

RESEARCH ARTICLE | MAY 15 2023

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AIP Conference Proceedings 2595, 040008 (2023)

<https://doi.org/10.1063/5.0123721>



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The Level of Science Self-Regulated Learning of Preservice Teacher Using Mobile Learning in the Covid-19 Pandemic Era

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Abstract. The Indonesian government has limited community mobilization to prevent the spread of COVID-19, as well as making policies regarding working from home and studying from home. Using information and communication technology, the learning process is transformed into distance learning to deal with the limitations of the direct teaching process. One crucial aspect of online learning is self-regulated learning. It is considered necessary in online learning because students need self-regulated learning skills to be able to coordinate and guide themselves, as well as adapt and monitor themselves when faced with learning tasks. This research aims to identify the level of self-regulated learning of students who learn using mobile learning as a discussion forum. The research used a survey method which conducted to 164 elementary education students at an Islamic university, Indonesia. Data were collected by questionnaire online through googleform. The results showed that, in general, the students' self-regulated learning ability was excellent. However, in the planning aspect, students' self-regulated learning ability still needs to be developed. The ability of self-regulated learning students in semester II and IV is better than semester VI students.

INTRODUCTION

The World Health Organization (WHO) pronounced COVID-19 a worldwide crisis on 30 January 2020 and a worldwide widespread on 11 March 2020. Right now, COVID-19 has influenced 213 nations and domains [1]. A few nations have actualized strict physical separating and lockdown arrangements to anticipate the progress far reaching COVID-19. This approach, of course, too incorporates a significant effect on schools, understudies, and instructors. As of 12 March 2020, 46 nations on five landmasses have reported school closings and 26 of these nations have closed school across the nation [2]. In Indonesia, the government has limited community mobilization to prevent the spread of COVID-19 and make policies regarding working from home and studying from home. Our university also has been temporarily closed for students since mid-March 2020.

The learning process transformed into distance learning by utilizing Information and Communication Technology (ICT) to deal with the limitations of the direct teaching process. Learning using e-learning is one of the best technologies in continuing the teaching and learning process during a pandemic [3]. Our university has developed an e-learning using Moodle platform to help the process learning in this network. E-learning can bridge online social media applications with offline learning. Online learning seeks to integrate technology in learning so that it can form quality learning [4]. Applications that are often used are messenger applications that can be used to communicate directly (synchronous).

One of the online learning strategies is mobile learning. Mobile learning can send text, images, and even voice, which is very appropriate as a discussion tool. Mobile learning can be a promising tool for communication and collaboration on online learning [5–7]. Based on the results of a survey that has been carried out, it shows that 88% of teachers use mobile learning as an online learning medium during the COVID pandemic. Barhoumi (2015) uses mobile learning as the primary media in online learning, resulting in increased student management skills. Grover et

al. (2020) also proved that the mobile learning application was beneficial in delivering lecture introductions. Besides, it turns out that mobile learning can also be used as a medium for further discussion in blended learning [6,10].

One crucial aspect of online learning is self-regulated learning (SRL). SRL is considered necessary in online learning because SRL ability is needed by students to be able to organize and direct themselves, be able to adjust and control themselves in facing learning tasks [11]. Self-regulated learning was an basic factor in the success of various studies [12,13]. Previous research [12,14] states the significance of self-regulated learning for learning victory and making strides understudy execution. People with high SRL, specifically those who can arrange, organize and control the learning handle, can learn quicker and have way better execution than those with low SRL [15]. Students who have SRL can actively carry out their learning activities independently [16]. By having SRL, students can make plans about what they learn, monitor their learning process, evaluate the learning process, look for supporting factors in learning, and learn to achieve superior achievements. Thus, students who have SRL will tend to be able and independent when learning takes place online.

