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## The Effectiveness of Integrating Learning Management to Online Project-Based Learning on Students' Metacognitive Abilities

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### ABSTRACT

Metacognition is one of the important components to measure student learning achievement in the university. Metacognition knowledge can significantly measure students' critical thinking skills, especially in solving problems. The ability to solve problems serves as a bridge among metacognition as well as educational success. This study aims to determine metacognitive knowledge on the ability to solve complex problems in social geography. The sample of the research sample were 163 divided into two control and experimental groups. The experimental class used online project-based learning, and the control group used conventional learning. The instrument used to collect the metacognitive data uses was learning and Study Strategies Inventory (LASSI) adapted to the characteristics of students. By 77 items of LASSI were 48 items were valid and reliable used in this study. The result showed that the experimental group using online project-based learning had better metacognitive knowledge, especially on variables that had significant differences of  $p < 0.05$ , such as Information Processing, Attitude, Motivation, Self-Testing and Aids Studies. Furthermore, differences in the ability to solve complex problems of social geography are discussed in this study.



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### INTRODUCTION

The global developments have encouraged humans to continue to increase creativity and adapt to various changes, both social and technological aspects, which increase rapidly. The guidelines adopted by international agencies such as OECD, the UNESCO and the World Bank 21st century skills, worldwide competences, and abilities to becoming citizens across borders. (Bourn, 2018). Referring to UNESCO program on Education for Sustainable Development (EDS) designed for 2030 aims to increase knowledge and awareness through cognitive learning, gender equality, complex thinking and problem-solving skills with a series of alternative solutions (UNESCO, 2020). The issue about the value of information or skills required in the 21st century and included in a learning institution's curricula is one that is fascinating.

According to Bourn (2018), International abilities associated with educational pursuits can be acquired by developing metacognitive abilities including critical and multidimensional or holistic thinking, social abilities including as working together and communicating, and abilities to solve problems that take a multi-perspective examine to multiple measurements such as reasoning ability. Metacognitive terms have evolved over the years. The terms related to metacognition are beliefs, awareness, experiences, knowledge, sense of knowing, learning assessment, theory of mind, meta-memory, skills, executive skills, higher order skills, meta-

components, understanding monitoring, learning strategies, heuristic strategies, and self-regulation (Banabed & Bekki, 2021; Padmanabha, 2020).

Professional teachers will develop metacognitive skills in their teaching plans. Four general approaches to improving pupils' metacognition. This involves raising the awareness of pupils of the significance of cognitive processing, expanding their understanding of cognition and techniques, improving cognition management, and fostering an atmosphere conducive to the development of metacognitive thinking (Asy'ari et al., 2019; Concina, 2019; Teng et al., 2022). The significance of (a) integrating metacognitive teaching in topic material, (b) alerting students about the utility of metacognitive strategies and activities, and (c) enhancing fluency and maintaining metacognitive activity application through continual training. Because interpersonal issues are still evolving, it is critical to use instructional methods based on advanced problem-solving skills in social science. Learners must be challenged to think about addressing higher or more complicated problems.

The importance of metacognition in learning is a person's learning achievement is influenced by his metacognitive ability. If every learning activity refers to learning indicators of how to learn, the optimal results will be easily achieved. The self-regulation skills starting from planning, evaluating and reflecting on problem are part of the metacognition process that can be observed by the teacher. Alejandro (2015) explains that various disciplines really need metacognition skills in their learning designs. Metacognitive knowledge can significantly measure students' critical thinking skills, especially in solving problems (Asy'ari et al., 2019; Chang et al., 2021; Farah & Ayoubi, 2020; Kozikoğlu, 2019). Problem solving is the only mediator between metacognition and learning achievement or academic achievement (Zhao, 2019). Thus, it can be said that learning based on problem solving can improve students' metacognitive skills.

