What is the relationship between self-regulated learning and students’ mathematical understanding in online lectures during the covid-19 pandemic?

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Abstract. Covid-19 pandemic forced online lecturing and learning from home (LFH) to be carried out on all campuses in Indonesia. One obstacle in implementing LFH is how students can organize themselves so they can learn well from home. Based on observations in class, students who can manage their learning (Self-Regulated Learning, SRL) well tend to better understand the mathematical material provided. Mathematical understanding is very important because it becomes the basis for students to be able to master other higher mathematical abilities. The purpose of this research is to determine the relationship between self-regulated learning and students’ mathematical understanding in online lectures during the covid-19 pandemic. This research is qualitative descriptive research. The subjects in this research were 14 students contracted discrete mathematics courses on mathematics education department at Wiralodra University in the 2019/2020 event semester by purposive sampling technique. The instruments of this research were self-regulated learning questionnaires, mathematical understanding tests and interviews. Data analysis consist of data reduction, data display, and conclusion drawing/verification. The results showed that there are directly proportional relationship between self-regulated learning and students' mathematical understanding. Based on these findings, it is necessary to apply self-regulated learning strategies in lectures to improve students' mathematical understanding.

1. Introduction
Coronavirus disease (Covid-19) has been designated as a pandemic by WHO on March 11, 2020 after more than 114 infected countries including Indonesia [1]. On March 14, 2020 the government of Indonesia established a covid-19 outbreak as a non-natural disaster with an emergency response status [2]. With that level on crunch, through Minister of Education and Culture circular of March 17, 2020 [3], Ministry of Education and Culture enforced online learning from home for students, teachers and lecturers from home for teachers and lecturer throughout Indonesia.

There are several obstacles faced by students in implementing full online lectures. These obstacles include technical and non-technical obstacles. Technical obstacles faced such as internet signal problems in the area where students live, technological devices (laptop and smart phones), and literacy of the technology device used. While non-technical obstacles such as how to organize themselves in learning which is called self-regulated learning (SRL). Learning in online learning environments requires learners to self-regulate their learning, as teachers are not physically present to offer support [4]. Following the lectures from home gives a different atmosphere by attending lectures in class. In face-to-face classes, students are assisted by lectures and education staff to study well. Online learning
environment are highly autonomous and learners decide on their own whether or not to act upon the prompt or to use the tools provided [4]. However, when lecturing online, all the control to arrange learning from home is at how capable students become a regulator for themselves in learning. Somehow, this has been established as mindset in the community that home is a place for rest and campus is a place for studying. So it necessary to change the mindset of students during the course of online lectures.

When attending an online lecture, students must be able to set themselves up to focus and minimize all possible learning obstacles. In other word, students must have good self-regulated learning. In SRL, time management [5], self-regulation [6], and know yourself habits to learn [7] plays an important role. Students learn more and better when they can take control of their learning by defining their goals and monitoring their progress [8]. SRL strategies, namely, self-evaluation, organization and transformation, goal setting and panning, information seeking, record keeping, self-monitoring, environmental structuring, giving self-consequences, rehearsing and memorizing, seeking social assistance (peers, teacher, or other adults), and reviewing (notes, books, or tests) [9].

Based on observations in class, students who can manage their learning well tend to better understand the mathematical material provided. They lead learning in class and usually have better mathematical abilities than their peers. This is in line with the results of previous researches, SRL was associated with good academic achievement [6, 9, 10]. Students who have a good SRL, can set themselves up to learn effectively [9]. Thus the student can understand the materials better. Understanding the process of knowledge change is a central goal in the development of learning and education [11]. Understanding of certain material in mathematics is very helpful for increasing confidence in learning and can help to be a prerequisite in learning further material. Mathematical understanding related to the ability of students to manage their learning. Mathematical understanding is very important because it becomes the basis for students to be able to master other higher mathematical abilities.

Mathematical understanding is defined as an ability that relates to mathematical notations and symbols that are relevant to the loading of mathematical ideas and combines them into a series of logical reasoning [12]. Understanding is an essential component of the knowledge needed to deal with novel problems and settings [8]. Mathematical understanding has been viewed both as a process of achieving understanding and as the result of having achieved understanding [13]. Based on Skemp [14], there are two proposed mathematical understanding (MU), namely instrumental understanding and relational understanding. Based on the description, the purpose of this research is to describe the relationship between SRL and students’ MU in online lectures during the Covid-19 pandemic.