SRL is the ability to regulate thoughts, emotions, and attitudes during the learning process. This skill encompasses a number of different facets of self regulated learning, namely cognitive, emotional, motivational, and social. SRL includes seven components (RSRLM - Revised Self Regulated Learning Model), among others: 1) Motivation - the students' internal desire to learn the more students see assignments as important to their future, the more motivated they are to learn. 2) Engagement (Engagement) - the students' contribution to the learning process. 3) Thought (Forethought) - student results, such as goal-setting and planning. 4) Performance - The techniques available for the learning process are actively used by the participants. 5) Continuous self-reflection and evaluation carried out by students during and after the assignment are related to success in the learning task. 6) Monitoring - learners keep track of whether their intrinsic motivation is appropriate for the learning process, prepare ahead, determine whether their performance meets goals, and evaluate their self-satisfaction with their progress, 7) Management - actions taken by students in order to learn and achieve their best performance. Learners with management skills can work independently and monitor the learning process from beginning to end. [17].

Several researchers have investigated the importance of self-regulated learning in online learning in recent years [18–20]. In comparison to traditional learning, online learning is more student-centered, and students assume more responsibility and autonomy, especially in synchronous learning environments. Online learning requires students to use mechanical skills [21–23]. Because of the versatility and design of online learning, students must gain more self-control in their learning [24]. Students with low abilities benefit more from online learning experiences than from face-to-face learning [15]. Thus, learning in an online environment forces students to face various cognitive and socio-emotional challenges that arise from online learning features, such as the need to have self-regulated skills [19]. The more skills students have, the more likely they will be successful in an online learning environment [18,20,25].

Studies that have identified the role of self-regulated learning in online learning have focused more on blended learning in recent years [20,22,26], massive open online courses [18], and online assignments [27]. Identification of self-regulated learning in mobile learning as a new discussion medium has not been widely used. Research that has used mobile learning focuses on the need for mobile learning as a medium of discussion [6,9,10]. Thus, considering the importance of the role of self-regulated learning in online learning [18–20], it is essential to identify student self-regulated learning in online learning. So that learning can be designed according to the level of student self-regulated learning. The novelty of this research lies in the use of mobile learning during the COVID-19 pandemic and the description of self-regulated learning at each indicator and at each student level. Thus, this study aims to identify the level of self-regulated learning of students who use mobile learning in the Covid-19 Pandemic Era. Student self-regulated learning is identified in three aspects, including 1) student self-regulated learning in all aspects, 2) self-regulated learning on each indicator, 3) self-regulated learning in each semester.

METHOD

This study used a quantitative approach to survey research method. The data generated in this study will be described quantitatively by statistical analysis. The survey is intended to obtain an overview of the characteristics of the population, such as attitudes, values or beliefs, and other aspects. The survey method in this study was used to reveal and describe the level of self-regulated learning of elementary education students during online learning during the COVID-19 pandemic in the science subject. The survey method described in Figure 1.

