Self-regulated learning: Intelligence quotient and mathematical disposition

J Sutrisno AB
STKIP-PGRI Bandar Lampung, Indonesia
joko_sutrisnoab@yahoo.com

Abstract. Self-regulated learning is very important in efforts to improve mathematics learning outcomes. For that, the factors that influence it need to get attention in learning mathematics. These factors include intelligence and mathematical disposition. The purpose of this study is to analyze the direct effect of intelligence quotient and mathematical disposition towards self-regulated learning in state junior high school students in Bandar Lampung City. The research uses survey methods with path analysis techniques. Intelligence quotient (X₁) and mathematical disposition (X₂) as exogenous variables, self-regulated learning (X₃) as an endogenous variable. The results show 1) there is a positive direct effect of intelligence quotient towards self-regulated learning; 2) there is a positive direct effect of mathematical disposition towards self-regulated learning.

1. Introduction

Learning outcomes of mathematics have not been as expected. this can be caused by learning not yet fully student-centered. Learning does not pay attention to the characteristics that exist in students. Many factors need to be considered in implementing learning. Whatever strategy the teacher uses in learning, it will be difficult to achieve optimal results if the teacher does not pay attention to how the child learns. The characteristics of students with regard to how learning is self-regulated learning. Self-regulated learning does not stand alone but is influenced by various factors such as intelligence, motivation, and students' attitudes towards mathematics. Learning mathematics should be able to increase the positive attitude towards mathematics. With intelligence and positive attitude towards mathematics, self-regulated learning will increase, and learning outcomes can be as expected.

Self-regulated learning in students is not as expected. This condition can be easily identified because mathematics learning is not yet entirely student-centered. Learning still tends to be teacher-centered. Learning has not fully taught children to learn. Students still learn if they get a learning assignment from their teacher, and there are still students who study if they will face an exam or test.

Self-regulated learning needs to be the attention of teachers in learning activities because self-regulated learning deals with how to learn, which is an internal factor of students who play a role and influence the activities and outcomes of learning. Self-regulated learning emphasizes the importance of personal responsibility and controls the knowledge and skills acquired. Organizing yourself in learning also brings students to become experts or master what they learn. Self-regulated learning underlines the importance of autonomy and personal responsibility in learning activities. In the learning process, students who have self-regulated learning can build learning goals, try to monitor, regulate, and control their cognition, motivation, and behavior to manage the goals that have been made [1].

Students who have high self-regulated learning will try to learn better. Trying to organize learning effectively, save time, monitor, evaluate, and try to complete tasks as well as possible, and try to get a
high score or score. Therefore, students must be involved in several activities to become genuinely active learners in learning [2].

Self-regulated learning is an active process carried out by students, where students set goals for their learning and then try to monitor, regulate, and control cognition, motivation, and attitudes, and make clues and direction of goals to be achieved [3]. This opinion is reinforced by [4], which explains that self-regulated learning is an efficient and constructive process where students set their own learning goals and try to regulate their cognition, motivation, and behavior. Self-regulated learning is a learning process that occurs because of the influence of thoughts, feelings, strategies, and behavior are oriented towards achieving goals. The goals are cognitive and affective aspects. The quality of self-regulated learning affects the ability to think because self-regulated learning begins with the awareness to be independent in learning. Self-regulated learning leads to a change in behavior for learning on an ongoing basis, which will also affect reasoning abilities due to the addition of the treasury of knowledge. With self-regulated learning, cognitive and affective aspects will always develop, which in turn can be utilized in problem-solving and achieving expected learning goals.

Munandar, formulated self-regulated learning indicators as follows: having intrinsic learning initiative and motivation; view difficulties as challenges; utilize and search for relevant sources; choose, implement learning strategies; set learning goals/targets; monitor, regulate, and control learning; evaluating learning processes and results; and show self-efficacy/self-concept/self-ability in learning [5]. From the description above, if summarized and sorted according to the learning hierarchy, then the indicator of someone having self-regulated learning has indicators: a) having initiative and intrinsic motivation in learning mathematics, b) analyzing mathematics learning tasks and needs, c) set targets for learning mathematics, d) view mathematics learning difficulties as challenges, and e) have self-efficacy/self-confidence and self-control.

