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Differences in the Improvement of Statistical Reasoning Ability Based on Students' Self-Regulated Learning Level in Online Learning Using LMS

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ABSTRACT

In the literature, studies on technology-supported learning, especially using LMS, have been widely carried out during a pandemic. However, little is known about LMS, which is interesting and helps to develop students' statistical reasoning abilities for online learning by considering the students' Self-Regulated Learning (SRL) levels (High, medium and low). This study aims to examine and analyze the differences in statistical reasoning abilities of students who study using LMS in terms of SRL levels (high, medium and low). This study uses a quantitative method with the type of One-group pre-test post-test design. What took sampled randomly at the University of Pasundan Bandung, totalling 54 third-level students of Pasundan University Bandung, Indonesia. Research data related to statistical reasoning abilities were collected through a test consisting of six questions. In contrast, SRL level data were collected using a questionnaire consisting of 46 question items. Paired t-test and One-way ANOVA analysis were applied to answer the research hypothesis. The results of the study concluded that students studying with LMS with High SRL obtained a higher increase in statistical reasoning ability than students studying with LMS with Medium and low SRL categories, with the criteria for improvement in the three categories being in the high and medium improvement categories. Research findings related to learning using LMS can be used as an alternative learning model in online learning situations.

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A. INTRODUCTION

Statistics is knowledge about data collection, data classification, presentation, processing, drawing conclusions, and making decisions based on certain problems (Hutasuhut, 2022; Kesumawati et al., 2017). Learning statistics in the higher education curriculum in Indonesia aims to provide a basic understanding of quantitative methods and their application for each study program graduate Cahyawati et al. (2020), Statistics courses provide a basic knowledge of descriptive and inferential statistics and their application in research and everyday life. Learning statistics courses requires the ability to obtain, present, and analyze data, and draw conclusions. To be able to understand and apply it requires statistical reasoning ability.

Students need statistical reasoning ability to master concepts in statistics that can be applied in research and real life (Rohana & Ningsih, 2020). Statistical reasoning ability

encourages students to understand concepts, connect ideas, and make interpretations to obtain the correct conclusions from the output produced (Kusumarasdyati, 2019). DelMas (2002) and Ramadhani et al. (2022) define statistical reasoning as a statistical way of thinking in generating statistical information. This includes the ability to interpret data sets, graphs and some statistical information. Another understanding states that statistical reasoning is the ability of students to do statistical calculations and reasoning against statistical concepts (Delyana et al., 2021). Although it can be applied in various scientific contexts, in general statistical reasoning is a goal that must be achieved in statistical learning. Statistical reasoning contains several basic concepts regarding probability, variability, sample selection, data distribution, and normal distribution (Fardillah et al., 2019; J Garfield, 2002; Joan Garfield & Ben-Zvi, 2005; Rosidah et al., 2018) especially in the study of statistics.

However, statistical reasoning abilities are still not wholly owned by students. This fact is explained by (Subekti & Akhsani, 2020; Subekti & Jazuli, 2022), who states that students are still experiencing: (1) Difficulties in giving reasons for choosing to present data in the form of the selected graph, (2) The meaning of data presentation, and (3) Difficulty solving the problem of data distribution size. Thus, statistical reasoning abilities are owned by students because they are the basis for the success of learning statistics.

On the other hand, the development of online-oriented learning allows learning statistics to be more varied. Online learning allows students to see first-hand examples of problems contextually related to statistics, and students' statistical reasoning abilities are needed. Online learning will be carried out well if students have good self-regulated learning (Aminulloh et al., 2021; Jin et al., 2023). Self-Regulaated Learning is one of the important things in a learning process. Self-Regulaated Learning is needed for every teenager, both students and students, so that they have the responsibility to organize and discipline themselves, in addition to being able to develop the ability to learn on their own accord (Aminulloh et al., 2021). The term self-regulated learning developed from the theory of social cognition proposed by (Jansen et al., 2019; Zimmerman, 1989). This theory explains as illustrated in Figure 1, there are three main factors that influence learning independence.

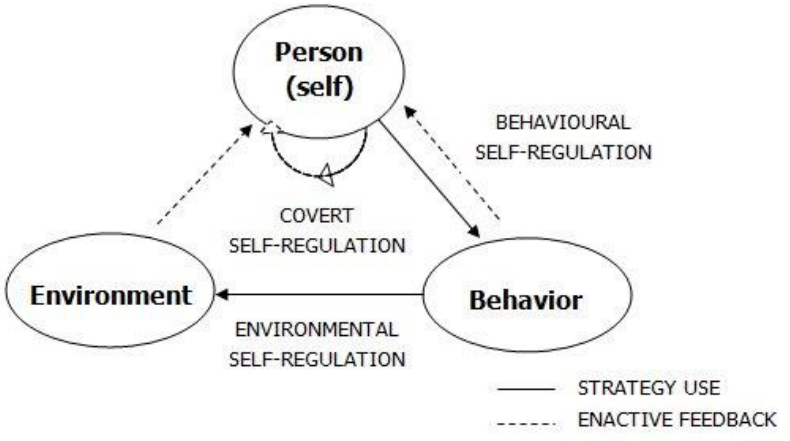

Figure 1. Triadic Analysis of Self-Regulated Functioning

According to social cognition theory, humans result from an interdependent causal structure that involves aspects of personal behaviour and environment. These three factors are the determining factors in independent learning. According to Garcia et al. (2018) these three determinant aspects are causally related; namely, when a person tries to self-regulate (self-regulated), the result is in the form of performance or behaviour, and this behaviour has an impact on environmental change and so on (Jakešová & Kalenda, 2015).