Various studies on metacognition are also interesting because the results can become the indicator of learning achievement. However, there are few studies which focus the knowledge and professional development of teachers on metacognition (Zohar, 2013). Hence, this study will conduct a research focusing on knowledge and professional development of teacher metacognition to fulfill the recommendation of previous studies and to discover opportunities of the innovation on learning management based on online project-based learning to enhance students' metacognitive ability in solving social-geographical problem. Furthermore, in the previous studies there is no study focusing in social-geographical problem, so this study are tend to conduct this research in order to fulfill the novelties and state of the art by the previous researches

However, metacognition-based learning during COVID-19 pandemic must continue, although it is not easy to do. This pandemic has forced all activities to be completely closed and move to online platforms such as business activities, sports and education (Babatunde & Emrah, 2020). Hence, this study objective are tend to find needs to be innovations and variations in teaching that can support students' metacognitive abilities. Online project-based learning is one of the solutions that will be carried out by researchers, considering that metacognition is based on students' ability to plan, conduct, evaluate and arrange follow-up actions on their own initiative. Effective distance education includes online instruction and learning, investigation into enhancement, concepts, early versions, hypotheses, integrity, and benchmarking intensity evaluations on quality virtual classroom design, along with educational instruction (Hodges et al., 2020; Bozkurt & Sharma, 2020). This study aims to conduct online project-based learning to determine students' metacognitive abilities in solving complex problems in social geography courses.

### Complex Problem Solving and Metacognition <sup>13</sup>

Complex Problem Solving (CPS) represents specially on constructing the comprehensive problem solving. Problem solving can also be understood as goal-directed cognitive processing to

transform a particular state into a desired state. Many problem situations that need to be faced in today's world will represent complex problem situations (Christoph et al., 2016).

Social problem-solving skills are very important to deal with the complex and challenging problems that children will face in the future (Mulrey, 2016). Solving complex problems requires multiple methodologies or complex approaches, and one of them is contextual learning in the real world. In the social sciences, the implementation of contextual learning is very relevant because students will be taught with case studies to overcome complex problems that train critical thinking skills. Recognizes critical reasoning and problem solving as one of the key skills for the twenty-first century (Kim & Jerine, 2019), and is considered a basic human skill (Yiling, 2017).

Metacognition is needed to solve complex and unstructured problems, or problems that require higher-order thinking skills. In meaningful learning theory, it is important for teachers to provide information relevant to students' prior knowledge and can connect new knowledge with students' prior knowledge. When students face the task of solving problems without any prior knowledge, it is important for teachers to facilitate with various kinds of trials (Vicki & Slava, 2017). The implementing the kinds of problem-solving trials in learning is important in complex problem solving. Problem solving may have been studied in many different ways by researchers over the years. But solving complex problems related to real-world problems is often overlooked. Learning to solve complex and unstructured Real-world challenges need pupils learning not just episodic information, as well as adaptive process understanding and mental versatility, which necessitates extensive specific to the setting problem solving experience (Andaloussi et al., 2020).

### Online Project-Based Learning

COVID-19 pandemic demands very fundamental changes in the practice of learning in universities. The use of learning methods has turned to the use of online learning and one of them is project-based learning (PBL). Online project-based learning involves students in real-world activities must be packaged in activities that allow them to work with the material. The online project-based learning steps are based on the six main features of PBL developed by Krajcik & Shin (2015), and the researchers modified to adapt the online learning during COVID-19 pandemic.

The stages modified by researcher in online project-based learning are as follow; First, set the objectives of the project done. Second, linking project objectives with expected learning outcomes. Third, carrying out scientific practice accompanied by systematic steps and guiding students to be able to find their own problems in the real world. Scientific practice, like professional activity in the subject, consists of asking questions, defining difficulties, and arranging for and carrying out research (Krajcik & Czerniak, 2013). Inkinen (2020) found that students were involved when doing activities in scientific practice. The fourth, finding solutions and solving problems. The fifth, compiling activity reports and producing using digital tools or technology. The last sequence is that students produce the results of their activities and present them to other students in the class online. Production is in the form of videos and photos while students carry out projects in the field. With online PBL, students can express ideas and ideas more detail. PBL learners engage with ideas, facts, and simulations to develop justifications and express their views to others as well. Inkinen (2020) discovered that learners who provided explanations expressed a greater degree of involvement in the Finnish sample. PBL has the ability to boost student engagement in general by concentrating on intriguing issues that connect basic curriculum principles to applied science.

