# IMPROVING STUDENT'S SELF-REGULATED LEARNING IN MATHEMATICS USING GARDNER'S MULTIPLE INTELLIGENCES TEACHING AND LEARNING

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## Abstract

During this time, the assessment of teachers put more emphasis on the cognitive aspects or competence of students' knowledge. Affective competence of students such as student's self-regulated learning received less attention. Besides, student's self-regulated learning in mathematics needed to be considered because it would support the learning process. However the fact is student's self-regulated learning in mathematics was still relatively low.

There were several things that indicated low student's self-regulated learning in mathematics. One of the indications was students were passive in participating the lesson. Another indication was students only learnt mathematics when there was homework or mathematics test, students did not reread the material at home.

There were studies that indicated Garner's multiple intelligences teaching and learning could improve student's self-regulated learning in mathematics. The question was: what can be done by mathematics teacher to help students improve their self-regulated in learning mathematics? For example, teachers could help students improve their self-regulated in mathematics learning by implementing Gardner's multiple intelligences teaching and learning. This paper will discuss how to improve student's self-regulated learning in mathematics through Gardner's multiple intelligences teaching and learning.

**Keywords**: student's self-regulated learning, mathematics, multiple intelligences

## INTRODUCTION

Nowdays, the paradigm of education has changed. Learning in the classroom has changed, which initially teacher-centered becomes student-centered. Therefore, students are demanded to be active in learning and have higher self-regulated learning. Similarly, in the mathematics teaching and learning, students should have higher self-regulated learning.

In fact, students' self-regulated learning in mathematics is still lacking. There are somethings indicate the lack of students' self-regulated learning in mathematics, such as: students do not have a certain schedule to learn mathematics, students do not prepare books and stationery before learning mathematics, students only learn mathematics if they have homework or exams, students do not note important things when they learn mathematics, students do not learn again the material they have learned in school, students do not look for another material source of mathematics, if the answer is wrong, students do not try to find the correct answer, the students cheat during the exam, students collect assignments over the limit specified time, etc.

The lack of students' self-regulated learning in mathematics is certainly not good. Therefore, the students' self-regulated learning in mathematics should be improved. The question is: how can mathematics teachers improve students' self-regulated learning in mathematics?

For example, teachers can help their student improve self-regulated learning in mathematics by applying Gardner's multiple intelligence teaching and learning. Why is students' self-regulated learning in mathematics low? It is because of the students' bad experience in learning mathematics, mathematics learning activities are not fun and interesting.

Therefore, the role of the teacher is to improve students' self-regulated learning in mathematics. One way to increase the students' self-regulated learning in mathematics is by applying Gardner's multiple intelligence teaching and learning. What is a gardner multiple intelligence teaching and learning? Why can Gardner's multiple intelligence teaching and learning improve students' self-regulated learning in mathematics?

This paper will discuss how to increase the students' self-regulated learning in mathematics by using Gardner's multiple intelligence teaching and learning. There are three sub-topics to be discussed, namely: (1) students' self-regulated learning in mathematics; (2) Gardner's multiple intelligence teaching and learning; and (3) improving students' self-regulated learning in mathematics.

## DISCUSSION
### Students' Self-Regulated Learning

Mathematics education experts elaborate that affective factors are as important as cognitive factors in teaching and learning mathematics. According to McLeod, D.B. (1992), "A variety of large-scale studies provide a substantial amount of the data indicate that there is good reason to be concerned about affective factors." One of the affective factor is students' self-regulated learning. According to Hargis (2000) in his studies, there is a positive correlation between students' self-regulated learning and students' mathematics achievement. Students' self-regulated learning is an affective factor to be considered because there is correlation with learning achievement.

