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Self-Regulated Learning in Online Mathematics Learning during the Covid-19 Pandemic: A Meta-Analysis

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ABSTRACT

With the Covid-19 Pandemic, the teacher's role is not only as a teacher in a formal school but is expected to be an agent of renewal in the face of a new normal where we must all be able to live with the coronavirus. This research aims to get an idea of teachers' experiences as community coaches or extensions and the most appropriate type of training during this pandemic. The data in this descriptive study was obtained from the spread of questionnaires to 16,546 respondents who were teachers at the early childhood education (PAUD) to high school (SMA) levels throughout Indonesia. Data processing and analysis were done descriptively and obtained some results. Notably, 77.8% of respondents have experience in providing training, and the most training materials ever given by teachers as coaches are about education, which is 88.9%. Related to the skills needed to act as a coach with material about life in the Era New Normal, most teachers assume that speaking in public, developing presentation materials, and using technology are skills that must be possessed. Furthermore, the study's results can be a reference for developing training forms with teachers as coaches or extensionists, especially in the New Normal era.

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1. INTRODUCTION

In Indonesia, Law No.20 of 2003 on the Education System, it is hoped that students in Indonesia can develop skills and knowledge, also instills in the character of dignified students. Education has an important role to play in developing human potential. Generally, Indonesia's teaching and learning process is held at school or face-to-face. However, during the Covid-19 pandemic outbreak, all face-to-face learning activities in Indonesia were suspended in the mid of March 2020. The World Health Organization (WHO), on January 30, 2020, previously announced that national authorities worldwide should impose travel bans, lockdowns, workplace restrictions, and facility closures. Preschools, schools, and universities have been closed locally and nationally in 172 countries, affecting around 98.5% of the world's student population (UNESCO, 2020). President Joko Widodo, on March 2, 2020, announced the first positive case of Covid-19, which has infected 2 people in Indonesia. The government made a learning from home policy to prevent the spread of Covid-19 in the learning process. This is done as an anticipatory plan so that the spread of Covid-19 does not occur in the educational environment.

The policy of learning from home means that all students, especially in Indonesia, cannot go to school because of social distancing. For the teaching and learning process to continue, through a circular of the Minister of Education and Culture (Mendikbud) Number 4 of 2020, the teaching and learning process is carried out online (KEMDIKBUD, 2020). There are many positive aspects of using SRL online learning during the Covid-19 pandemic. Therefore, this study aims to examine the information from several papers reviewed regarding the relationship between the use of self-regulated learning (SRL) in online mathematics learning during the Covid-19 pandemic.

Online learning is an effective alternative for this pandemic (Peters et al., 2020; Silvana et al., 2021). Online learning refers to "learning that is carried out using the internet" either synchronously or asynchronously so that communication between students and teachers can be done whenever and wherever they are (Singh & Thurman, 2019). Teachers require students to access the internet to obtain helpful knowledge even though learning is not carried out in the classroom directly (Dong et al., 2020).

Online learning's potential is the flexibility of time and environment to study (Johan et al., 2020; Gusty, 2020). Each student has the comfort of choosing a time and place that suits their interests so that students are more active in seeking information and become more confident in learning specific topics (Rohaeti et al., 2019). Moreover, Miguel-Revilla et al. (2020) argue that free access to various platforms (Kahoot!, Google Classroom, Edmodo, and others based on game quizzes) in learning makes students more interested and enthusiastic in online learning mathematics rather than conventional ones.

Students who have independent learning can optimize their potential without others' guidance (Chen, 2002). In this online learning, students can move from dependence on their teachers to become independent, especially in mathematics learning. Therefore, using SelfRegulated Learning (SRL) during online learning skills in independent learning will be trained over time (Ratnafuri & Muslihati, 2020).