## RESEARCH METHOD

### Design

This research was conducted by providing the Learning and Study Strategies Inventory (LASSI) instrument to students at the Department of Geography Education, Faculty of Social Sciences,



State University of Surabaya. This study aims to determine their metacognitive abilities related to appropriate learning attitudes and strategies, and maximize students' enjoyment of successful learning experiences in university. Group A as the control group consisted of students from Class of 2018 (N=80), and group B as experimental group consisted of new students from Class of 2020 (N=83). The two groups have similarities in age range, gender, and parents' economic background. The equation for this particular variable is very important because it affects the LASSI score. Furthermore, in this study, the impact of online project-based learning on the two groups was compared. It should be noted that during the COVID-19 pandemic, the 2020 batch of students have never received offline learning, this is what is considered for this group to be designated as an online project-based learning experimental class. The research was conducted for 1 semester starting in August - December 2020. Data analysis used the Mann-Whitney difference test to measure the independent sample.

### Materials

To measure the ability of metacognition in this study, the researcher used the LASSI. The LASSI instrument consists of three main variables, namely skill, will, and self-regulation. Skills consist of: Information Processing (IP), Selecting Main Ideas (SMI), and Test Strategies (TS). Will consists of: Attitude (ATT), Motivation (MOT), and Anxiety (ANX). Meanwhile, Self-Regulation consists of: Concentration (CON) Time Management (TM), Self-Testing (ST), and Study Aids (SA). The LASSI instrument which has been modified into Indonesian language was tested on a limited sample of 50 respondents. The results obtained were Corrected Item-Total Correlation < 0.3 with 33 items, and > 0.3 with 48 items. An item whose value is < 0.3 meaning that the item cannot measure the intended indicator or dimension (Skill, Will, and Self Regulation). While the item whose value is > 0.3 meaning that the item can be used to measure the intended indicator, which is then used to measure metacognitive ability in this study. The following items can be seen in the Table 1.

Table 1. Component of LASSI.

Dimention and Indicator	Number of Items
<b>A. Skill</b>	
IP	12, 32, 40, 47, 76
SMI	72, 77
TS	20, 27, 34, 52, 59, 71, 75
<b>B. Will</b>	
ATT	14, 29, 38, 51, 69
MOT	13, 28, 33, 41, 49, 56
ANX	1, 9, 25, 31, 54, 57, 63
<b>C. Self-Regulation</b>	
CON	6, 39, 43, 46, 55, 68
TM	3, 22, 42, 66

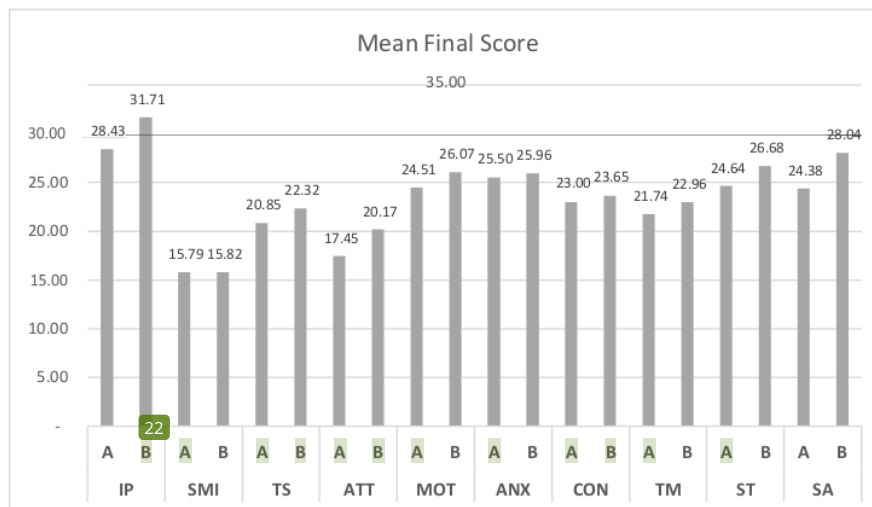
The percentage of each item that is still used from the original LASSI instrument is as follows: Skill (IP 63.00 %, SMI 40.00 %, TS 88.00 %), Will (ATT 63.00 %, MOT 75.00 %, ANX 88.00 %), Self-Regulation (CON 75.00 %, TM 50.00 %, ST 38.00 %, and SA 38.00 %).