In learning mathematics, students face tasks as a problem that needs to be solved. To solve the problem, they must have the ability to think and the reason. By thinking of using mathematical concepts, principles, and operations that have been studied, students learn to find, solve problems. In determining mathematics, children are used to solving problems using their thinking skills that can be developed through mathematical learning activities. The ability to think or reason and problem-solving skills as competencies to be achieved can develop through learning activities with good self-regulated learning. Self-regulated learning is a learning process that occurs because the influence of thoughts, feelings, strategies, and behavior that is oriented towards achieving goals, has a close relationship with the intelligence quotient level that students have. The expressions of the mind, ways of speaking, how to ask questions, problem-solving skills, and so on reflect a person's intelligence. Humans who know can maintain and improve the quality of life from time to time increasingly complex, through the process of thinking and learning continuously [6].

Intelligence is a general ability that includes various types of mental skills such as abstract thinking, mechanical, mathematical, remembering, understanding, language, and so on to make adjustments to a situation or problem [7]. In addition, intelligence includes many mental abilities, such as the ability to plan, solve problems, think abstractly, understand ideas and languages, and learn [8]. Intelligence can also be interpreted as an ability that allows someone to do something in a certain way that was brought from birth [9].

The term intelligence can be interpreted in two ways, namely, in the broad sense of information as an ability in which the ability to think plays a role in achieving the expected achievements in various fields of life. In a narrow sense, intelligence can be interpreted as intellectual ability or academic ability as the ability to achieve results in schools in which thinking holds a central role [10]. But intelligence is not the only determinant of academic achievement. As stated by [11], that intelligence is not the only determinant of academic achievement. Motivation and high involvement in learning have consistently increased student success.

Based on some limitations about intelligence above, it can be explained that intelligence is the ability that a person has to solve problems in his life, as the ability to achieve academic achievement in school. Intelligence plays a role as the ability to think, the ability to capture various relationships, and the ability
to learn, as well as the ability to adjust to new situations. In learning, intelligence as an intellectual ability needs attention because it can be seen as a factor that supports learning success. Mentioned in the International Journal of Information and Education Technology, that mental ability is a strong predictor of academic achievement [12].

The existence of several factors that influence a person's intelligence showing one's intelligence or intelligence quotient, is abbreviated as IQ varies. Intelligence quotient is a general term of intellectual intelligence that can be used to explain thinking skills that include the ability to reason, plan, think abstract, understand ideas, solve problems, learn, use language, and other abilities. Intelligence is also often referred to as a person's cognitive abilities. Intelligence can be measured through IQ tests using instruments as psychometric tools. It is said that IQ is a number score based on the results of a standard test that measures one's intelligence [13].

Another factor that needs to be considered in developing self-regulated learning through mathematical learning is mathematical disposition. Disposition as a character brings a person to a particular experience and to make individual choices. Dispositions are guided by self-confidence and attitudes related to values — mathematical disposition as an attitude, judgment, interest in mathematics. Mathematical disposition means the tendency to think and act in a positive way of learning mathematics. This tendency is reflected in students' interests and beliefs in learning mathematics, willingness to reflect on their own thoughts when learning mathematics and diligently, and trying to explore mathematical problems in solving.

Mathematical disposition is one of several factors that influence students in learning mathematics. Mathematical disposition is a component of the affective domain in mathematics learning. Mathematical disposition can be interpreted as self-confidence and a positive attitude towards values in mathematics. Mathematical disposition has a big impact on one's success in learning mathematics.

Disposition, as a character, brings a person to make certain choices and experiences [14]. Dispositions are guided by self-confidence and attitudes related to values. Mathematical disposition refers to beliefs or tendencies that show behavior, consciously, and voluntarily to learn mathematics [15].

In mathematics learning, students' attitudes toward mathematics need attention. Students will find it challenging to get excellent achievements in learning mathematics if their beliefs or dispositions towards mathematics are not reasonable because there is a relationship between attitudes or dispositions towards mathematics with the results or learning achievement of mathematics. This opinion is reinforced by the results of research that there is a relationship between attitudes towards mathematics and mathematics learning achievement [11].

Mathematical disposition as an attitude towards mathematics is a tendency to think and act positively. This tendency can be said as the interest and confidence of students in doing and working in learning mathematics. Mathematical disposition can also be explained as a willingness to explore and diligently solve mathematical problems diligently, and willingness to reflect on the results of his thinking in learning mathematics.

The National Research Council (NRC) states that students who have a "productive disposition" towards mathematics mean that students have a tendency, the habit of seeing mathematics as rational or reasonable, useful, valuable, adds benefits, perseverance, and self-confidence [16]. Mathematical disposition needs to be developed through mathematics learning. The development of mathematical dispositions means developing characters in mathematics. Character development in mathematics aims to enable students to appreciate mathematics as useful in life, indicated by interest, curiosity, attention in learning mathematics, perseverance, and confidence in solving problems [17].