Self-regulated learning (SRL) is an important cognitive learning approach for elementary and advanced students (Graham & Harris, 1993). In brief, Fasikhah & Fatimah (2013) explain that SRL strategy generally includes: 1) cognitive regulatory strategies are related to various types of cognitive and metacognitive activities that individuals use to adjust and change their cognition; 2) motivational strategies related to interactive and external motivation to generate

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motivation in overcoming failure in learning; and 3) behavioral regulation is related to the control of the individual's actions and behavior.

The implication of using SRL in online learning is that students can take part in learning independently with adaptive learning facilities according to their abilities, and students are expected to be able to create their own learning experiences in learning material provided by the teacher using all their abilities (Gusty et al., 2020). Lai & Hwang (2016) show that using SRL in learning can increase student self-confidence and learning achievement. Students get better learning experiences and learning abilities, be able to apply learning strategies to improve academic achievement, and be able to monitor learning, and be able to evaluate their academic skills (Fauzi & Widjajanti 2018).

The study aims to examine the relationship between the use of SRL in online mathematics learning during the Covid-19 pandemic based on several papers reviewed.

2. METHODOLOGY

Data collection was conducted through the Mendeley program by browsing journals as literature to examine the effect of using self-regulated learning (SRL) on mathematics learning while learn-ing from home during the Covid-19 pan-demic. The keywords were used to narrow down research topics and to facilitate literature searches, namely pembelajaran matematika daring, online mathematics learning, and self-regulated learning. There were 41 articles resulted from the keywords as shown in Table 1. The articles used in this study are focused on the published journals in 2020 and employed quantitative research method, about Covid-19 pandemic and the sample of students used is at the elementary school to university level

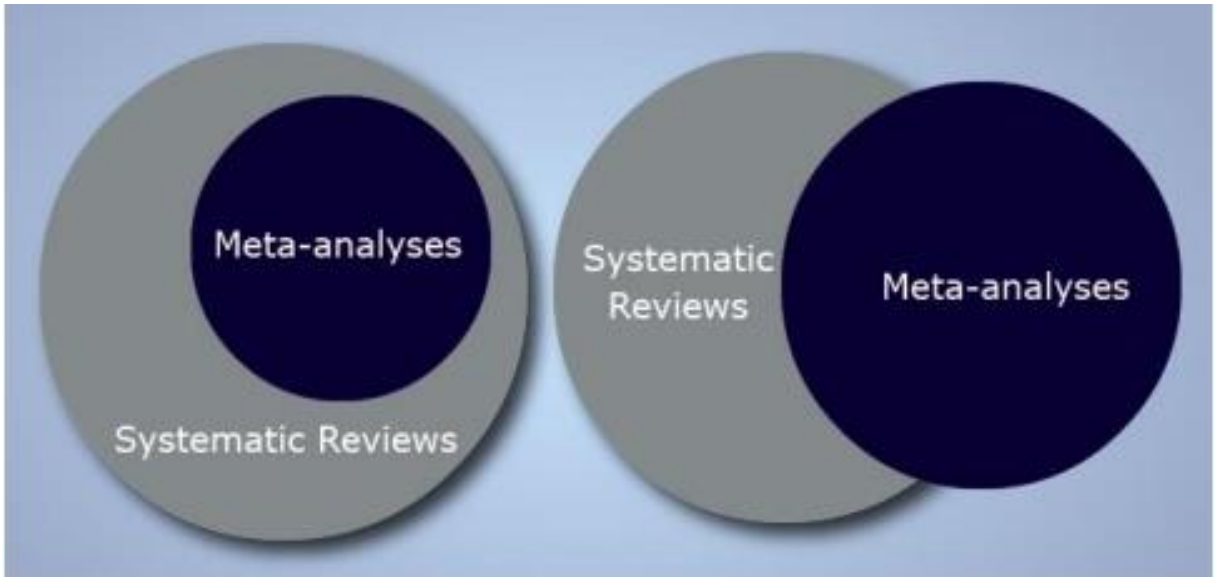

Figure 1. Meta-Analysis

This research uses meta-analysis. The analysis was carried out with quantitative comparisons by comparing the average score before and after using SRL in online mathematics learning (Adam et al., 2017; Anas, 2008). The score is taken from the papers that were previously obtained. This study identifies the amount of improvement after using SRL by comparing the difference in student achievement scores before using SRL and learning achievement scores after using SRL. Then these results are divided by student achievement

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scores before using SRL (in the form of a percentage) to determine the amount of influence. The use of SRL in online mathematics learning. Data analysis used statistical software, namely SPSS version 23.0.