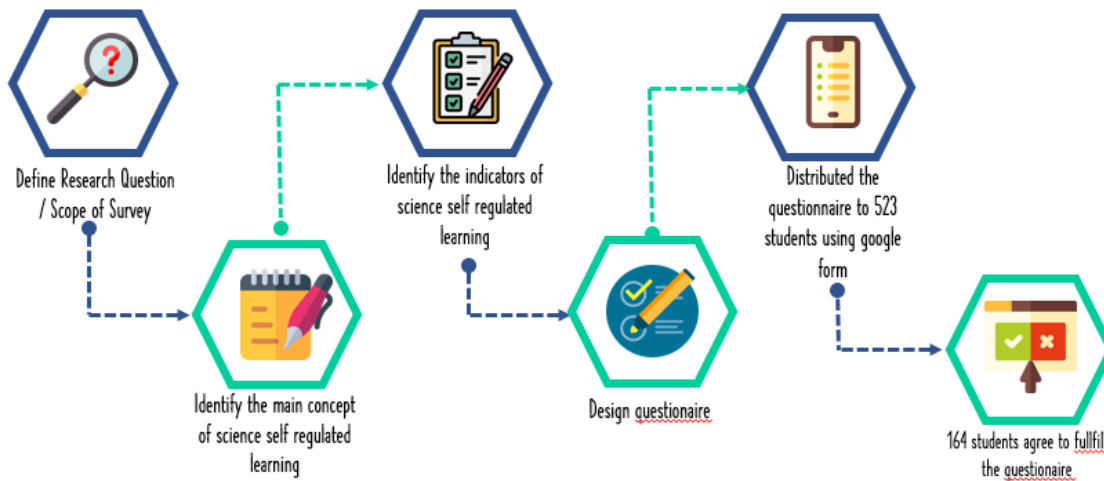


FIGURE 1. *The Survey Method*

This research was conducted at Universitas Islam Negeri Maulana Malik Ibrahim Malang in the Madrasah Ibtidaiyah Teacher Education study program. The research time required is one month, including observation to obtain data and to distribute research questionnaires. The population of this study was all students of elementary education students at Universitas Islam Negeri Maulana Malik Ibrahim Malang, totaling around 523 students. While the sample of this study only randomly took students who volunteered to fill out an online questionnaire. The research sample obtained some 164 students. The following details the subject of this study described in Table 1.

TABLE 1. Description subject of the study

Grade	Gender	
	Male	Women
Semester II	11	19
Semester IV	35	59
Semester VI	1	39
Total	47	117

The variables in this study consisted of only one independent variable, namely mobile learning and the dependent variable, namely preservice teacher's science self-regulated learning. The research data collection technique was carried out by surveying by distributing questionnaires online to all students.

The research instrument is a questionnaire that is distributed online via Google Forms. The research instrument was prepared based on the operational definition of SRL. In general, SRL is an individual's ability to regulate the learning process, which includes planning, implementing, and evaluating learning both in cognitive, psychomotor, and affective aspects to achieve learning goals. Based on this definition, there are indicator aspects in SRL, including 1) learning planning, 2) learning implementation, 3) learning evaluation. Based on these indicators, a grid of SRL instruments can be arranged as Table 2.

TABLE 2. Science Self-regulated learning instrument

Aspect	Indicator	Item Number		Total
		Positive	Negative	
Planning (Forethought)	Determine the learning strategy to be used	1, 2, 3, 4, 5	6, 7	7
	Feeling obliged to complete school work	8, 9, 10	11, 12, 13	6
	Set yourself up for study preparation	14, 15, 16	17	4
Implementation	Implement cognitive and metacognitive strategies	18, 19,	23, 24,	8

Aspect	Indicator	Item Number		Total
		Positive	Negative	
(Performance / Volitional Control)		20, 21, 22	25	
	Monitor and control emotions and motivation	26, 27, 28, 29	30, 31	6
	Doing activities	32, 33	34, 35, 36, 37	6
Evaluation	Choosing strategies to overcome failure in learning	38, 39, 40	41	4
	Feeling able to evaluate learning outcomes	42, 43, 44	45	4
	Review the results of your work	46, 47	48, 49	2
Total				49

The scale used in this study is a Likert scale consisting of four levels, 1) Never, 2) Sometimes, 3) Often, 4) Always. The data analysis technique in this study used quantitative descriptive analysis techniques using the percentage results regarding the ability of self-regulated learning. The percentage value obtained is then entered into the standard criteria for categorizing self-regulated learning, which consists of high, medium, and low.

RESULTS AND DISCUSSION

Description of Preservice Teacher Science Self-Regulated Learning in All Aspects

The information gathered in this study comes from an examination of the self-regulated learning capacity scale, which included aspects of planning, execution, and assessment. This study involved 164 students who volunteered to fill out this SRL questionnaire. Overall, the SRL questionnaire consisted of 49 items. The ability of SRL of all students has an average of 49.69. With a minimum score of 9 and a maximum score of 83. The description of student SRL data is generally described in Table 3.

TABLE 3. Description of self-regulated learning ability in all aspects

Self-Regulated Learning	Number of Items	Maximum	Minimum	Mean	SD
	49	83	9	49.69	13.12

Furthermore, categorization is carried out from the results of the general data. The self-regulated learning data were categorized into low, medium, and high categories based on the overall data. Based on the data analysis that has been done, it was found that 0% of students have Low SRL ability, 60% of students have Medium SRL ability, and the remaining 40% have High SRL ability. The percentage of self-regulated learning ability for each category is described in Figure 2.