Mathematical disposition is the interest and appreciation of mathematics is the tendency to think and act positively, confidently, curious, enthusiastic, diligent, persistent in learning, flexible, willing to share with others, and reflective in mathematical activities [18].

One way to arouse student interest and help them gain confidence in learning mathematics is through developing mathematical concepts from real-life experiences of students, as well as from an idea that has been mastered. Students will be interested in learning mathematics if it offers fun learning.
From the various opinions above, it can be concluded that mathematical disposition is an attitude towards mathematics which is a tendency to think and act positively towards mathematics as indicated by a) confidence in learning mathematics, b) flexible, trying to find alternatives in solving mathematical problems, c) interest, curiosity, perseverance, diligence in doing mathematical assignments, d) passionate, monitor, reflect on appearance and reasoning, and severe attention in learning mathematics, e) apply mathematics to other situations, f) appreciate mathematical roles, expect and metacognition, and g) sharing opinions with others.

The author considers it necessary to conduct research regarding factors that influence self-regulated learning. This is because research that discusses the factors that influence self-regulated learning in mathematics learning has not yet been encountered. The research that is encountered is generally concerned with learning strategies and their effects on objects learned in mathematics. It is hoped that this research can provide input on the importance of self-regulated learning, intelligence, and mathematical disposition in an effort to improve mathematics learning outcomes. Whatever strategy is chosen in implementing learning, it is hoped that it can improve intelligence, mathematical disposition, and self-regulated learning, so that the learning objectives of mathematics can be achieved.

2. Research Methods

The research method used is a survey method with path analysis techniques. Intelligence quotient (X_1) and mathematical disposition (X_2) as exogenous variables and self-regulated learning (X_3) as endogenous variables.

The population in this study was the eighth-grade students of the State Junior High School in Bandar Lampung City. The sample was determined by a multistage random sampling technique, which in this study, sampling took into account the rank and location of the school, obtained 355 students from 11 schools.

Data from all variables in this study are quantitative data with interval types. Intelligence quotient data were collected using the testing technique. The intelligence quotient test was carried out by a psychologist. While self-regulated learning data and mathematical disposition were collected using a questionnaire. In this research, all instruments have been tested for validity and reliability, and the standardization process used First Order Confirmatory Factor Analysis (CFA).

Based on the path diagram of the correlation between research variables, it can be seen that X_1 and X_2 affect X_3. Path coefficient (p_ij) analysis of the direct effect of X_1 and X_2 on X_3 follows the structure formed by the research constellation, estimated in the regression coefficient or beta coefficient (β_ij).

Testing the research hypothesis with the help of Lisrel software through the interpretation of the output t-value. Before testing hypotheses, testing the analysis requirements first, which includes the normality test, linearity test, and the significance of simple regression between the two variables.

3. Results and Discussion

Intelligence Quotient (IQ) is a score obtained through IQ tests. IQ data has the highest score of 136 and the lowest of 64. The average is 103.21, with a standard deviation of 12.52. The average student IQ score of 103.21 lies in the normal intelligence interval (80-120). It can be said that the average intelligence of state junior high school students in Bandar Lampung City is in the normal category.

Mathematical disposition is a score obtained through a questionnaire. This data has the highest score of 160 and the lowest 91. The average is 121.79, with a standard deviation of 13.96. The average score of 121.79 lies in intervals 118 - 126. Thus there are 72 or 20.28% of students who are included in the average range, 15 students or 4.23% have superior intelligence ( > 120 ), and 2 students or 0.56% in the genius intelligence category ( > 130 ). Judging from the average IQ score of 103.21 lies in the normal intelligence interval (80-120). It can be said that the average intelligence of state junior high school students in Bandar Lampung City is in the normal category.
average group, 146 or 41.13% of students who are in the group below the average, and 137 or 38.59% of students are in the group above the average.

Self-regulated learning is a score obtained through a questionnaire. This data has the highest score of 135 and the lowest 72. The average is 105.81, with a standard deviation of 12.03. The average score of 105.81 lies in intervals 104 - 111. Thus there are 79 or 22.25% of students included in the average group, 157 or 44.23% of students who are in the group below the average, and 119 or 33.52% of students in the group above the average.