2. Method

This research is qualitative descriptive research. This research was conducted on March 19-April 30, 2020. The subject in this research is 14 students contracted discrete mathematics courses on mathematics education department at Wiralodra University in the 2019/2020 even semester. Subject were selected by purposive sampling technique base on consideration so that this research could be carried out effectively and efficiently, especially in terms of subject conditions and research time. Three students from high (S-11), medium (S-14) and low (S-9) ability groups were selected to be interviewed.

Data collection methods in this research include documentation, tests, and interviews. The documentation method is used by researchers to document the data and answers of research subjects, the test method is used by researchers to obtain answers from SRL questionnaires and mathematical understanding tests, and interviews methods are used by researchers to obtain additional information that didn’t obtained from the SRL questionnaires and mathematical understanding tests.

SRL questionnaires and mathematical understanding tests used have been validated by three experts. SRL indicators [14] that researchers used are initiatives and motivation to learn intrinsic; The habit of diagnosing learning needs; Setting learning objectives/targets; Monitor, regulate, and control learning; See difficulties as challenges; Utilize and search for relevant sources; Choose and implement a learning strategy; Evaluate the process and learning outcomes; Self-efficacy/self-concept/self-ability. The SRL questionnaires that used is consist of 39 statements in Likert Scale (1-5). The maximum score of the questionnaires is 195 and the minimum score is 39. Meanwhile, to measure the level of MU researchers used an instrument test that consist of 3 questions, in accordance with two mathematical understanding
indicators by Skemp [14], namely instrumental and relational understanding. Maximum score test is 60 and the minimum score is 0.

All data obtained were then analyzed following the qualitative data analysis steps proposed by Miles and Huberman [15], namely data reduction, data display, and conclusion drawing/verification. The verification technique that researchers used is triangulation, which is a data validity checking technique that utilizes something else [16]. Triangulation used is source triangulation, that is confirm the answer data with interview data.

3. Result and Discussion
SRL scores that have been changed from nominal data to interval data using Method of Successive Interval (MSI) are shown in table 1.

Table 1. SRL score

| Subject | S-1  | S-2  | S-3  | S-4  | S-5  | S-6  | S-7  | S-8  | S-9  | S-10 | S-11 | S-12 | S-13 | S-14 | Average |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|---------|
| SRL Score | 101.8 | 88.4 | 85.9 | 101.6 | 85.1 | 115.1 | 106.1 | 101.5 | 76.3 | 83.0 | 120.3 | 105.7 | 87.3 | 98.7  | 96.9    |

Table 1 shows that of the 14 students, 8 students had an above-average SRL score, while 6 students had an under-average SRL score. The SRL score obtained by students is low, when compared to the maximum score, which is 195. Only S-11 can be said to have a good SRL score. For a clearer view of the student SRL picture in each indicator, table 2 is presented to show the average of SRL indicators score.

Table 2. SRL indicators average score

| SRL Indicators Score | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9  |
|----------------------|-----|-----|-----|-----|-----|-----|-----|-----|----|
| Average              | 2.7 | 2.6 | 2.3 | 2.3 | 2.6 | 2.2 | 2.4 | 2.5 | 2.6|

Table 2 shows that an average score of each indicator less than 3, this shows that students still have a low SRL. Among the 9 indicators, indicator 1 gets the highest average value and indicator 6 gets the lowest average value compared to other indicators. Indicator 1, which is used are initiatives and motivation to learn intrinsically, with an average score of 2.7 means that initiative and motivation to learn from within can be said to be still low even though the numbers are approaching neutral. In interviews with students who have high SRL scores (S-11), stating that learning is their own will not just because it will complete the task, it appears that the initiative and motivation to learn from within is very high. Indicator 2, the habit of diagnosing learning needs, with an average score of 2.6, indicates that students do not have the ability to diagnose their needs in learning.

Indicator 3, setting of learning objectives / targets, with an average score of 2.3, means that students have not determined the goals and targets to be achieved in their learning. Indicator 4, monitor, regulate, and control learning, with an average score of 2.3 shows that students have not been able to monitor, manage and control their learning, students need to be trained so that they can focus and not do anything else while attending online lectures. Indicator 5, which is see difficulties as challenges, with an average of 2.6 means that students do not have a high level of struggle in facing challenges in learning yet.