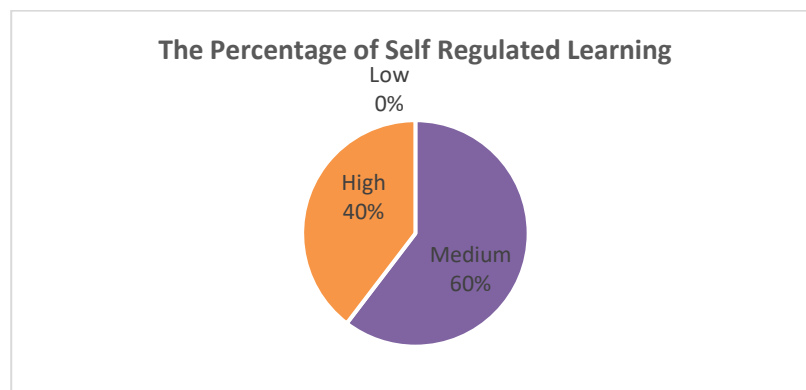


FIGURE 2. The percentage of self-regulated learning

Description of Student Self Regulated Learning on Each Indicator

Self-regulated learning consists of 3 aspects, namely, planning, implementation, and evaluation. Each aspect consists of 3 indicators, as described in the instrument grid above. Self-regulated learning data on each indicator can be described in Figure 3.

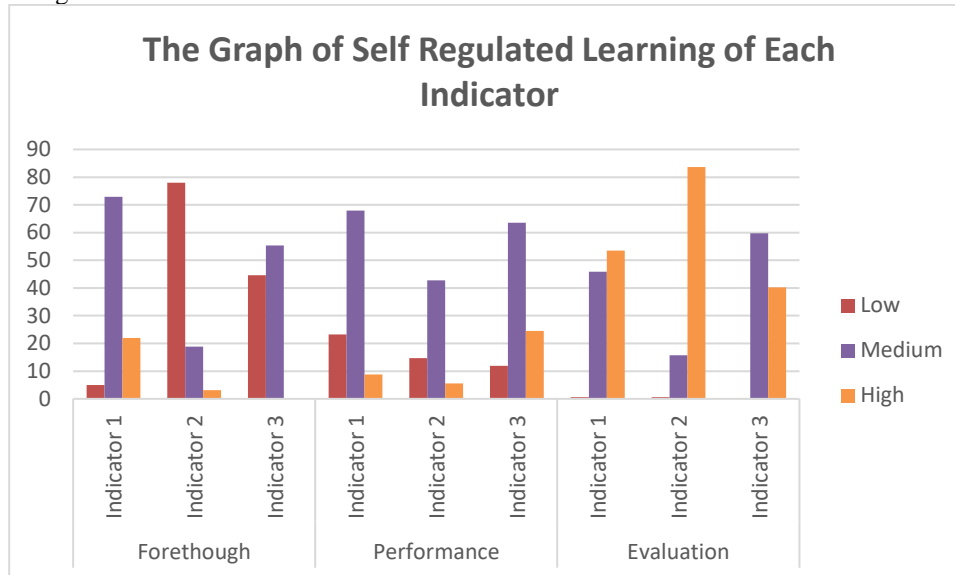


FIGURE 3. Self-regulated learning of each indicator

Forethought Aspects

The first aspect of SRL is the forethought aspect. In the forethought aspect, there are three indicators, namely 1) Determining the learning strategy to be used, 2) Feeling obliged to complete school assignments, 3) Organizing yourself for learning preparation. The description of students' self-regulated learning abilities in the planning aspect can be seen in Table 4.

TABLE 4. Description of Student Self Regulated Learning Aspects of Planning

Indicator	Number of Items	Mean	Minimum	Maximum	SD
Determine the learning strategy to be used	7	10.47	3	16	2.58
Feeling obliged to complete school work	6	2	-5	8	2.26
Set yourself up for study preparation	4	6.87	-1	11	1.98

Students' SRL ability in planning aspects on the indicators of determining the learning strategy to be used as an average of 10.47, with a minimum score of 3, a maximum score of 16, and a standard deviation of 2.58. Whereas in the second indicator, feeling obliged to complete school assignments, the average student self-regulated learning ability was 2, with a minimum score of -5, a maximum score of 8, and a standard deviation of 2.26. In the third indicator, managing yourself for learning preparation, the average score of students' self-regulated learning ability is 6.87, with a minimum score of -1, a maximum score of 11, and a standard deviation of 1.98.