Self-regulated learning is an ability where a person can activate and encourage thoughts (cognition), feelings (affection), and actions (actions) that have been planned systematically and repeatedly oriented to achieve a goal in learning (Kusno & Setyaningsih, 2021; Wong et al., 2019; Zimmerman, 2002; Zubaidah, 2020). Thus, self-regulated learning will help students have the responsibility to regulate, discipline themselves, and develop the ability to learn on their own in training mental thinking skills, leading to statistical reasoning abilities (Farhan, 2020).

The world, including Indonesia, is experiencing restrictions on social interaction due to the coronavirus outbreak (Corona Virus diseases-19). The coronavirus is spreading worldwide rapidly, so WHO declared this outbreak a global pandemic on March 11, 2020 (Fadilla et al., 2021; Yusuf et al., 2021). After WHO determined the outbreak caused by the coronavirus as a global pandemic, the government established social distancing intending to break the chain of spreading the coronavirus (Fauzy & Nurfauziah, 2021; Hulukati et al., 2021). This impacts many things, one of which is the world of education. The government's sudden decision to move the learning process to home or use a distance learning system. This learning process leads to the development of industrial revolution 4.0, which utilizes digital technology in teaching and learning. Education in the Industrial Revolution Era 4.0 is a phenomenon that responds to the needs of the industrial revolution by adjusting the new curriculum according to the current situation. The curriculum can open a world window through the hand, for example, by utilizing the internet of things (IoT) (Janner Simarmata et al, 2020).

In 1997, along with the development of internet technology, people worldwide began to be connected to the internet. The need for information that could be obtained quickly began to be felt as an absolute necessity, and distance and location were no longer obstacles. From here emerged the Learning Management System (Agustina et al., 2016). Learning Management System is software for administrative purposes, documentation, reports on an activity, teaching and learning activities and online activities, and e-learning and training materials, all done online (Alturki & Aldraiweesh, 2021; Wibowo et al., 2014).

Higher education is one of the most important sectors facing the development of the industrial revolution 4.0. For universities, the Industrial Revolution 4.0 is expected to realize smart education through increasing and equalizing the quality of education, expanding access and relevance in realizing world-class. To achieve this, learning interactions are carried out through blended learning (through collaboration), project-based learning (through publications), flipped classrooms (through public interactions and digital interactions) (Theffidy, 2020).

All universities are required to have programs that are accessible to students for distance learning or online learning. For example, in one of the Social and Political Science faculties at a private university in the city of Bandung, which previously did not have a web or media that

could be used by lecturers and students in the lecture process, in less than a month the IT team at the university prepared a web that lecturers and students could access. Students using Learning Management System (LMS). These conditions are certainly many obstacles to implementing the effectiveness of learning.

The obstacles experienced impact the learning process of students who are unfamiliar with learning using LMS, especially in subjects that contain calculations such as Statistics. Statistics courses are always found at every university in Indonesia, including non-science faculties; for example, in one of the private universities in Bandung, the Faculty of Social and Political Sciences has a statistics course called Introduction to Social Statistics. To achieve Social Statistics learning using LMS, students need to have good Self-Regulated Learning. Because independent students are aware of their learning processes and strategies and take an active approach to adapting to the learning environment (McCardle et al., 2017), learning changes drastically from face-to-face to online learning be implemented well if students have good self-regulated learning.

According to previous research, online learning can identify the most effective Self-Regulated Learning compared to face-to-face learning (Kizilcec et al., 2017). According to research by Allison Littlejohn, Nina Hood, Colin Milligan, and Paige Mustin, students with high SRL levels value their participation in online learning because it allows them to expand their knowledge and skills (Littlejohn et al., 2016). With the rapid growth of online learning, students' self-directed learning is more successful in online learning than traditional face-to-face or mixed learning (Xu & Jaggars, 2014). This is similar to Ana and Achdiani, which found that students' self-regulated learning increased with internet-based learning (Ana & Achdiani, 2017).

They were referring to research results (Kizilcec et al., 2017; Littlejohn et al., 2016; Xu & Jaggars, 2014), which explain that Self-Regulated Learning is an important factor in determining learning success in online learning situations. On the other hand, researchers have not found any research that examines aspects of Self-Regulated Learning in statistics learning, especially for students in online learning situations. So specifically, the researcher focused on the research by observing the improvement of Statistical Reasoning Ability based on the level of Student Self-Regulated Learning by using LMS as a liaison medium and delivering material in online learning situations.

Based on the explanation above, the purpose of this research is to find out (1) the statistical reasoning abilities of students who study online using the LMS based on the level of self-regulated learning ability; (2) the implementation of online learning using the LMS has a significant effect on the acquisition of statistical reasoning abilities at the SRL level; and (3) differences in the statistical reasoning abilities of students who study online using the LMS based on the level of self-regulated learning.

B. METHODS

1. Research Design

This quantitative study has a one-group pre-test and post-test design (Cohen et al., 2007; Fraenkel, J. R., Wallen, N. E., & Hyun, 2013; Ishtiaq, 2019). This study involves two variables: the ability of statistical reasoning and self-regulated learning.