Self-regulated learning has several definitions. Bandura (1977) defines self-regulation, as the ability to control our own behavior and it is the workhorse of the human personality. Bandura suggests three steps: (1) Self-observation, we look at ourselves, our behavior, and keep tabs on it; (2) Judgment, we compare what we see with a standard; (3) Self-response, if we did well in comparison with our standards, we give self-responses reward. If we did poorly, we give self-responses punishment. Meanwhile, according to Lowry (Utari, 2004: 3), self-regulated learning is defined as a process in which the individual: learning initiative with or without the help of others; diagnose their own learning needs, formulating learning goals; identifying learning resources that can be used; selecting and applying learning strategies, and evaluating learning outcomes. In contrast to the opinion, according to Zimmerman (Zumbrunn, 2011: 4), self-regulated learning is a process that assists students in managing reviews their thoughts, behaviors, and emotions in order to successfully navigate reviews their learning experiences. It means self-regulated learning is a process that helps students in managing their minds, behaviors, and emotions in order to successfully direct their learning experience.

Moreover, Song & Hill (2007: 32) define 3 aspects of self-regulated learning, they are:

1. Personal Attributes

   Personal attributes are aspects relating to student's motivation, student's responsibility in learning, the use of learning resources, and learning strategies. Students who have a high learning motivation will diligently study, they are not easy to give up, and diligently read books to expand their knowledge. Responsibility of the student as a learner is learning well, doing home work that has been given to them, and discipline in carrying out school's rules.

2. Processes

   Processes are aspects related to autonomous learning process performed by the students including designing learning, monitor learning, and evaluation of learning. Designing self-learning is very important for students because students will have the readiness and maturity to learn well. The ability to design their own learning can be reflected from the activities of students make learning schedule, prepare books, stationery,

study math at home although there is no homework/assignments, learn while note the important things, learn and do math exercises not only when they have exam, re-read the material that has been studied, improve math notes, and check the completeness of their mathematics notes.

Monitoring learning activities encompasses asking yourself questions whether the strategy is fit with the plan and whether the strategy has been worked well. The monitoring activities are to implement learning activities even when the teacher does not come, always active in the following study and make notes if necessary. Furthermore the activities that belong to evaluation activities are doing test item at home and trying to correct the mistake if the answer is wrong.

3.  Learning Context

Learning Context is the environmental factors and how these factors affect the level of students' self-regulated learning. There are several factors in learning that can affect self-regulated learning of students, such as the structure and nature of the task in the context of learning.

What are the consequences of the students' low self-regulated learning in mathematics lessons? Several studies show a positive correlation between students' self-regulated learning and academic achievement. Based on the studies by Hargis (2000) at the university science and engineering major students, there is a positive correlation between students' self-regulated learning and students' mathematics achievement. In a study of high school students, Labuhn (Zumbrunn, 2011) found that learners were taught self-regulated learning skills through monitoring and imitation were more likely to elicit higher levels of academic self-efficacy (ie, confidence) and perform higher in measuring academic achievement compared to students who did not receive self-regulated learning instruction. Based on studies conducted by Zumbrunn, Tadlock, and Roberts (2011), by teaching students to be more self-regulative, teachers may experience greater success in promoting academic achievement, motivation, and life-long learning.

**Gardner's Multiple Intelligences Based Learning**

In this world there are no individuals who are identical in every way, even for two people who are twins. Therefore, it is plural if students in a class are diverse in many ways, including in terms of their intelligence. Ideally, a teacher must pay attention to the diversity of the type and level of intelligence of the students in the class so that teacher is able to help each student achieves their optimal performance by utilizing their potential intelligence.

Although there are many factors determine the success of a person, but so far most people consider intelligence (IQ, intelligence quotient) as one of the important factors. For Howard Gardner, an IQ test is not enough to prove how high the level of intelligence of a person. However there are various types of human intelligences. So it is not very suitable if the test is only written test. However IQ tests that have been used only emphasize the mathematical-logical ability. There are so many varieties of human intelligences so it is not possible if only using IQ tests as the measurement (Ula, 2013: 87).

Being smart is no longer determined by scores of the test, being smart is determined by how well students learn in different ways. Gardner (2011: xv) said about intelligence as: "A property of all human beings (All of us possess these 8 or 9 intelligences), a dimension on which human beings differ (No two people—not even identical twins—possess exactly the same profile of intelligences), and the way in which one carries out a task in virtue of one's goals". Howard Gardner has conducted research and discover the theory of multiple intelligences (MI). Gardner's multiple intelligences is defined as the ability to solve problems or create a product that is valuable in society (Hoerr, 2007; Yaumi, 2012).