Students' SRL ability in the planning aspect can be categorized into low, medium, and high categories. Based on graph 2, it can be described the percentage of students' self-regulated learning ability on each indicator. In the planning aspect, indicator 1: Determining the learning strategy to be used, 5.03% of students are in a low category, 72.95% of students are in the medium category, 22.01% are in the high category. In the planning aspect, indicator 2: Feeling obliged to complete school work, 77.98% of students are in a low category, 18.87% of students are in the medium category, and 3.14% of students are in the high category. While the planning aspect, indicator 3: Organize yourself for learning preparation, 44.65% is in the low category and 55.34% is in a medium category.

Performance Aspects

The second aspect of SRL is performance. In the performance aspect, there are three indicators, namely 1) Implementing cognitive and metacognitive strategies, 2) Monitoring and controlling emotions and motivation, 3) Carrying out activities. The description of the ability of student SRL in the performance aspect can be seen in Table 5.

TABLE 5. Description of Student Self Regulated Learning Performance Aspects

Indicator	Number of Items	Mean	Minimum	Maximum	SD
Implement cognitive and metacognitive strategies	8	8.72	1	16	2.77
Monitor and control emotions and motivation	6	7.41	0	13	2.84
Doing activities	6	1.95	-9	4	2.27

The ability of student SRL in the performance aspect of the indicators of applying cognitive and metacognitive strategies has an average of 8.72, with a minimum score of 1, a maximum score of 16, and a standard deviation of 2.77. Whereas in the second indicator, monitoring, and controlling emotions, the average student SRL ability was 7.41, with a minimum score of 0, a maximum score of 13, and a standard deviation of 2.84. In the third indicator, doing the activity obtained an average score of students' SRL ability of 1.95, with a minimum score of -9, a maximum score of 4, and a standard deviation of 2.27.

Students' SRL ability in the performance aspect can be categorized into low, medium, and high categories. Based on graph 2, it can be described the percentage of students' SRL ability on each indicator. In the aspect of performance indicator 1: Implementing cognitive and metacognitive strategies, 23.27% of students are in a low category, 67.92% are in the medium category, and 8.81% of students are in the high category. In the aspect of performance indicator 2: Monitoring and controlling emotions, 14.64% of students are in a low category, 42.72% of students are in the medium category, and 5.54% of students are in the high category. While the performance aspect, indicator 3: Doing activities, 11.95% is in a low category, 63.52% is in the medium category, and 24.53% is in a high category.

Aspect Evaluation

The third aspect of SRL is evaluation. In the evaluation aspect, there are three indicators: 1) Choosing a strategy to overcome failure in learning, 2) Feeling able to evaluate learning outcomes, 3) Reviewing the results of their work. The description of students' SRL abilities in the evaluation aspect can be seen in Table 6.

TABLE 6. Description of Student Self Regulated Learning Aspects of Evaluation

Indicator	Number of Items	Mean	Minimum	Maximum	SD
Choosing strategies to overcome failure	4	6.54	3	11	1.72

Indicator	Number of Items	Mean	Minimum	Maximum	SD
in learning					
Feeling able to evaluate learning outcomes	4	7.84	5	11	1.23
Review the results of your own work	2	2.04	-2	5	1.45

The ability of student SRL aspects of evaluation on the indicators of choosing a strategy to overcome failure in learning has an average of 6.54, with a minimum score of 3, a maximum score of 11, and a standard deviation of 1.72. Whereas in the second indicator, Feeling able to evaluate learning outcomes, the average student SRL ability was 7.84, with a minimum score of 5, a maximum score of 11, and a standard deviation of 1.23. In the third indicator, reviewing the results of their work, the average score of students' SRL ability is 2.04, with a minimum score of -2, a maximum score of 5, and a standard deviation of 1.45.

Students' SRL abilities in the evaluation aspect can be categorized into low, medium, and high categories. Based on graph 2, it can be described the percentage of students' SRL ability on each indicator. In the evaluation aspect of indicator 1: Choosing a strategy to overcome failure in learning, 0.63% of students are in a low category, 45.91% of students are in the medium category, and 53.46% of students are in the high category. In the evaluation aspect, indicator 2: Feeling able to evaluate learning outcomes, 0.63% of students are in a low category, 15.72% of students are in the medium category, and 83.65% are in the high category. While the evaluation aspect, indicator 3: Reviewing the results of their work, 59.75% are in the medium category and 40,25% are in the high category.