### RESULTS AND DISCUSSION

Based on the results of the final average score between group A using conventional learning, and group B using online project-based learning, it is known that of the ten variable components in the LASSI questionnaire show the differences. The final scores for both groups were taken after 6 months of students studying in the geography education study program, Faculty of Social Sciences and Law, State University of Surabaya. Furthermore, the final score can be seen in the Table 2.

**Table 2.** Component of LASSI.

	Group	N	Mean	SD	SE
IP	A	81	28.43	5.63	0.62
	B	82	31.70	4.46	0.49
SMI	A	81	15.79	2.96	0.32
	B	82	15.81	2.82	0.31
TS	A	81	20.85	5.38	0.59
	B	82	22.32	5.07	0.56
ATT	A	81	17.45	5.21	0.57
	B	82	20.17	5.24	0.58
MOT	A	81	24.50	4.22	0.47
	B	82	26.07	3.32	0.36
ANX	A	81	25.50	5.54	0.61
	B	82	25.96	5.12	0.56
CON	A	81	23.00	5.34	0.59
	B	82	23.65	5.04	0.56
TM	A	81	21.74	4.23	0.46
	B	82	22.96	4.23	0.47
ST	A	81	24.64	4.55	0.50
	B	82	26.68	4.81	0.53
SA	A	81	24.38	4.85	0.53
	B	82	28.03	5.47	0.60



**Figure 1.** Mean final score

The difference in the average scores of the ten components in LASSI shows that group B using online project-based learning has a higher score <sup>23</sup> in group B. Furthermore, to find out whether the difference in scores is significant or not, it can be seen in the Table 3.

**Table 3.** Student's t-test.

	t	df	p
Inf Processing	-4.118	161	< .001 <sup>a</sup>
Selecting Main Ideas	0.049	161	0.961
Test Strategies	1.790	161	0.075
attitude	3.323	161	0.001
Motivation	-2.633	161	0.009

	t	df	p
Anxiety	0.554	161	0.581
Concentration	0.804	161	0.423
Time Mnj	1.837	161	0.068
Self Testing	-2.779	161	0.006
Study Aids	-4.506	161	< .001

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Note. Student's t-test.

<sup>a</sup> Levene's test is significant ( $p < .05$ ), suggesting a violation of the equal variance assumption

Based on the results of the statistical test using the t-test above, it was found that not all differences in the ten variables were significant. Variables that have a significant difference if  $p < 0.05$  are IP, ATT, MOT, ST and SA. While the different variables are not significant because  $p > 0.05$  are SMI, TS, ANX, CON, and TM. Furthermore, the values that are important to consider in metacognitive formation can be seen in the Table 4. Based on the statistical results, it can be seen that the order of variable values that are important to consider to form metacognition from the highest to the lowest is as follows: IP, SA, ANX, ST, MOT, CON, TM, TS, ATT, and SMI. The score value of each variable can be seen in the Figure 2.

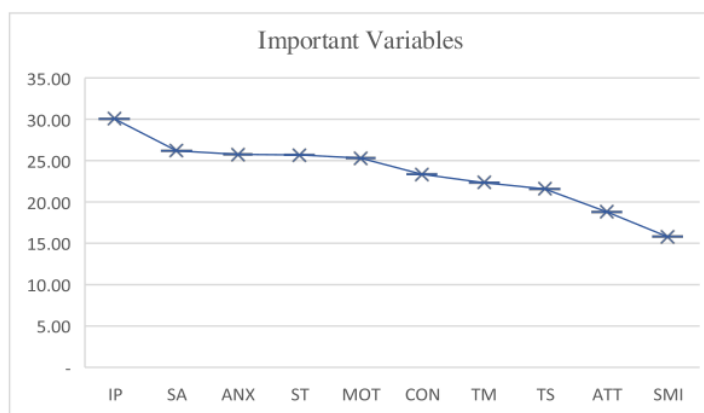


Figure 2. Important variables

Furthermore, this study also looks at the difference in average scores between group A and group B in terms of the ability to solve complex problems of social geography. Based on the results of the independent sample t-test, it is known that the average value of group B using online project-based learning is 81,817, and group A using conventional learning has an average score of 78,407. Therefore, it can be seen that group B who uses online project-based learning has a higher score than group A. The p-value is  $0.001 < 0.05$ , so it can be said that there is a significant difference between group A and group B in terms of ability to solve complex social geographic problems as in Figure 2 and Figure 3.