3. RESULT AND DISCUSSION

Tabel 1. The Results of Searching for Relevant Papers

No	Authors	Research Method	Subject	Location Data
1	Alten et al., (2020)	Quasi-Experimental Design	Senior High School	Netherland
2	Badjeber, (2020)	Descriptive Qualitative	Undergraduate	Indonesia
3	Cai et al., (2020)	Quasi-Experimental Design	Junior High School	China
4	Cleary et al., (2020)	Synthesis Literature Review	Junior High School	USA
5	Hudaifah (2020)	Literature Review	Elementary to University	Indonesia
6	Handayani et al., (2020)	Descriptive Qualitative	Undergraduate	Indonesia
7	Harahap (2020)	Descriptive Qualitative	Undergraduate	Indonesia
8	Indira Ratnafuri & Muslihati, (2020)	Quantitative with One Group Pretest-Posttest	Senior High School	
9	Suryani et al., (2020)	Descriptive Qualitative	Undergraduate	Indonesia
10	Kusuma, (2020)	Qantitative Descriptive	Senior High School	Indonesia
11	Sulisworo et al., (2020)	Descriptive Survey Method	Junior High School	Indonesia
12	Lestari et al., (2020)	Descriptive Qualitative	Undergraduate	Indonesia
13	Pertiwi et al., (2020)	Descriptive Qualitative	Junior High School	Indonesia
14	Muhammad, (2020)	Descriptive Quantiative	Undergraduate	Indonesia
15	Tzu-chi, (2020)	Quasi-Experimental Design	Senior High School	North Taiwan
16	Yuliati et al., (2020)	Descriptive Qualitative	Undergraduate	Indonesia
17	Wijaya et al., (2020)	Descriptive Qualitative	Elementary School	China
18	Tince Koroh, (2020)	Descriptive Qualitative	Undergraduate	Indonesia

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No	Authors	Research Method	Subject	Location Data
19	Windi &Haryanto (2020)	Quantative (Ex Post Facto)	Undergraduate	Indonesia
20	Mustakim (2020)	Descriptive Quantative (Survey Method)	Senior High School	Indonesia
21	Nurani & Maula (2020)	Descriptive Qualitative	Elementary School	Indonesia
22	Hutauruk & Sidabutar (2020)	Descriptive Qualitative	Elementary to University	Indonesia
23	Ahmad & Firdausi Nuzula (2020)	Descriptive Quantative	Senior High School	Indonesia
24	Soraya Djamilah & Ahmad Lazwardi (2020)	Descriptive Qualitative	Undergraduate	Indonesia
25	Nuraeni et al. (2020)	Descriptive Qualitative	Elementary School	Indonesia
26	Kusumaningrum & Wijayanto (2020)	Descriptive Qualitative	Undergraduate Vocational and	Indonesia
27	Hidayat et al., (2020)	Descriptive Quantative	Senior High School	Indonesia
28	Putri Utami and Alan Dheri Cahyono (2020)	Descriptive Qualitative	Undergraduate	Indonesia
29	Putra & Roza (2020)	Systematic Literature Review	Elementary to University	Indonesia
30	Hodiyanto & Firdaus (2020)	Quantitative	Undergraduate	Indonesia
31	Hermawantie et al., (2020)	Descriptive Qualitative	Elementary School	Indonesia
32	Hignasari & Supriadi (2020)	Quantative	Undergraduate	Indonesia
33	Alfirahmadita & Maarif (2020)	Qualitative	Senior High School	Indonesia
34	Ahmad, Firdausi, N & Khalid (2020)	Quantative	Islamic Senior High School	Indonesia
35	Febrian et al., (2020)	Qualitative	Senior High School	Indonesia
36	Mulyana & Taufan (2020)	Research and Development	Senior High School	Indonesia
37	Kusmaharti & Yustitia (2020)	Descriptive Qualitative	Undergraduate	Indonesia
38	Hutagaol & Sopia (2020)	Classroom Action Research	Undergraduate	Indonesia
39	Viberg et al., (2020)	Systematic Literatur Review	Elementary to University	Sweden