According to Howard Gardner in the book "Frame of Mind" there are at least nine types of multiple intelligences. Those nine intelligences are by Djamilah (2012: 3-5), ie:

1. **Linguistic Intelligence**

   According to Armstrong (2013: 6), linguistic intelligence is the ability to use words effectively, both oral and written. A person with a high level of linguistic intelligence is generally good at reading, writing, listening, storytelling and memorizing words. They tend to learn best by reading, taking notes, listening to lectures, and discussing and arguing about what they have learned. To accommodate students with high linguistic intelligence, mathematics teachers can give a problem/ mathematical issues in narrative form, then ask the students who have a high linguistic intelligence to explain verbally what is known and what is being asked.

2. **Musical Intelligence**

   According to Armstrong (2013: 7), musical intelligence is the ability to perceive, discriminate, transform, and express forms of music. Howard Gardner defines intelligence as the ability to float musical, express, and enjoy the forms of music and sounds, such as sensitivity to rhythm, melody and notation, the ability to play music instrument, sing and write songs, music and sing (Ula, 2013: 95).

   A person with a high level of musical intelligence is usually able to sing, play an instrument, remember the melody, or write music. It is because there is a strong auditory component to this intelligence, so they generally learn best through lectures, or using the song. Teacher begins mathematics learning by playing song/music to attract the attention of the students with high musical intelligence, especially for early childhood education, or basic education. Introducing the concept and principles of mathematics, especially the concept of numbers and operations counted, can be done through a song to encourage students with musical intelligence.

3. **Logical-Mathematical Intelligence**

   According to Armstrong (2013: 6), logical-mathematical intelligence is the ability to use numbers effectively and for good reason. This intelligence includes sensitivity to patterns and logical relationships, statements and propositions, functions, and other related abstractions. According to Gardner, logical-mathematical intelligence is the ability that has more to do with the use of numbers and logic effectively (Ula, 2013: 90).

   Those who have high logical-mathematical intelligence are interested in the mathematical exploration activities, such as classify, calculate, prove, or generalize. Methods of the invention will be preferred by students with high logical-mathematical intelligence. To make the math attract students with high logical-mathematical intelligence, the teacher must be able to make a challenge for them, to give them the opportunity to discover, make hypothesis, or prove a particular mathematical formula. Mathematics teacher will optimize logical-mathematical intelligence of the students by designing a student worksheet.

4. **Visual-Spatial Intelligence**

   According to Armstrong (2013: 7), visual-spatial intelligence is the ability to understand the visual-spatial world accurately and to make changes in the perception. This intelligence involves sensitivity to color, line, shape, space, and the relationships that is exist between these elements.

   Those with high visual-spatial intelligence can recognize and draw in two and three dimensions, imaginative, creative, and sensitive to color, line, shape, space, and the relationships between these elements. They tend to remember things using scribbles, sketches, or drawings. Math teacher can present certain material using a power point of interest: color, there is a picture in two or three dimensions, there are interesting graphs, sketches, diagrams, or illustrations, to help students utilize and develop visual-spatial intelligence. The use of geometry software can assist students who lack of the visual-spatial intelligence.

5. **Bodily-Kinesthetic Intelligence**

   According to Armstrong (2013: 7), body-kinesthetic intelligence is using the expertise of the entire body to express ideas and feelings and agility in using hands to

create or change something. This intelligence includes specific physical skills such as coordination, balance, agility, strength, flexibility, and speed, as well as capacities proprioception, tactile, and haptic.

Those who have high body-kinesthetic intelligence are able to move with high accuracy, skillfully uses their hands to create or change something, and have some specific physical skills such as coordination, balance, skill, strength, flexibility, and speed of movement. They also have a sensitivity to accept or tactile stimulation. To utilize and develop bodily-kinesthetic intelligence of the students, math teacher can design hands-on activities. Allow students to move in class, give students the opportunity to demonstrate the use of props in front of the class, or doing math games that require movement, can also be done by mathematics teachers to motivate students with high bodily-kinesthetic intelligence actively involved in learning mathematics.