With the help of Lisrel software, the path coefficients obtained from the structure model are shown in the following figure.

![Figure 1. Structure Model Path Coefficient](image)

The path coefficient analysis model of the above structural model is expressed in the equation \( X_3 = p_{31}X_1 + p_{32}X_2 + \epsilon_3 \). From the calculation obtained the equation \( X_3 = 0.15X_1 + 0.79X_2 + 0.18 \). The results of the complete hypothesis testing are explained through the paths of the influence of \( X_1 \) and \( X_2 \) on \( X_3 \) as follows.

- Based on the results of the path coefficient calculation obtained \( p_{31} = 0.15 \) with \( t_{value} = 4.63 \). At a significant level of 5% or \( \alpha = 0.05 \) it is known that \( t_{table} = 1.96 \). Because \( t_{value} > t_{table} \), then \( H_0 \) is rejected, which means intelligence quotient or \( (X_1) \) has a positive direct effect on self-regulated learning \( (X_3) \).
- Based on the results of the path coefficient calculation obtained \( p_{32} = 0.79 \) with \( t_{value} = 24.38 \). At a significant level of 5% or \( \alpha = 0.05 \) it is known that \( t_{table} = 1.96 \). Because \( t_{value} > t_{table} \), then \( H_0 \) is rejected, which means mathematical disposition \( (X_2) \) has a positive direct effect on self-regulated learning \( (X_3) \).

From the results of the analysis, it is known that the intelligence quotient \( (X_1) \) has an indirect effect on self-regulated learning \( (X_3) \) through mathematical disposition \( (X_2) \). The coefficient of the indirect effect of the intelligence quotient towards self-regulated learning through mathematical disposition is 0.57.

3.1 The Effects of Intelligence Quotient towards Self-Regulated learning

The results showed that the intelligence quotient had a positive direct effect on self-regulated learning. Thus the high and low self-regulated learning can be explained by the intelligence quotient. The coefficient of the direct effect of the intelligence quotient towards self-regulated learning is 0.15.

Students with good intelligence will be able to evaluate themselves positively about the learning experience that is experienced, both to the mastery of teaching material or the benefits of what they learn. Students feel they have confidence in their abilities. Confidence in the ability to learn mathematics and the belief in his ability, that is to manage his way of learning independently, causes his self-regulated learning to increase as well. It is influenced by his ability to give a positive response to learning
mathematics. This ability to respond is called intelligence. This statement is reinforced by Thorndike, who said that intelligence is the ability to provide a good response from the view of truth or fact [19].

The influence of intelligence quotient towards self-regulated learning is caused by students being able to manage their learning independently. Students who have high intelligence will easily receive learning material, which allows them to provide confidence in their ability to learn. Intelligence also leads to doing or choosing how to learn. Students who have high intelligence have the ability to explore the teaching material they face, making them more confident in learning. Students who lack intelligence will often face difficulties in learning mathematics. Frequently facing these difficulties makes children less interested in learning mathematics, lazy to explore or study independently. The illustration above shows that the better one's intelligence will be, the better the independence of learning will be. This is because self-regulated learning is a way of learning, which is a person's ability to manage their learning independently. Having good intelligence, children will always try to think about how to learn because they are aware of their quality of life. This description is reinforced by the statement that humans with intelligence can maintain and improve the quality of life from time to time increasingly complex, through the process of thinking and learning continuously [6].

3.2 The Effects of Mathematical Disposition towards Self-Regulated Learning

The great contribution of mathematical disposition or the effect of mathematical disposition towards self-regulated learning, because mathematical disposition is a positive attitude and appreciation of mathematics. Mathematical disposition is a tendency to think and act positively in mathematics. This tendency is reflected in students' interests and beliefs in doing mathematics, willingness to explore and diligent in learning mathematics, and willingness to reflect on their thoughts when they study mathematics.

Self-regulated learning is the attitude and way of learning students in managing their learning activities independently. Students who have self-regulated learning mathematics then have the initiative and intrinsic motivation in learning mathematics. He can analyze tasks and learning needs and has learning targets in mathematics. In addition, he has confidence and views the difficulty of learning mathematics as a challenge. This was reinforced by Munandar's explanation which formulated the self-regulated learning indicator as follows: having intrinsic learning initiative and motivation; view difficulties as challenges; utilize and search for relevant sources; choose, implement learning strategies; set learning goals/targets; monitor, regulate, and control learning; evaluating learning processes and results; and show self-efficacy/self-concept/self-ability in learning [5].

