoras Theorem, MS can develop it with first and second way. Another difference is when FS can recall materials she learned in elementary, junior high, and senior high school. Meanwhile, MS can only recall the materials he learned in junior high and senior high school. This difference can happen because according to Jensen (2008) the factors that can influence a certain ability between male and female student are the development of psychologic, physical, and brain. This is also explained by Slavin [8] that by processing information is highly influenced by the mind, past experiences, previous knowledge, and motivation.

4 CONCLUSIONS

Base on result and discussion above it can be concluded that the thinking process of high IQ male

and female student as a whole is relatively the same, either when receiving, processing, and recalling information. However, high IQ male student can solve mathematical problems using six different ways, while high IQ female student can solve it using five ways only. This can happen because high IQ male student can develop mathematical connections on the implementation of the Pythagoras Theorem. The male and female students are also different in recalling information at the time-solving problems using Pythagoras Theorem and triangular area. The implication of this research is on the students' classical learning need to be taught to recognize and use the connection between mathematical concepts and principals with paying attention to their thinking process. Thus, the problems faced by the students in learning mathematics can be known to be given help to the individual.

REFERENCES

Moore, R., Lopes, J., 1999. Paper templates. In *TEMPLATE'06, 1st International Conference on Template Production*. SCITEPRESS.

Smith, J., 1998. *The book*, The publishing company. London, 2nd edition.

APPENDIX

Deary, I.J., Strand, S., Smith, P., & Fernandes, C. 2007. Intelligence and Educational Achievement. ScienceDirect, Intelligence 35.13-21, (www. sciencedirect.com).

Goos, M., Gloria, S., & Colleen, V. 2007. Teaching Secondary School Mathematics, Research and Practice for the 21st Century. Australia: Allen & Unwin.

Hodgson, T. R. 1995. "Connections as Problem-Solving Tools", in year-book P.A. House (1995), Connecting Mathematics across the Curriculum. Virginia: The National Council of Teachers of Mathematics, Inc.

Jensen, E. 2008. Brain-Based Learning: Pembelajaran Berbasis Kemampuan Otak, Cara Baru dalam Pengajaran dan Pelatihan. Yogyakarta: Pustaka Pelajar.

Kemendikbud. 2014. Peraturan Menteri Pendidikan dan Kebudyaan No. 59 Tahun 2014. Tentang Kurikulum 2013 Sekolah Menengah Atas/Madrasah Aliyah. Jakarta: Kemendikbud.

Miles, M. B., & Huberman, A. M.1994. Qualitative Data Analysis. Second Edition. SAGE Publications. International Educational and Professional Publisher.

NCTM. 1989. Curriculum and Evaluation Standards for School Mathematics. Reston, VA: Arthur.

NCTM. 2000. Principles and Standards for School Mathematics. Reston, VA: Arthur.

Ruggiero, V. R. 1984. The Art of Thinking. A Guide to Critical and Creative Thought. New York: Longman, An Imprint of Addison Wesley Longman, Inc.

Ruspiani. 2000. Kemampuan Siswa dalam Melakukan Koneksi Matematika. Unpublished Thesis. Bandung: Pendidikan Indonesia University.

Santrock, J.W. 2010. Psikologi Pendidikan. Edisi Kedua. Penerjemah Tri Wibowo, B.S. Jakarta: Kencana.

Showalter, E. 1989. Speaking of Gender. New York & London: Routledge.

Slavin, R.E. 2011. Psikologi Pendidikan, Teori dan Praktik. Edisi Kesembilan. Penerjemah Marianto Samosir. Jakarta: PT. Indeks.

Solso, R.L. 2001. Cognitive Psychology. Sixth Edition. Boston: Allyn and Bacon, Inc.

Sternberg, R. J. 2008. Psikologi Kognitif. Edisi Keempat. Terjemahan dalam Bahasa Indonesia (Penerjemah: Yudi Santoso). Yogyakarta: Pustaka Pelajar.

Sugiman. 2010. Koneksi Matematika dalam Pembelajaran Matematika di Sekolah Menengah Pertama. Artikel. Jurusan Pendidikan Matematika, Universitas Negeri Yogyakarta. Diperoleh dari http: //www. staff.uny.ac.id/sites/default/ files/ 131930135/ 2008_Koneksi_Mat.pdf.

Suharnan. 2005. Psikologi Kognitif. Surabaya: Srikandi.

WHO. 2015. What is gender. Diperoleh dari http: //www.who.int/gender/whatis-gender/en/. Diakses pada tanggal 5 November 2015.

Winkel, W. S. 2009. Psikologi Pengajaran.Yoyakarta: Media Abadi.

Zhu, Z. 2007. Gender differences in mathematical problem solving patterns: A review of literature. International education Journal. 8(2), 187-203. ISSN 1443-1475, (http: //iej.com.au).