Descriptions of Student Self Regulated Learning for Each Semester.

The subjects of this study consisted of students in semester II, semester IV, and semester VI of the elementary education students of Universitas Islam Negeri Maulana Malik Ibrahim Malang. They were taking online learning during the COVID-19 pandemic. Previous data exposure is the general data exposure for all students, regardless of the semester level. Furthermore, student SRL data can be grouped based on semester levels. This grouping aims to determine the level of SRL at each semester level. The ability of students to SRL in each semester is depicted in Figure 4.

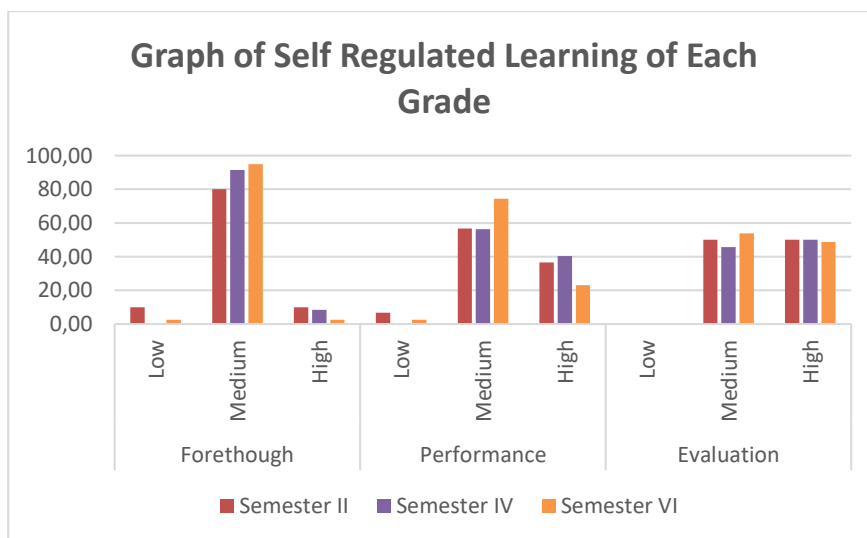


FIGURE 4. Self-regulated learning of each grade

In the planning aspect, 10% of students' SRL ability in semester II is at a low level, 80% of students are at a moderate level, and 10% are at a high level. Meanwhile, in semester IV students, 91.49% of students had a moderate

level of SRL, and 8.51% had high SRL. In semester VI students, 2.56% have SRL in the low category, 94.87% in the medium category, and 2.56% in the high category.

In the implementation aspect, the ability of SRL of second-semester students is 6.67% at a low level, 56.67% of students are at a medium level, and 36.67% are at a high level. Meanwhile, in the fourth-semester students, 56.38% of students had a moderate level of SRL, and 40.43% had high SRL. In semester VI students, 2.56% have SRL in the low category, 74.36% in the medium category, and 23.08% in the high category.

In the implementation aspect, 50% of the students' SRL ability in semester II is at a moderate level, and 50% is at the high level. Meanwhile, in semester IV students, 4.26% of students had a low level of SRL, 45.74% had a moderate level of SRL, and 50% had high SRL. In semester VI students, 53.85% have SRL in the medium category, and 48.72% are in the high category.

SRL is an essential aspect of online learning because students need SRL skills to coordinate and guide themselves, as well as adapt and manage themselves when confronted with learning tasks [11]. Self-regulated learning has been described as a critical component in the success of a variety of learning activities and the improvement of student performance [12]. Individuals with high SRL, namely those who can plan, organize, and control the learning process, can learn faster and have better performance than those with low SRL [28]. Students who have SRL can actively carry out their learning activities independently [16]. By having SRL, students can make plans about what they learn, monitor their learning process, evaluate the learning process, look for supporting factors in learning, and learn to achieve superior achievements. When learning takes place online, students who have SRL will tend to be able and independent.