2. Research Sample

This research involved one class with online learning using LMS. This research was conducted in semester 3 for five meetings on the material on Central Tendency Measures and Dispersion Measures. The research sample consisted of 54 undergraduate students taking introductory social statistics courses. The research was conducted during an odd 2021/2022 school year semester. The learning process was carried out during the Covid-19 pandemic, where learning was carried out by online learning using the LMS. Students can access the LMS by first logging in using the student identification number, and students can read teaching materials provided by lecturers in the form of text or ppt; in addition, students can submit assignments in the LMS.

3. Research Instruments

The data collection consists of 2 types: statistical reasoning ability test questions and self-regulated learning ability questionnaires. The statistical reasoning ability test consists of 6 questions in the form of an essay. The test was conducted to measure the statistical reasoning ability of students using LMS. The indicators used to measure the statistical reasoning ability are those proposed by Joan Garfield (2002), namely Idiosyncratic reasoning, Verbal reasoning, Transitional reasoning, Procedural reasoning and Integrated reasoning. And on the self-regulated learning ability questionnaire, researchers used a Self-Regulated Learning questionnaire consisting of 46 items, consisting of 23 positive questions and 23 negative questions. The SRL indicators are followed the three phases of rotation proposed by Pintrich, Zusho and Zimmerman, namely forethought and planning, monitoring and reflection on performance (Kusno & Setyaningsih, 2021; Pintrich & Zusho, 2002; Zimmerman, 2000). Each item was measured using a Likert scale of four points, ranging from strongly disagree (1) to agree (4) strongly.

Before being used as a data collection tool, statistical reasoning ability test instruments and self-regulated learning questionnaires were validated and tested to ensure that the data obtained during the study were valid and reliable. Validity test through content validity and empirical validity procedures. Content validity is an assessment by experts, in this study involved as many as 2 experts, namely two professors in the field of mathematics. The results of the content validity test showed that the test instrument was content valid.

Empirical validity on statistical reasoning ability test questions is in the form of statistical instrument testing using product moment correlation analysis, namely comparing test scores with certain criteria used as benchmarks outside the question test. Before being used, the statistical reasoning ability test instrument was tested on 20 students who studied the material in the form of measures of concentration and data spread. Empirical validity is carried out by correlating the scores obtained by students on statistical reasoning ability tests with the average scores for the final semester examination of introductory social statistics obtained by students in the previous semester. The valid coefficient on the instrument is $0.552 > 0.268$, so the statistical reasoning ability test is valid. While the reliability test used alpha-Cronbach, the test results obtained a score of 0.531, so the statistical reasoning ability test is reliable in the medium category. The empirical validity of the self-regulated learning ability questionnaire in the form of test reliability found that the overall reliability of the student self-regulated learning

questionnaire was 0.704. The self-regulated learning questionnaire was given at the end of the lesson via a google form.

4. Data Analysis

Analysis of research data using statistical tests quantitatively. Normality and homogeneity tests were carried out before statistical tests were performed. The normality test used the Kolmogorov-Smirnov test, while the homogeneity test used the Levene test. Normalized gain is used to measure the increase in students' mathematical reasoning ability in both classes used. The normalized Gain formula and criteria follow the scheme in Table 1.

$$\text{Normalized Gain } (g) = \frac{\text{posttest score} - \text{pretest score}}{\text{ideal maximum score} - \text{pretest score}}$$

Table 1. Normalized Gain Score Criteria

Normalized Gain Score (g)	Interpretasi
g ≥ 0,70	High
0, 30 ≤ g < 0,70	Medium
g < 0, 30	Low

The research questions posed are descriptive and hypothetical. The first research question is descriptive. Descriptive statistical analysis is used to describe the criteria for increasing statistical reasoning abilities in students based on the level of Self-Regulated Learning Ability in Online Learning using LMS, which includes the meaning, standard deviation, and skewness. The criteria for increasing the ability of Statistical reasoning for students with high, medium and low SRL abilities refer to Table 1. At the same time, the second and third research questions are statistically paired with sample t-tests and one-way ANOVA. They are Used to answer the second and third research questions. The analysis process is assisted by using SPSS 25 software. The analysis procedure begins with pre-test, post-test, and N-gain analysis to determine whether the data is normal and homogeneous. This was followed by a paired sample t-test and one-way ANOVA (Allan Bluman, 2011; Ellena & Leonardi, 2014).

C. RESULT AND DISCUSSION

1. RESULT

The purpose of the study was to determine the increase in students' statistical reasoning abilities based on the level of Self-Regulated Learning Ability in Online Learning using LMS. Three questions were derived from achieving the intended research objectives based on these objectives. The following describes the results of descriptive statistical analysis related to increasing statistical reasoning abilities based on the level of self-regulated learning abilities. Descriptive analysis was used to answer the first research question. The results obtained are presented in Table 2.

Table 2. Descriptive statistics of KSR improvement scores by SRL Category

	SRL Category			**Statistic**	**Std. Error**
Ngain	High	Mean		.8085	.03158
		95% Confidence Interval for Mean	Lower Bound	.7397	
			Upper Bound	.8773	
		5% Trimmed Mean		.8111	
		Median		.8400	
		Variance		.013	
		Std. Deviation		.11386	
		Minimum		.64	
		Maximum		.93	
		Range		.29	
		Interquartile Range		.22	
		Skewness		-.285	.616
		Kurtosis		-1.651	1.191
	Medium	Mean		.6689	.03218
		95% Confidence Interval for Mean	Lower Bound	.6036	
			Upper Bound	.7342	
		5% Trimmed Mean		.6730	
		Median		.6950	
		Variance		.037	
		Std. Deviation		.19311	
		Minimum		.33	
		Maximum		.93	
		Range		.60	
		Interquartile Range		.31	
		Skewness		-.270	.393
		Kurtosis		-1.120	.768
	Low	Mean		.4600	.08337
		95% Confidence Interval for Mean	Lower Bound	.2285	
			Upper Bound	.6915	
		5% Trimmed Mean		.4561	
		Median		.4200	
		Variance		.035	
		Std. Deviation		.18641	
		Minimum		.25	
		Maximum		.74	
		Range		.49	
		Interquartile Range		.33	
		Skewness		.770	.913
		Kurtosis		.507	2.000