6. **Intrapersonal Intelligence**

According to Armstrong (2013: 7), intrapersonal intelligence is self-knowledge and the ability to act adaptively based on that knowledge. This intelligence includes having an accurate picture of yourself; awareness of mood and mind, intent, motivation, temperament and desire; as well as the ability to discipline yourself, self-understanding, and self-esteem.

Those who have a high intrapersonal intelligence tend to have a deep understanding of themselves, what strengths or weaknesses they have, and what makes them unique. They are also able to predict the reaction of themselves or their own emotions in facing something. Students with high intrapersonal intelligence need to be given the opportunity to think or learn individually before they learn in groups. Giving students the opportunity to do self-reflection, write what you like and dislike, or what is understood and what is not understood from the mathematics learning activities can help students develop and utilize their intrapersonal intelligence.

7. **Interpersonal Intelligence**

Interpersonal intelligence relates to a person's ability to understand, interact, and collaborate with others. In theory, people who have high interpersonal intelligence are sensitive to moods, feelings, and the temperament of others. They are smart in interpersonal usually learn best by working with others and often enjoy discussion and debate. To utilize and develop students' interpersonal, group work and discussion activities can be an option.

8. **Naturalist Intelligence**

According to Armstrong (2013: 7), naturalist intelligence is the expertise to identify and classify the various species of flora and fauna, from an individual environment. Those who have a high naturalist intelligence generally have the ability to recognize shapes and classify species of flora and fauna in their natural surroundings. They are also happy to learn something by classifying according to certain characteristics, and love outdoor activities. Mathematics learning activities outside the classroom do not only help students with high naturalist intelligence, but also will please students with a variety of their intelligence.

9. **Existentialist Intelligence**

Existentialist intelligence is related to the person's ability to question everything. Those who have existentialist intelligence tend to question everything like human existence, the meaning of life, the meaning of death, and various human realities faced in life. They tend to ask "why". By giving the task to find the origins of a mathematical formula, or to learn the history of mathematics, teachers can develop and utilize student existentialist intelligence.

By noticing the diversity of types of students' intelligence in a class, does it mean that a teacher must plan and implement individual learning for each student in the class? Of course not. However, ignoring or do not consider the multiple intelligences of each student are not

expected. The multiple intelligences of the students should be able to be used as a "capital" by a teacher to help each student achieve their optimal performance.

In its application, multiple intelligences assume that every student has the intelligence (Hoer, 2007: 14). The concept of multiple intelligence focuses on the unique where teachers always find children's strength. Through multiple intelligences every student can do something, because every child will have at least one advantage (Chatib, 2009: 92).

The essence of learning by empowering multiple intelligence is how teacher wraps teaching styles so it will be comprehended by students. The application of Gardner's multiple intelligences in the learning process will help students get more meaning and brain stimulation in their learning process, as well as providing variety and pleasure in learning activities, and also develop and strengthen students' intelligence (DePotter et al, 2005: 99 ).

Currently there are several studies that show the advantages of Gardner's multiple intelligences teaching and learning. Temur (2007) investigated the influence of multiple intelligences teaching and learning on mathematics achievement in grade 4 elementary school students in Gazi University Foundation Private Primary School. The results show the advantages of the experimental class, that is the class that uses multiple intelligences teaching and learning. Xie and Lin (2009) examined the influence of the multiple intelligences teaching and learning on the ability of polytechnic students in Taiwan in color theory. It shows that the experimental class students significantly are better than the control class, especially in tasks design project. Bass and Beyhan (2010) have conducted research experiments on 50 students in grade 5 elementary school in Turkey to determine the influence of multiple intelligences supported by project-based learning on achievement and students' attitudes toward learning English. Result of the researc show the advantages of multiple intelligence teaching methods supported project-based learning compared to traditional teaching methods, in terms of attitude and motivation of student's learning process.

**Improving Students' Self-Regulated Learning in Mathematics**

Basically, in learning mathematics students need to get a challenge to grow their ability to think critically and creatively. The teachers can design tasks, both of the which will be completed independently or as a group, both of which contain a challenge for students. In forming a group, teachers should also pay attention to prominent multiple intelligences of students, so in a group compose of students with diverse multiple intelligences. It would be advantageous so that students can work together and help each other, thus the students' self-regulated learning can be further increased.