In general, self-regulated learning of elementary education students using mobile learning during the COVID-19 pandemic has begun to develop. It is proven that 60% of students have a moderate level of SRL. This means that students should, in general, take charge of their own learning and the methods they create to help them learn. [29]. Students are often good at setting learning goals and then attempting to track, regulate, and manage their intellect, motivation, and actions, all of which are influenced and governed by their goals and the environment [30]. This is also in line with research that has been carried out previously [18,27,31].

If investigated further on each indicator, it turns out that the level of student self-regulated learning on several indicators is still not fully developed. In the planning aspect, students' SRL ability has begun to develop. This is evident from the percentage of students' SRL levels on the indicators of determining learning strategies, and organizing themselves for learning preparation, is quite good. However, the indicators feel obligated to complete tasks that still need to be improved. This shows that students are able to analyse learning activities, assess their ability to successfully achieve and set goals and plans for completion [32]. This is in line with research [29] that SRL students are able to take control of their own learning and the methods they devise to help them succeed.

In the implementation and evaluation aspects, students' self-regulated learning ability has also been good and has begun to develop. This demonstrates that students are capable of exercising self-control and self-observation. Self-control can be achieved by a range of methods, such as self-instruction, finding support, or imposing self-consequences. Self-observation also entails two modes of action: self-monitoring and self-recording [33]. Besides, students can also assess their learning and provide reasons for getting the right results, namely through self-assessments [34].

Self-regulated learning at each level is generally almost the same. In the aspects of planning and evaluation, the ability of self-regulated learning among semester II, IV, and VI students is almost the same. However, in the implementation aspect, students in semester II and IV have better self-regulated learning implementation than semester VI students. Yot-Domínguez C and Marcelo [29] explained that SRL can be implemented in students that use digital technologies through practices that require a higher degree of intentionality and sophistication, such as reading, classifying, utilizing, or exchanging knowledge with others, personal management, self-monitoring, or self-assessment. So that students who have high SRL will be better in the learning process than students who have low SRL. This is in line with the opinion of Achdiani [35] who found the obstacle that the aspect of independence in the application of internet based SRL needs to be improved in terms of preparation for students. However, in the process, it is undeniable that there will be several obstacles that are felt and experienced by students such as internet signal interference, facilities used such as laptops or cell phones that are not supported, internet quotas used, conditions of places / homes that are less comfortable and others. In a situation like this, students have an obligation to be able to manage their condition well during the learning process [36].

CONCLUSION

The Indonesian government has restricted community mobilization in order to prevent the spread of COVID-19 and to establish policies regarding working and studying from home. To overcome the limitations of direct teaching and learning, the learning process is turned into distance learning using Information and Communication Technology (ICT). One crucial aspect of online learning is self-regulated learning (SRL). SRL is thought to be important in online learning because students need to be able to coordinate and guide themselves, as well as adapt and manage themselves when confronted with learning tasks. The students' ability to self-regulate their learning was outstanding, according to the findings. However, students' self-regulated learning capacity still needs to be improved in terms of preparation. Semester II and IV students have better self-regulated learning abilities than semester VI students, particularly in terms of implementation. As a result, to train students in their abilities, self-regulated learning strategies are needed in online learning. This study is restricted to research topics that are exclusive to a single university. As a result, further research is needed. Therefore, further research is expected to provide an overview of students' self-regulated learning profiles throughout Indonesia.