Based on the average score, standard deviation and skewness in Table 2, it is found that the average increase in Statistical reasoning ability of students who study online using LMS with a High SRL (N gain average = 0.81) is higher than the average increase in Statistical reasoning ability of students who have a Medium SRL level (mean N gain = 0.67) and Low (Mean N gain = 0.46). The criteria for improvement experienced at the three levels are high and medium levels. When viewed from the distribution of the increased data at the three SRL levels, the increase in Statistical reasoning abilities of students who study online using LMS with Low SRL (s= 0.193) is more diverse than the increase in Statistical reasoning abilities of students who

have High SRL levels (s = 0.114) and low (s=0.186). Meanwhile, based on the skewness score, two levels, namely high and moderate SRL, obtained a negative score (High skewness score = -0.285 and Medium = -0.270), so the graph of the increase in statistical reasoning ability of the two categories tends to be negatively skewed, which means that the scores of statistical reasoning ability improvement that are categorized as high and moderate tend to gather in high scores. At the same time, the low SRL category (low skewness score = 0.770) obtained a positive score, which means that it tends to be skewed to the right, which means that scores of increasing statistical reasoning abilities in the low category tend to converge on a small score.

The next analysis is related to the normality and homogeneity of the data on each score of statistical reasoning ability obtained from three categories (High, medium and low SRL) as a requirement before the paired sample t-test and One Way Anova test was carried out. This test is a series of answers to the second and third research questions. The results of the data normality test using the Kolmogorov-Smirnov test are presented in Table 3.

Table 3. Normality Test of Pre-test, Post-test, N-gain data in the three categories

	SRL Category	**Kolmogorov-Smirnov[a]**		
		Statistic	**df**	**Sig.**
Post-test_SR	High	.227	13	.066
	Medium	.142	36	.065
	Low	.236	5	.200*
Pre-test_SR	High	.205	13	.138
	Medium	.114	36	.200*
	Low	.188	5	.200*
N_Gain_SR	High	.227	13	.066
	Medium	.142	36	.065
	Low	.185	5	.200*

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The results in table 3 show that the significance level (sig.) at the three grade levels is far above .05. All data, both pre-test, post-test and N-gain scores, come from groups with normal distribution. At the same time, the homogeneity test uses the Levene test, which is presented in Table 4.

Table 4. Test of Homogeneity of Pre-Test, Post-Test, and N-gain Data in both classes

	Levene Statistic	**df1**	**df2**	**Sig.**
Post-test_SR	1.993	2	51	.147
Pre-test_SR	2.296	2	51	.111
N_Gain_SR	2.713	2	51	.076

Table 4 shows that the significant level of pre-test, post-test and N-gain scores is well above 0.05. This condition explains that the pre-test, post-test and N-gain scores have homogeneous variances. Because the statistical requirements related to the normality and homogeneity of the data were met, a paired sample t-test and one-way ANOVA could be performed. The analysis results using SPSS software obtained the output of Paired sample t-test in Table 5 and Table 6,

which explains the implementation of online learning using LMS has a significant effect on the acquisition of statistical reasoning abilities at each SRL level as shown in Table 5 and Table 6.

Table 5. Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test_SR_High	32.9231	13	5.07381	1.40722
	Post-test_SR_High	86.9231	13	8.04634	2.23165
Pair 2	Pre-test _SR_Medium	35.6389	36	4.40878	.73480
	Post-test _SR_Medium	78.6389	36	12.22446	2.03741
Pair 3	Pre-test SR_Low	50.4000	5	8.26438	3.69594
	Post-test _SR_Low	73.4000	5	9.76217	4.36578

Table 6. Paired Sample t-Test in the three categories

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre-test_SR_High - Post-test_SR_High	-54.00	6.84	1.898	-58.135	-49.864	-28.450	12	.000
Pair 2	Pre-test_SR_Medium - Post-test_SR_Medium	-43.00	13.12	2.186	-47.439	-38.560	-19.663	35	.000
Pair 3	Pre-test_SR_Low - Post-test_SR_Low -	-23.00	9.72	4.347	-35.070	-10.929	-5.291	4	.006

Table 6 shows the results of Pair 1, namely the comparison of Statistical Reasoning Pretest-Posttest abilities of students with a high SRL level, a significance level of 0.00 is obtained, which is smaller than the alpha value = 0.05. In contrast, table 5 shows a higher post-test score (86.923) than the pretest score (35.293). Thus, the implementation of learning using LMS is significant in acquiring statistical reasoning abilities in students with a high SRL level. The results of Pair 2 compare the ability of Statistical Reasoning Pretest-Posttest Students with a Medium SRL level, a significance level of 0.00 is obtained, which is smaller than the alpha value = 0.05.