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The search results for relevant journals using the keywords were then filtered based on the inclusion criteria: employed quantitative research methods, conducted in the context of covid-19, and included the sample of all levels of education: from elementary school to university. 7 papers meet the categories as shown in table 1. Among the 7 papers, 2 papers include Undergraduate students, 4 papers employed senior high school students, 1 paper conducted in junior high school, and there is no paper focusing on elementary school students. The papers were then extracted for processing and analyzed for further synthesis regarding the effectiveness of using selfregulated learning (SRL) during online mathematics learning. Data resulting from SRL analysis on online mathematics learning during the Covid-19 pandemic is shown in table 2.

Tabel 2. Appropriate Search Results Papers

No	Authors	Research Method	Subject	Location Data
1	Alten et al., (2020)	*Quasi-Experimental Design*	Senior High School	Belanda
2	Kusuma (2020)	*Quantitative Descriptive*	Senior High School	Indonesia
3	Indira Ratnafuri & Muslihati (2020)	*Quantitative*	Senior High School	China
4	Cai et al., (2020)	*Quasi-Experimental Design*	Junior High School	USA
5	Muhammad (2020)	*Literature Review*	Elementary to University	Indonesia
6	Windi Fitriani & Haryanto (2020)	*Descriptive Qualitative*	Undergraduate	Indonesia
7	Yang (2020)	*Quasi-Experimental Design*	Undergraduate	Indonesia

Table 3 shows that student achievement increased after implementing SRL in online mathematics class during the Covid-19 pandemic. The average increase in students' mathematics learning scores using SRL from the lowest at a score of 2.82 with a percentage of 15.977%, to the highest at 31.3 with a percentage of 50.894%. The average increase in students' mathematics learning scores before using SRL was 41.905, increasing to 55.654. The average value before and after SRL has increased significantly by 30.361%. These results were continued with the help of the SPSS 23.0 program from the output data from the paired sample test. A significant increase in scores occurred before (M = 41.904; SD = 17.391) and after (M = 55.654; SD = 27.064) using SRL in online mathematics learning.

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Tabel 3. Comparison of Online Mathematics Learning Scores Before and After Using SRL

No	Using SRL		Gain	Gain (%)
	Before	After		
1	17,65	20,47	2,82	15,977
2	63,16	89, 86	26,7	42,274
3	61,5	92,8	31,3	50,894
4	22,684	32,218	9,534	42,03
5	45	52,5	7,5	16,667
6	44,067	51,83	7,763	17,616
7	39,272	49,903	10,631	27,07
Mean Total	**41,905**	**55,654**	**13,749**	**30,361**

The correlation test uses the SPSS 23.0 program to investigate the relationship between pre and post-SRL implementation in online mathematics learning. The output results obtained are that there is a relationship with a positive and very significant direction between before and after using SRL in online mathematics learning statistically ($p = .000 < .05$) with a correlation coefficient r of 0.976. This shows that there is an effect of the use of SRL on online learning.

The paired sample t-test was tested to determine whether there was a difference in the average before and after using SRL in online mathematics learning. The test results related to using SRL obtained the average score of online mathematics learning before and after using SRL along with the standard deviation ($M = -13,749$; $SD = 10,749$), where the average was opposing because the results of the score before were subtracted after. The results obtained from the value t-value of -3.374 (t-value < t-table = 2.447) with a significance was 0.015 ($p < .05$). According to the data, it can be concluded that there is a significant difference in the use of SRL before and after statistically. These results indicate that using SRL in online mathematics learning during the Covid-19 pandemic has had a positive effect, especially in increasing student mathematics learning achievement.