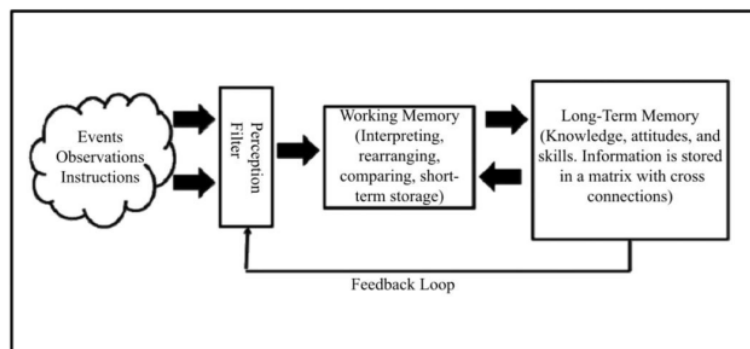


Figure 3. Model of information processing used

### Will Components

<sup>29</sup> The will component consists of attitude, motivation, and anxiety. Based on the results of this study, attitude and motivation are indicators that can measure the significant difference in metacognitive ability between the control and experimental groups. Both of these indicators have  $p < 0.05$ . The experimental group using online project-based learning had higher metacognitive abilities and better learning outcomes. John et al. (2019) argues that learning with metacognition can improve student learning outcomes. Regarding the attitude, that it cannot be assessed in an instant or in a single context. Attitude is related to students' attitudes in participating online and conventional project-based learning. The positive attitude of students will affect the improvement of learning outcomes. If we link attitude and motivation to metacognitive skills, it can be seen from Albert Bandura's theory of social learning theory. Albert Bandura said that the theory of social learning is different from the belief that applies when the individual's capacity to learn is biological.

Humans are not entirely driven by their own cognition nor are they powerless from their environment. Bandura's theory of social learning becomes a theory of social-cognitive learning and incorporates an agentic perspective in the theory. Intentionality, proactive thinking, self-reactivity, and reflection are key characteristics that characterize human agency (Alfaiz et al., 2019; Huang & Yip, 2021; Tajuddin et al., 2021). The intentions we make are centered on plans, which lead to forward thinking. This, in turn, requires a set of actions. This might signify encouragement to keep going or supervision to keep the action under control. Motivational and metacognitive elements must be examined through specific SRL training and performance assessment if we are to gain a thorough picture of the components that impact self-management including the degree to whether managing learners do better (Linda, 2019). Many studies have also proven that motivation has a significant influence on metacognition (Senol, 2016). As pupil motivation wanes, they also lose their faith in their capacity to succeed in the subject matter, which can result in a significant decline in exam scores (Muenks et al., 2019; Puspita & Amelia, 2020).

### Self-Regulation Component

The self-regulation component in LASSI consists of CON, TM, ST and SA. These indicators show that ST and SA are indicators to significantly distinguish metacognitive abilities between the control and experimental groups in solving complex problems of social geography. The self-testing value of 0.006 and study aids  $< 0.001$  is an accepted value because it is less than 0.05. According to Daniel (2017), there are many metacognitive studies related to SR or SRL. There are also many references related to the practice of self-regulated learning in improving students' skills in schools, and the ability to master their own learning. Generally, the research related to metacognition is by linking knowledge of metacognition and regulation of metacognition. Most



believe that the two components of metacognition, cognitive knowledge and cognitive regulation are interrelated. Some evidence suggests that cognitive knowledge may precede cognitive regulation. The results of his research provide information that those who have high cognitive knowledge are more likely to show greater cognitive regulation. Idea that future research should continue to address the relationships among measures of self-regulatory constructs.