In contrast, table 5 shows the post-test score, whereas table 5 shows the post-test score. The test score (78,639) is higher than the pretest score (35,639), so the implementation of learning using LMS is significant for the acquisition of Statistical Reasoning ability in students who have a moderate SRL level. Also, in the results of pair 3, namely the comparison of the ability of Statistical Reasoning Pretest-Posttest Students who have a Low SRL level, a significance level of 0.00 is obtained, which is smaller than the alpha value = 0.05, whereas in table 5 shows the post-test score (73,400) is higher than the score pretest (50,400). Thus the implementation of learning using LMS is significant to the acquisition of the Statistical Reasoning ability of students with a low SRL level. Further analysis, in the form of hypothesis testing, related to differences in statistical reasoning abilities of students learning to use LMS based on high, medium and low SRL levels using the one-way ANOVA test presented in Table 7.

Table 7. N-gain comparison test in the three categories

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.460	2	.230	7.340	.002
Within Groups	1.600	51	.031		
Total	2.060	53			

Based on Table 7, the test results obtained a significant level of 0.002, far below 0.05. so it can be concluded that there is a significant difference in statistical reasoning ability improvement between students with high, medium and low SRL levels. Furthermore, to find out which SRL level had a significant increase, a post-ANOVA follow-up test was carried out using the Tukey HSD test, as presented in Table 8.

Table 8. Tukey HSD test on Statistical Reasoning ability based on SRL category

(I) SRL Category	(J) SRL Category	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
High	Medium	.13957*	.05731	.048	.0012	.2779
	Low	.34846*	.09320	.001	.1235	.5734
Medium	High	-.13957*	.05731	.048	-.2779	-.0012
	Low	.20889*	.08453	.044	.0048	.4129
Low	High	-.34846*	.09320	.001	-.5734	-.1235
	Medium	-.20889*	.08453	.044	-.4129	-.0048

Table 8 shows a significant difference in the comparison of increasing statistical reasoning abilities between students who have high SRL levels with moderate SRL levels (sig = 0.048 < = 0.05), between high SRL levels and low SRL levels (sig = 0.001 < = 0.05) and a moderate SRL level with a low SRL level (sig = 0.044 < = 0.05). Based on Table 2, it can be seen that students who have high SRL levels (0.81 increase) obtain higher statistical reasoning abilities compared to students who have SRL levels of medium and low SRL. Meanwhile, students with a moderate SRL level (0.67 increase) obtain higher statistical reasoning abilities than those with a low SRL level (0.47 increase).

2. DISCUSSION

Online learning is a medium for delivering material during the COVID-19 pandemic. By using various online media, students and lecturers can communicate remotely. Several applications have their advantages, thus requiring several applications to support the entire online learning process. For example, the Zoom meeting application delivers material face-to-face and virtually. In contrast, the Google Classroom and Google Form applications manage assignments and record student attendance. The use of LMS can help students and lecturers manage classes that will be held for 1 semester or 1 year of learning so that students can coordinate learning well. The use of LMS is more effective than other application media because it has been adapted to the needs of the university. In addition, LMS is also very easy to use, in which students are given material in the form of reading texts and learning videos. When the lecturer holds a virtual face-to-face meeting, students click the link given by the lecturer at the LMS, so they don't need to open the zoom application again. This becomes automatically read by the student by the LMS system having filled in attendance at the meeting, and there is chat content in it. All these interactions occur directly on the monitor layer, so students do not have

to wait long to find out whether the response given is right or wrong. Learning situations like this can motivate students when studying in a COVID-19 situation. The application of learning series can keep students' emotions even though they cannot interact directly with lecturers and students. Because students can control their own study time. The results of research related to the use of LMS can assist lecturers in monitoring student activity with assignments, discussion forums, and other activities (HG et al., 2022; Wibowo et al., 2014)

The results of the descriptive analysis show that the category of increasing statistical reasoning abilities experienced by students who have high SRL levels who learn to use LMS is in the high category, while the increase in statistical reasoning abilities of students who learn to use LMS with moderate and low SRL levels is in the medium category. This condition explains that learning LMS can improve students' statistical reasoning abilities. These results are reinforced by the analysis in table 6, which explains that the implementation of online learning using LMS significantly affects the acquisition of statistical reasoning abilities at each SRL level. This is shown in the difference in students' acquisition of statistical reasoning abilities before and after the application of learning using LMS based on high, medium, and low SRL levels. This finding strengthens the application of LMS as an alternative in delivering mathematics learning (Haeruman et al., 2021; Supriyadi & Juandi, 2022).

Table 5 shows students' statistical reasoning ability using LMS learning based on the categories of High, medium, and low SRL abilities. The results showed that the post-test scores of statistical reasoning abilities based on High, medium, and low SRL abilities after learning using LMS were higher than the pre-test scores before learning using LMS. These findings confirm that each level's SRL abilities and the LMS application in this study helped students improve their statistical reasoning abilities. SRL capabilities encourage students to remain consistent in online learning and complete each assignment (Aminulloh et al., 2021; Jin et al., 2023).

Self-regulated learning helps students to be able to activate and encourage thoughts (cognition), feelings (affection), and action (action) so that it has an impact on differences in increasing statistical reasoning abilities at each SRL Level. In addition, the online learning process using the LMS helps students understand statistical concepts systematically by providing the context of the problem and applying it in solving relevant problems to impact students' statistical reasoning (Rahmi Ramadhani et al., 2022).