Self-Regulated Learning (SRL) is very much needed during online learning during the Covid-19 pandemic for students, including junior high school and university students. The use of SRL affects increasing student achievement. The results showed that the average increase in students' online mathematics learning after using SRL was 13.749, shown in table 5, with a percentage of 30.361%. In line with several other studies showing an increasing change in student scores before and after SRL (Kusuma, 2020; Muhammad, 2020; Fitriani & Haryanto, 2020). Based on research by Cai et al. (2020) shows that the average score after using SRL in mathematics has increased by several points, and the use of SRL in online mathematics learning can improve academic achievement ($p = 0.179 > 0.05$). Fauzi & Widjajanti (2018) argue that SRL is a very effective strategy for student achievement. The results of research conducted by Alten et al. (2020) show that their academic achievement is high, and students with high SRL will also increase their persistence and learning motivation. SRL is proven to increase students' learning motivation so that with such motivation, their academic achievement will also increase (Cho & Heron, 2015).

Teachers should use Self-Regulated learning (SRL) during the online learning process because there is a significant relationship between using SRL during the online learning

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period. The SRL implementation in online mathematics learning from the selected papers is summarized as follows. The teacher directs students to :

- Self-evaluate;
- Set targets and learning objectives;
- Dig for information;
- Motivate learning from intrinsic to extrinsic;
- Set the time and learning environment;
- Self-regulation;
- Organize tasks;
- Reflecting on yourself
- Self-monitoring;
- Checking self-readiness in learning (materials, assignments, learning tools, etc.);
- Initiative;
- Reflect on the lessons learned and
- Review the lessons that have been implemented

The results showed an effect of using SRL on online mathematics learning. This result is evidenced by the correlation coefficient r of 0.976. In line with this, these results can support the research of Muhammad (2020), which states that there is a significant effect related to independent learning or Self-Regulated learning with online lectures of mathematics education study program students. In their research, Cai et al. (2020) suggest, among others: 1) teachers should guide their students to use SRL in learning; and 2) by the student's academic conditions, meaning that the teacher must consider the choice of method used for each material. So that SRL will be truly effective if it is used in learning, especially online mathematics learning.

The application of SRL in online learning is very beneficial during the Covid-19 pandemic because there is a significant effect between before and after using SRL. Carter et al., (2020) research, with his findings related to students' online learning performance during the Covid-19 pandemic, proves that students who carry out online learning supported by SRL show better performance than students who do online learning without being supported by SRL 5 shows the research area subjects interested in Digital Leadership in Education. Among these subjects, "Social Sciences" is the dominating subject, generating 32.5% of publications between 2015 and 2023. Next, the subject of "computer science" is in second place, generating 20.8%; in third place is the subject of "business management" generating 9.2%; in fourth place is the subject of "engineering" generating 8.3%, while the subject "Decision Science" is in fifth place generating 5.0%.

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Figure 2. Self-Regulated Learning Phases

Self-regulated learning (SRL) developed from Bandura's theory, which states that humans result from a causal structure from personal, behavioral, and environmental aspects (Bandura, 1991). These three aspects are determinants of SRL because these aspects are interrelated causes and effects in student SRL. The result is performance or behavior, and this behavior will affect environmental changes and others. SRL in learning will make students proficient in managing their learning according to their abilities and wishes so that, in the end, it can improve their learning achievement.

4. CONCLUSION

This study's results indicate that effectively used self-regulated learning (SRL) in online mathematics learning during the Covid-19 pandemic based on several review papers. There was an increase in self-regulated learning scores during the online learning period. The results obtained indicate an effect of the use of SRL in online mathematics learning activities. Several relevant studies show positive aspects of using SRL during the online learning period, namely increased student achievement. This study's results support previous research on improving student performance supported by self-regulated learning (SRL) during online learning and other research related to SRL in online mathematics learning.

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