REFERENCES

- 1 W. H. Organization, 2020 Coronavirus disease (COVID-19) pandemic. *Acessado Em* (2020).
- 2 R. H. Huang, D. J. Liu, A. Tlili, J. F. Yang and H. H. Wang, *Handbook on Facilitating Flexible Learning During Educational Disruption: The Chinese Experience in Maintaining Undisrupted Learning in COVID-19 Outbreak* (SLIBNU, Beijing, 2020).
- 3 S. Maré and A. T. Mutezo, *Open Learn. J. Open Distance E-Learn.* **36**, 164-180 (2020).
- 4 J. C. Evans, H. Yip, K. Chan, C. Armatas and A. Tse, *High. Educ. Res. Dev.* **39**, 643-656 (2020).
- 5 S. F. E. S. A. Fattah, *J. Educ. Pract.* **6**, 115-127 (2015).
- 6 K. Qamar, S. Riyadi and T. C. Wulandari, *J. Educ. Learn. EduLearn* **13**, 370-378 (2019).
- 7 F. Yavuz, *Int. J. Educ. Sci.* **15**, 408-415 (2016).
- 8 C. Barhoumi. *Contemp. Educ. Technol.* **6**, 221-238 (2015).
- 9 S. Grover, B. Garg and N. Sood, *J. Postgrad. Med.* **66**, 17-22 (2020).
- 10 R. I. Sandoval-Cruz, Y. N. Rangel, J. M. G. Calleros and M. D. Perales-Escudero, *RELC J.* 1-15 (2020).
- 11 A. Trisnawati, *J. Pijar Mipa* **13**, 6-12 (2018).
- 12 N. M. Müller and T. Seufert, *Learn. Instr.* **58**, 1-11 (2018).
- 13 U. Hijriyah, E. Pratiwi, A. Susanti, W. Anggraini, and A. P. Febriani, *J. Phys. Conf. Ser.* **1467**, 1-7 (2020).
- 14 M. Zeidner, *High Abil. Stud.* **30**, 255-276 (2019).
- 15 R. F. Kizilcec, M. Pérez-Sanagustín and J. J. Maldonado, *Comput. Educ.* **104**, 18-33 (2017).
- 16 B. J. Zimmerman, *Theory Pract.* **41**, 64-70 (2002).
- 17 M. A. S. Nodoushan. *Int. J. Language Stud.* **6**, 1-16 (2012).
- 18 M. E. Alonso-Mencía, C. Alario-Hoyos, J. Maldonado-Mahauad, I. Estévez-Ayres, M. Pérez-Sanagustín and C. D. Kloos, *Educ. Rev.* **72**, 319-345 (2020).
- 19 T. Shamir-Inbal and I. Blau, *Prof. Dev. Educ.* 1-17 (2020).
- 20 M. Shih, J. C. Liang and C. C. Tsai, *Interact. Learn. Environ.* **27**, 1192-1206 (2019).
- 21 N. Michailidis, E. Kapravelos and T. Tsiatsos, *Interact. Learn. Environ.* 1-12 (2019).
- 22 R. Prifti, *Open Learn. J. Open Distance E-Learn.* 1-15 (2020).
- 23 D. Song and D. Kim, *J. Res. Technol. Educ.* **53**, 249-263 (2020).
- 24 D. Putwain, P. Sander and D. Larkin, *Br. J. Educ. Psychol.* **83**, 633-650 (2013).
- 25 J. S. Stephen, A. J. Rockinson-Szapkiw and C. Dubay, *Am. J. Distance Educ.* **34**, 306-321 (2020).
- 26 D. Duchatelet and V. Donche, *High. Educ. Res. Dev.* **38**, 733-747 (2019).
- 27 K. Beckman, T. Apps, S. Bennett, B. Dalgarno, G. Kennedy and L. Lockyer, *Stud. High. Educ.* **46**, 821-835 (2019).
- 28 R. F. Kizilcec, M. Pérez-Sanagustín and J. J. Maldonado, *Comput. Educ.* **104**, 18-33 (2017).
- 29 C. Yot-Domínguez and C. Marcelo, *Int. J. Educ. Technol. High. Educ.* **14**, 1-18 (2017).
- 30 Y. Zeng and C. Goh, *Stud. Second Lang. Learn. Teach.* **8**, 193-218 (2018).
- 31 A. L. Marca and L. Longo *Int. J. Inf. Educ. Technol.* **7**, 230-235 (2017).
- 32 E. Panadero and J. Alonso-Tapia, *An. Psychol.* **30**, 450-462 (2014).

- 33 N. Dabbagh and A. Kitsantas, *Using Learning Management Systems as Metacognitive Tools to Support Self-Regulation in Higher Education Contexts* (Springer, New York, 2013).
- 34 B. J. Zimmerman and A. R. Moylan, *Self-Regulation: Where Metacognition and Motivation Intersect* (Routledge, New York, 2009).
- 35 A. Ana and Y. Achdiani *invotec* **11**, 15-22 (2015).
- 36 A. C. P. Harahap, *AL-IRSYAD* **10**, 36-42 (2020).