Chervaney, Benson, and Iyer (Chervany et al., 2016) define statistical reasoning as how a student can work with statistical content (remembering, recognizing, and distinguishing between statistical concepts) and the student's skill in using statistical concepts in stages. Specific problem-solving. They view statistical reasoning as a process of using statistical content through three stages, including: (1) Comprehension, namely seeing the problem as the same in one class; (2) Planning and execution, namely applying appropriate methods to solve problems; and (3) Evaluation and interpretation, namely interpreting the results related to the original problem (original).

The LMS given in the introductory social statistics course has been designed so that students can pass the three stages. Online learning has become the main medium to keep the learning process running during the Covid-19 period, which requires a lot of support. The systematic presentation of the material guides students to understand the given statistical concepts.

Concept Reinforcement by presenting relevant and accessible problems online helps students understand the application of these concepts. Researchers realize that a good student learning independence factor can support the implementation of online learning. This includes student emotions that must be supported. This opinion is reinforced by Sun & Zhang (2021) which state that students' emotions in online learning show a dynamic transition from anxiety and curiosity to emotional stability and then back to anxiety. This condition is a phenomenon that interacts with changing sources in the context of research. Hence, the selection of appropriate learning models and the use of various media that can help strengthen the delivery of information to students is important prepare. Simple learning can occur through model observations (in this case, lecturers, LMS, and teaching materials in the form of animated videos), which can slightly ease the burden on lecturers and students. Lecturers must become models and present alternative models that can make students focus on learning in online learning situations. The selection and use of various supporting applications that can regulate the delivery of learning information to students can be a researcher's effort to maintain the emotional stability of students to stay focused on learning. The implications of the results of this study can be used as consideration for lecturers in carrying out statistics learning, especially during the covid-19 pandemic.

D. CONCLUSION AND SUGGESTIONS

The results showed that the criteria for increasing the statistical reasoning abilities of students who learned to use the LMS in the three SRL categories (high, medium, and low) were in the high category. The implementation of LMS learning successively has a significant influence on students' statistical reasoning abilities. Where students who have a high SRL get a higher improvement than students who have a medium and low SRL ability.

The research has limitations. Namely, the research subjects are only level 3 students who contract introductory social statistics courses. So it is necessary to research again in applying the learning model using LMS at the school or other student levels. In addition, the statistical ability aspect is only limited to statistical reasoning ability, so measurements on higher statistical aspects need to be followed up. Based on the research findings and limitations in this study, further research can develop a learning model in the form of LMS media as one of the models or learning media in online learning situations. In addition, suggestions for further researchers, the LMS web that is used is designed even better so that in the learning process, students learn, not just download the material and be read by their system following the lecture. So it is necessary to improve the system on the LMS web when the material is displayed. Students can download it after reading the material. Reading the material can be seen in the pauses accessed by students, for example, 30 minutes in the settings.

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REFERENCES

Agustina, R., Santosa, P. I., & Ferdiana, R. (2016). Sejarah, Tantangan, dan Faktor Keberhasilan dalam Pengembangan e-Learning. *Seminar Nasional Sistem Informasi Indonesia*, *November*.

Allan Bluman. (2011). Elementary Statistics_ A Step By Step Approach, (8th Edition). In *Science Engineering Math* (Vol. 1999, Issue December). Science Engineering Math.

Alturki, U., & Aldraiweesh, A. (2021). Application of learning management system (Lms) during the covid-19 pandemic: A sustainable acceptance model of the expansion technology approach. *Sustainability (Switzerland)*, *13*(19). https://doi.org/10.3390/su131910991

Aminulloh, R., Jupri, A., & Juandi, D. (2021). Students' Self-Regulated Learning During Online Learning In Vocational High School Bandung. *Journal of Innovative Mathematics Learning*, *4*(1), 41–48. https://doi.org/10.22460/jiml.v4i1

Ana, A., & Achdiani, Y. (2017). Penerapan Self Regulated Learning Berbasis Internet Untuk Meningkatkan Kemandirian Belajar Mahasiswa. *Innovation of Vocational Technology Education*, *11*(1), 15–22. https://doi.org/10.17509/invotec.v11i1.4835

Cahyawati, D., Wahyudin, & Prabawanto, S. (2020). Students' statistical reasoning reviewed from academic internal factors in two learning classes. *Journal of Physics: Conference Series*, *1480*(1), 0–5. https://doi.org/10.1088/1742-6596/1480/1/012051

Chervany, N. L., Benson, P. G., & Iyer, R. K. (2016). The Planning Stage in Statistical Reasoning. *Taylor & Francis*, *34*(4), 222–226. https://doi.org/10.2307/2684064

Cohen, L., Manion, L., & Morrison, K. (2007). Research Methods in Education. In *Research Methods in Education*. https://doi.org/10.4324/9780203029053

delMas, R. C. (2002). Statistical literacy, reasoning and learning: A commentary. *Journal of Statistics Education*, *10*(3). https://doi.org/10.1080/10691898.2002.11910679

Delyana, H., Fauzan, A., Armiati, A., Gistituati, N., & Asmar, A. (2021). Pengembangan Modul Statistika Berbasis Project Based Learning. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *5*(3), 2313–2323. https://doi.org/10.31004/cendekia.v5i3.772

Ellena, R. C., & Leonardi, T. (2014). Perbedaan Self-Regulated Learning Siswa SMA Ditinjau dari Persepsi Terhadap Pola Asuh Orangtua. *Psikologi Pendidikan Dan Perkembangan*, *3*(3), 179–186. https://doi.org/ISSN 2301-7104