Indicator 6, utilize and search for relevant sources, with an average score of 2.2 means that students are not maximally able to use and find relevant sources to facilitate their learning. In interviews, students with low SRL scores (S-9) stated that they took part in online lectures without preparation and were less active during the lectures.Indicator 7, choose and implement a learning strategy, with an average score of 2.4 means that students are still looking for learning strategies that make it easy and in accordance
with their learning styles. In interviews, students with low SRL scores (S-9) stated that while attending lectures in class and online, there were no changes in their habits of study. Meanwhile, students with an average SRL score (S-14) stated that there were changes in learning habits when attending lectures online. Now he able to arrange time to study and relearn the material discussed in lectures where previously only studied in campus because of working (S-14 already have a job), so when at home already tired.

Indicator 8, evaluate the process and learning outcomes, with an average score of 2.5 means that students have not evaluated their learning processes and outcomes yet. Students must be encouraged to reflect on their learning process so that their mathematical abilities are better. Indicator 9, self-efficacy/self-concept / self-ability with an average score of 2.6 means that students lack courage, lack confidence in learning by themselves. Furthermore, the result score description of completing the MU test instrument is shown in table 3.

Table 3. MU score

| MU Indicators Score | Subject Average |
|---------------------|-----------------|
| S-1 24 S-2 17 S-3 16 S-4 19 S-5 28 S-6 19 S-7 16 S-8 11 S-9 23 S-10 22 S-11 17 S-12 18 S-13 18.9 S-14 18.9 |
| S-1 5 S-2 10 S-3 10 S-4 10 S-5 10 S-6 10 S-7 10 S-8 10 S-9 10 S-10 10 S-11 10 S-12 10 S-13 10 S-14 10.1 |
| MU Score 29 27 26 29 26 38 34 29 17 21 43 32 27 28 29 |

Table 3 shows that 7 out of 14 students had MU scores above the average and 7 others had scores below the average. The MU average score is 29 at an ideal maximum score of 60, this shows that students still have low MU. MU indicator 1, instrumental understanding, where students can remember one concept / principle without any relation to other concept, can apply formulas in simple calculations, and perform calculations algorithmically. Instrumental understanding is classified as low level ability. MU indicator 2, relational understanding, where students can link one concept / principle to another concept / principle. Relational understanding is classified as a high level of ability. The average score of instrumental understanding is greater than relational understanding, this means that students can solve problems in the category of instrumental understanding compared with relational understanding.

Table 2 and 3 shows that 7 out of 8 students who have SRL scores above average also have MU scores above average. This shows that there are directly proportional relationship between SRL scores and MU scores. Descriptively, this relations can be illustrated in Figure 1.

Figure 1. Result of SRL and MU score
In the figure 1, it appears that students who have a high MU score also have a high SRL score and students who have a low MU score have a low SRL score too, this is in accordance with the results of the research [10], which states that the group of students who were given SRL training had higher academic achievement compared to groups not given SRL training. A high SRL score indicates that the person runs more SRL strategies in himself while learning, in line with the results of the research [6] also reveals that the participants who were more academically capable were reported using a wider range of strategies, and more often, than participants who were less academically capable. The results of this research are in accordance with previous research which states that there is an association between mathematical reasoning and SRL [17], but different from another results of research conducted which states that there is no association between mathematical ability and SRL [18].

4. Conclusion
The results showed that there are directly proportional relationship between self-regulated learning and student’ mathematical understanding. Students who have a high MU score also have a high SRL and students who have a low MU score also have a low SRL score too. This implies that training and implementation of SRL strategies are needed in lectures so that students can learn better and more effectively. The eventual achievement is to enhance the mathematical understanding also academic achievement. The limitations of this research is small subject size, namely a group of students who contracted certain courses, thus future studies in this area could involve a larger subject size, such as taking samples representing each years.

5. Acknowledgments
We would like to thank Dr. Aan Juhana Senjaya, Dr. Sri Hartini, and Dr. Runisah for the willingness to become an instrument validators and also for the suggestions given in order to repair the instruments used in this research.

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