The results of this research have shown that self-regulation is one of the significant dimensions to measure metacognition. This research is based on Social Cognitive Learning Theory. Based on the socio-cognitive viewpoint, self-regulation is defined as an approach in which pupils have the ability to continually and productively track and handle their own inspiration, cognition, and behaviors in order to complete their education successfully (Puspi & Amelia, 2020; Teng, 2021; Wong & Wong, 2021). In the online project-based learning system, the ability of students to adapt themselves to the existing learning environment is so important. In online learning, it is very necessary for the ability of students to regulate themselves. Students who are independent learners and have metacognitive abilities will be able to take advantage of greater flexibility and control in online project-based learning. Meanwhile, students who do not have good metacognition and self-regulation skills have lower learning outcomes. The results of this study are also in line with Tang (2016) that students generally lack knowledge of metacognitive strategies and they cannot apply strategies appropriately to the task at hand.

Actually, many studies show that teachers play an important role in motivating and managing students to use their metacognitive strategies. Learners must be competent to go for help whenever they encounter issues, implement instructional methods, and organize their time effectively in order to build metacognitive abilities (Ozturk, 2017). Those pupils who are lacking in strong metacognitive abilities at the start might benefit from tasks and feedback on a regular basis (Putwain, et al., 2015). Through online project-based learning, students are expected to improve their metacognitive skills. It can be started from planning projects, implementing, to evaluating and following up on project activities. This requires high self-efficacy, attitude, and motivation to work on their project. Self-efficacy is a key motivational belief that supports behaviors, such as looking for help and managing efficient time, and ensuring that they can last longer on a project. Learners with poor self-esteem, on the other hand, tend to utilize restricted ways of organizing their educational endeavors and become more hesitant to ask for help. For a consequence, pupils who fall into this class are more inclined to struggle with distance learning. As a result, in order to conduct online education effectively, learners have to participate in metacognition at crucial points.

### Instructional Organization in Educational Management

Education management can be interpreted as a series of activities to plan, organize, motivate, control and develop all efforts in managing and utilizing human resources, facilities and infrastructure to achieve educational goals effectively, efficiently and productively. The general objective of managing learning is to provide and use classroom facilities so that it is always fun to learn and direct or guide the intellectual and social processes in the classroom so as to enable students besides learning to also develop performance and learn effectively in the sense of smooth learning processes in class (Mulh & Aminatun, 2020; Siswanto & Hidayati, 2020).

Furthermore, learning management have a positive effect on student learning outcomes. The management process in schools must start from the stages of planning, organizing, implementing, supervising, evaluating and following up (Pelton, 2019). What is being demanded is that the learning management process is carried out properly and correctly by professional teachers, so that it contains learning content that is capable of producing complete academic and non-academic competencies in students. Managerial ability, namely the ability to understand and implement educational management concepts, especially learning leadership, is actually one of the things that really determines the quality of educational services so that school institutions show their position as quality educational institutions and are in demand by the wider

community or schools that attract the attention of the community, especially students who study or follow daily learning in it (Bafadal et al., 2019; Prastiawan et al., 2020; Sitorus et al., 2020).

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### CONCLUSION

The implementation of online project-based learning during COVID-19 pandemic is one of the right learning models to improve students' metacognition skills, especially in solving complex problems in social geography courses. There are five indicators that can significantly distinguish metacognitive abilities, namely: IP, ATT, MOT, ST and SA. While the other five variable indicators, namely SMI, TS, ANX, CON, and TM can distinguish between the control and experimental groups, but these differences are not significant. Activities such as planning how to approach a given learning task, monitoring understanding, and evaluating the progress of completing a task or named learning management are metacognitive in nature. Metacognitive abilities are believed to be high-level cognitive abilities that are necessary for knowledge management. The findings of this study need to be followed up by conducting trials on other students related to differences in metacognitive abilities. For this reason, the researcher suggests that there are many more metacognitive studies by taking a wider sample by looking at the differences in aspects of social background, economy, gender, and so on.

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