Fadilla, A. N., Relawati, A. Su., & Ratnaningsih, N. (2021). Problematika Pembelajaran Daring Masa Pandemi Covid-19. *Jurnal Jendela Pendidikan*, *8*(2), 145–150. https://doi.org/10.32505/tarbawi.v8i2.2562

Fardillah, F., Sutaagra, O., Supriani, Y., Farlina, E., & Priatna, N. (2019). Developing Statistical Reasoning Ability of Industrial Engineering Students Through Experiential Learning. *Journal of Physics: Conference Series*, *1179*(1). https://doi.org/10.1088/1742-6596/1179/1/012068

Farhan, M. (2020). Kemandirian Belajar dan Kemampuan Penalaran Matematis Pada Mata Kuliah Analisis Real. *Prosiding Seminar Nasional Dan Diskusi Panel Pendidikan Matematika Universitas Indraprasta PGRI*, *80*, 351–358. http://proceeding.unindra.ac.id/index.php/DPNPMunindra/article/view/4759

Fauzy, A., & Nurfauziah, P. (2021). Kesulitan Pembelajaran Daring Matematika Pada Masa Pandemi COVID-19 di SMP Muslimin Cililin. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *5*(1), 551–561. https://doi.org/10.31004/cendekia.v5i1.514

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2013). How to Design Research in Education and Evaluate. *The McGraw-Hill Companies, Inc*.

Garcia, R., Falkner, K., & Vivian, R. (2018). Systematic literature review: Self-Regulated Learning strategies using e-learning tools for Computer Science. *Computers and Education*, *123*, 150–163. https://doi.org/10.1016/j.compedu.2018.05.006

Garfield, J. (2002). The Challenge of Developing Statistical Reasoning. *Journal of Statistiks Education*, *10*(3). https://doi.org/10.1080/10691898.2002.11910676

Garfield, Joan, & Ben-Zvi, D. (2005). a Framework for Teaching and Assessing Reasoning About Variability. *Statistics Education Research Journal*, *4*(1), 92–99. https://doi.org/10.52041/serj.v4i1.527

Haeruman, L. D., Wijayanti, D. A., & Meidianingsih, Q. (2021). Efektivitas Blended Learning Berbasis LMS dalam Pembelajaran Matematika. *Jurnal Riset Pembelajaran Matematika Sekolah*, *5*(1), 80–84.

https://doi.org/10.21009/jrpms.051.10

HG, I. R., Wulandari, F., & Devianto, D. (2022). Analysis of Students' Satisfaction Level on iLearn Quality during COVID-19 Pandemic with WebQual 4.0 and PLS-SEM. *JTAM (Jurnal Teori Dan Aplikasi Matematika)*, *6*(2), 397. https://doi.org/10.31764/jtam.v6i2.7440

Hulukati, E., Achmad, N., & Bau, M. A. (2021). Deskripsi Penggunaan Media E-Learning dalam Pembelajaran Matematika di Masa Pandemi Covid-19. *Jambura Journal of Mathematics Education*, *2*(1), 21–27. https://doi.org/10.34312/jmathedu.v2i1.10061

Hutasuhut, S. H. (2022). Peranan Statistika Dalam Penelitian Pendidikan Matematika. *MES: Journal of Mathematics Education and Science*, *7*(2), 60–69. https://doi.org/10.30743/mes.v7i2.5186

Ishtiaq, M. (2019). Book Review Creswell, J. W. (2014). Research Design: Qualitative, Quantitative and Mixed Methods Approaches (4th ed.). Thousand Oaks, CA: Sage. *English Language Teaching*, *12*(5), 40. https://doi.org/10.5539/elt.v12n5p40

Jakešová, J., & Kalenda, J. (2015). Self-regulated Learning: Critical-realistic Conceptualization. *Procedia - Social and Behavioral Sciences*, *171*, 178–189. https://doi.org/10.1016/j.sbspro.2015.01.105

Janner Simarmata, Mustofa Abi Hamid, Rahmi Ramadhani, Dina Chamidah, Lidia Simanihuruk, M. S. D. N., & Muhammad Iqbal, N. A. S. (2020). *Pendidikan Di Era Revolusi Industri 4.0 (Tuntutan, Kompetensi dan Tantangan)*. Yayasan Kita Menulis.

Jansen, R. S., van Leeuwen, A., Janssen, J., Jak, S., & Kester, L. (2019). Self-regulated learning partially mediates the effect of self-regulated learning interventions on achievement in higher education: A meta-analysis. *Educational Research Review*, *28*(June), 100292. https://doi.org/10.1016/j.edurev.2019.100292

Jin, S.-H., Im, K., Yoo, M., Roll, I., & Seo, K. (2023). Supporting students' self-regulated learning in online learning using artificial intelligence applications. *International Journal of Educational Technology in Higher Education*, *20*(1). https://doi.org/10.1186/s41239-023-00406-5

Kesumawati, N., Retta, A. M., & Sari, N. (2017). *Pengantar statistika penelitian*. Rajawali Pers.