The better the mathematical disposition of students, the more likely they are to think and act in mathematics—the higher their initiative and motivation to learn. Learning will be better because he has needs and targets in learning mathematics. This activity will produce a positive attitude and appreciation of mathematics. A positive attitude towards mathematics arises because he knows how important and the benefits of learning mathematics. This approach will make students active in learning and have the confidence to learn mathematics independently. Without increasing intrinsic attitude and motivation in learning mathematics and generating love and appreciation for mathematics, it will be challenging to create student self-regulated learning. The meaning of gaining independence reinforces it, that self-regulated learning is a constructive, effective, and efficient process, with students drawing up their learning plans and goals and trying to regulate their individual cognitive, affective aspects [4]. It can be said that by cultivating a right attitude or pleasant disposition towards mathematics it will instill intrinsic motivation to learn mathematics as part of students' self-regulated learning.

It is this character development that will create or produce a good disposition towards mathematics. Mathematical disposition needs to be developed through mathematics learning. This statement was reinforced by Titin SuryatiSukmaDewi, that the development of mathematical dispositions meant developing characters in mathematics. Character development in mathematics aims to enable students to appreciate the usefulness of mathematics in life, indicated by curiosity, attention, and interest in learning mathematics, as well as perseverance and confidence in solving problems [17].
4. Conclusion

Based on the results of the research on State Junior High School students in Bandar Lampung City and the discussion above, it can be concluded that: 1) there is a positive direct effect of intelligence quotient towards self-regulated learning, 2) there is a positive direct effect of mathematical disposition towards self-regulated learning. In addition to the direct effect, it is also known that intelligence quotient has an indirect effect on self-regulated learning through mathematical disposition.

The results of this study have implications if the teacher wants to develop students’ self-regulated learning in mathematics, then the learning carried out by the teacher should be able to teach students to learn. For this reason, in mathematics learning, the teacher should pay attention to the characteristics of students, such as their intelligence, and try to develop positive attitudes or dispositions towards mathematics.

References

[1] Valle, A et al 2008 Psicothema 2 724
[2] Ormrod J E 2009 Psikologi Pendidikan Membantu Siswa Tumbuh dan Berkembang (Jakarta: Erlangga) p 38
[3] Schunk D H 2005 Educ. Psychol. 40 84
[4] Yildizli H and Ahmed S 2016 Cogent Educ. 3 2
[5] Sumarmo U 2014 Pengembangan Hard Skill dan Soft Skill Matematik bagi Guru dan Siswa untuk Mendukung Implementasi Kurikulum 2013 Proc. Seminar Nasional Pendidikan Matematika Program Pascasarjana STKIP Siliwangi Bandung p 10
[6] Irvaniyah, I and Akbar R O 2014 EduMa 39 139
[7] Dalyono M 2005 Psikologi Pendidikan. (Jakarta: Rineka Cipta) p 124
[8] Legg S and Hutter M 2007 Front. Artif. Intell. Appl. 157 4
[9] Purwanto N M 2004 Psikologi Pendidikan (Bandung: Rosdakarya) p 52
[10] Winkel W S 2004 Psikologi Pengajaran (Yogyakarta: Media Abadi) p 156
[11] Moenikia M and Babelan A Z 2010 Procedia Soc. Behav. Sci. 2 1538
[12] Veas A, Gilar R and Minano P 2016 Int. J. Inf. Educ. Technol. 6 594
[13] Azari S et al 2013 Eur. J. Child Dev. Educ. Psychopathol. 1 62
[14] Damon W 2005 Fwd Arresting Insights Educ. Stanford Univ. 2 2
[15] Atallah F, Bryant S L and Dada R 2010 Res. High. Educ. J. 1 1
[16] Feldhaus C A 2012 How Mathematical Disposition and Intellectual Development Influence Teacher Candidates’ Mathematical Knowledge for Teaching in a Mathematics Course for Elementary School Teachers Dissertation The Faculty of The Patton College of Education of Ohio University p 21
[17] Dewi T S S 2014 J. Mat. Integr. 10 130
[18] Wardani S 2008 Pembelajaran Inkuiri Model Silver untuk Mengembangkan Kreativitas dan Kemampuan Pemecahan Masalah Matematik Siswa Sekolah Menengah Atas Dissertation Universitas Pendidikan Indonesia p 40
[19] Azwar S 2015 Pengantar Psikologi Inteligensi (Yogyakarta: Pustaka Pelajar) p 6