Teachers can use the student's worksheet to help discussion in group. Student is worksheets do not only contain any exercises, but also contain the invention of the formula. Thus, students will conduct discovery in groups and students more actively in learning. So that the students' self-regulated learning in mathematics is will be increased.

Teachers can design student worksheets based on Gardner's multiple intelligences. Student worksheet that contains the invention of the mathematical formula can facilitate students who stand out in logical-mathematical intelligence. Students work in groups,so it can facilitate interpersonal intelligence. In the introduction to student is worksheets, teachers can write a narrative related to the lesson topic. The existence of the narrative as a preliminary student's worksheets can facilitate linguistic intelligence. In addition, teachers can use a song that relates to the topic of mathematics in order to facilitate musical intelligence. Exercises are related to musical instruments or the name of the students' idol singer will also facilitate musical intelligence. Teachers should also make an interesting student's worksheets with the appropriate mathematical illustrations, It will facilitate visual-spatial intelligence.

Teachers should also create a nice atmosphere in the classroom. Teachers can occasionally make a game at outside the classroom. By playing games at out side of the classroom can facilitate body-kinestetic and naturalistic intelligence. In addition, teachers can also use teaching aid in learning mathematics. The use of teaching aid in learning mathematics can facilitate body-kinestetic intelligence. Occasionally, teachers can also play the video related

to mathematics learning and nature. It certainly can increase the enthusiasm of students in learning mathematics and can also facilitate visual-spatial and naturalist intelligence.

After students discuss in the group, the teacher should provide the opportunity for students to present the results of the discussion. Students can present the results of their discussion individually or in groups. Students will be more responsible when they work on students' worksheets in discussion and students must be ready to present the results of their discussion. This can increase students' self-regulated learning in mathematics.

In addition, teachers can design a challenging task for the students, such as the assignment to make an article related to the discovery of mathematical formulas, mathematical figures, or related topic to be studied. Students can look for sources in mathematics books, articles, internet, and others. It can improve students' self-regulated learning. The task can also facilitate existential intelligence.

Teachers also should provide opportunities for students to note the important things in every mathematics lesson. Students can note important mathematics material. In addition, teachers should also evaluate learning. The teacher can evaluate students with a quiz question that must be done individually. The quiz will facilitate intrapersonal intelligence and enhance students' self-regulated learning in mathematics.

In addition to design mathematics learning that can facilitate multiple intelligences of students, teachers can do other things to improve students' self-regulated learning. Teachers should be able to create fun and challenging atmosphere of learning mathematics that will actively engage students in learning, creating meaningful learning which can develop the creativity of students. Teachers should also be able to prepare appropriate tasks to improve students' self-regulated learning in mathematics.

## CONCLUSION AND SUGGESTION

Students' self-regulated learning in mathematics will support the learning process and it has positive correlation between self-regulated learning and learning achievement. So it can be concluded that the teacher should be able to design and implement Gardner's multiple intelligence teaching and learning to improve self-regulated learning. Teachers have to design a lesson plan, instructional media such as student's worksheets and assignments that match the topics of mathematics learning.

Some tips for mathematics teachers for teaching and learning mathematics activities based on Gardner's multiple intelligences are: (1) each student has intelligence, so the teacher must know the intelligence that stands on each student, (2) the teacher should be able to facilitate all intelligences of the students, (3) the teacher should be able to design learning scenarios that can facilitate the multiple intelligences of the students, (4) the teacher should be able to design worksheets and appropriate mathematics instructional media to facilitate the multiple intelligences of the students, (5) in the form of group discussion, teachers should pay attention to multiple intelligences of the students, and (6) the teacher can take advantage of not only the logical-mathematics but also other intelligence in learning, so that students are less prominent in logical-mathematical intelligence can also learn well.

To enhance students' self-regulated learning in mathematics, mathematics teacher are recommended to always: (1) create fun, meaningful, memorable, and challenging learning, (2) designing tasks according to the mathematical topics, and (3) lead students to be active in learning mathematics.

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