Kizilcec, R. F., Pérez-Sanagustín, M., & Maldonado, J. J. (2017). Self-regulated learning strategies predict learner behavior and goal attainment in Massive Open Online Courses. *Computers and Education*, *104*, 18–33. https://doi.org/10.1016/j.compedu.2016.10.001

Kusno, K., & Setyaningsih, E. (2021). Self-Regulated Learning of Mathematics for Teacher Prospectives in the Development of Student E-Worksheets. *JTAM (Jurnal Teori Dan Aplikasi Matematika)*, *5*(1), 205. https://doi.org/10.31764/jtam.v5i1.3911

Kusumarasdyati. (2019). Statistical reasoning or statistical method: Students' preferences for learning Statistics. *Journal of Physics: Conference Series*, *1417*(1). https://doi.org/10.1088/1742-6596/1417/1/012041

Littlejohn, A., Hood, N., Milligan, C., & Mustain, P. (2016). Learning in MOOCs: Motivations and self-regulated learning in MOOCs. *Internet and Higher Education*, *29*, 40–48. https://doi.org/10.1016/j.iheduc.2015.12.003

McCardle, L., Webster, E. A., Haffey, A., & Hadwin, A. F. (2017). Examining students' self-set goals for self-regulated learning: Goal properties and patterns. *Studies in Higher Education*, *42*(11), 2153–2169. https://doi.org/10.1080/03075079.2015.1135117

Pintrich, P. R., & Zusho, A. (2002). The development of academic self-regulation: The role of cognitive and motivational factors. *Development of Achievement Motivation*, *1446*(2), 249–284. https://doi.org/10.1016/b978-012750053-9/50003-6

Ramadhani, R., Saragih, S., Maulida, R., & Simanjuntak, S. M. B. (2022). Measuring Changes of Students' Statistical Reasoning Taught by Ethnomathematics Approach Assisted TinkerPlots: A Stacking Analysis Study. *JTAM (Jurnal Teori Dan Aplikasi Matematika)*, *6*(3), 511. https://doi.org/10.31764/jtam.v6i3.8375

Rohana, & Ningsih, Y. L. (2020). Statistical reasoning of prospective teachers through blended learning. *Journal of Physics: Conference Series*, *1480*(1). https://doi.org/10.1088/1742-6596/1480/1/012006

Rosidah, Ketut Budayasa, I., & Juniati, D. (2018). An Analysis of Statistical Reasoning Process of High School Students in Solving the Statistical Problem. *Journal of Physics: Conference Series*, *1028*(1), 0–5. https://doi.org/10.1088/1742-6596/1028/1/012125

Ryann K. Ellis. (2010). A Field Guide to Learning management systems. *International Anesthesiology*

Clinics, *48*(3), 27–51. http://www.ncbi.nlm.nih.gov/pubmed/20616636

Subekti, F. E., & Akhsani, L. (2020). Pengembangan Modul Statistika Deskriptif Berbasis Pemecahan Masalah. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *9*(3), 530. https://doi.org/10.24127/ajpm.v9i3.2869

Subekti, F. E., & Jazuli, A. (2022). Pengembangan Modul Aplikasi Penelitian Berbasis Penalaran Statistik. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(1), 1–11.

Sun, J., & Zhang, X. (2021). Exploring Chinese college students' emotions as they engage in online learning during a pandemic. *Asia Pacific Journal of Education*, 1–12. https://doi.org/10.1080/02188791.2021.1965541

Supriyadi, E., & Juandi, D. (2022). Persepsi Siswa Terhadap Pembelajaran Matematika Secara Daring Dengan Menggunakan Lms Moodle Selama Pandemi Covid-19. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *5*(2), 485. https://doi.org/10.22460/jpmi.v5i2.10016

Theffidy, S. G. A. (2020). *Pendidikan Era Revolusi Industri 4.0 di Tengah Covid-19*. OMBUDSMAN Republik Indonesia. https://ombudsman.go.id/artikel/r/artikel--pendidikan-era-revolusi-industri-40-di-tengah-covid-19

Wibowo, T. A., Akhlis, I., & Nugroho, S. E. (2014). Pengembangan LMS (Learning Management System) Berbasis Web untuk mengukur Pemahaman Konsep dan Karakter siswa. *Scientific Journal of Informatics*, *1*(2), 127–137. https://doi.org/10.15294/sji.v1i2.4019

Wong, J., Khalil, M., Baars, M., de Koning, B. B., & Paas, F. (2019). Exploring sequences of learner activities in relation to self-regulated learning in a massive open online course. *Computers and Education*, *140*(June), 103595. https://doi.org/10.1016/j.compedu.2019.103595

Xu, D., & Jaggars, S. S. (2014). Performance Gaps between Online and Face-to-Face Courses: Differences across Types of Students and Academic Subject Areas. *The Journal of Higher Education*, *85*(5), 633–659. https://doi.org/10.1080/00221546.2014.11777343

Yusuf, Y., Suyitno, H., Sukestiyarno, Y. ., Isnarto, I., & Jaenudin, A. (2021). Implementasi E-Learning Dengan Model Pace Berbantuan Modul Berbasis Masalah Pada Kondisi Pandemic Covid-19. *Proximal: Jurnal Penelitian Matematika Dan Pendidikan Matematika*, *4*(1), 1–13. https://doi.org/10.30605/proximal.v4i1.461

Zimmerman, B. J. (1989). A Social Cognitive View of Self-Regulated Academic Learning. *Journal of Educational Psychology*, *81*(3), 329–339. https://doi.org/10.1037/0022-0663.81.3.329

Zimmerman, B. J. (2000). Self-Efficacy: An Essential Motive to Learn. *Contemporary Educational Psychology*, *25*(1), 82–91. https://doi.org/10.1006/ceps.1999.1016

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, *41*(2), 64–70. https://doi.org/10.1207/s15430421tip4102_2

Zubaidah, S. (2020). Self Regulated Learning : Pembelajaran dan Tantangan pada Era Revolusi Industri 4 . 0 1. *Publikasi Ilmiah*, *5*(April), 1–19.