Self-regulated Learning and Metacognitive Ability in Neuroscience

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Abstract. Online learning makes great demands, including in terms of self-regulated learning. Self-regulated learning in terms of using learning resources to find solutions to learning problems in terms of concept discovery and problem-solving of their own learning patterns. This is related to the concept of self-knowledge in the scope of metacognitive abilities in information processing involving neuroscience studies. Descriptions of self-regulated learning and metacognitive abilities were obtained through a literature study as well as analysis of the results of interviews and filling out questionnaires that had been carried out in previous research on the neuroscience studies in self-regulated learning for science teacher candidates through optimizing the Learning Management System (LMS) with the SPADA feature. The results of the study that explain the involvement of self-regulated learning and metacognitive abilities in neuroscience are used as a basis for further research related to learning innovations which are absolutely necessary in conducting in-depth studies on this subject.

Keywords: Self-regulated learning · Metacognitive · Neuroscience

1 Introduction

Self-regulated learning has become a global issue in the learning process during the Corona Virus Disease (Covid-19) Pandemic related to the implementation of online learning. Based on the 2020–2021 Odd Semester Implementation Guidelines in Higher Education (2020), online learning is conducted independently and guided by using a variety of learning resources. Self-regulated learning is a learning process initiated by students within a certain period. Lecturers prepare various tasks and triggers/initiations by utilizing Information and Communication Technology (ICT) to help students learn independently. The next explanation is about guided learning to help the student learning process in the form of online tutorials by requiring student interaction with lecturers, or students with other students mediated by ICT. Based on this explanation, self-regulated learning is related to the facilities provided by the lecturer in the form of integrated media in the active learning process.

The ICT-based media used in learning at Sultan Ageng Tirtayasa University has utilized a structured and integrated Learning Management System (LMS), namely the Online Learning System (SPADA). Several features in SPADA have been developed to

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help students learn independently or guided learn. Lecturers can initiate by delivering a brief introduction regarding course achievements by adding an information column at each meeting. Lecturers can upload files that explain task descriptions, and add a place for the collection of assignments to the feature of direct grading so that students will get notifications after the assignment is assessed. Student interaction with lecturers can also take advantage of the use of google meet or zoom which can be added directly to the SPADA feature. Some of these features turned out to have caused various actions and reactions from students because of the various self-knowledge of each student.

Self-knowledge is related to metacognitive abilities because according to [1] metacognitive knowledge is knowledge about cognition in general and awareness of, as well as knowledge about, and self-cognition (self-knowledge). Self-knowledge includes one's own strengths and weaknesses in relation to cognition and learning. Students who know that they do not know something will have certain strategies to find the required information. Students also need to know the different types of strategies to use in different situations. This confirms that students' awareness of learning goals and the objectives of each task or other learning activity is important in determining strategies to achieve these goals.

The achievement of the intended goal is also related to the mechanism of the brain in processing information or what is known as neuroscience. The results of the research that has been done on neuroscience studies in self-regulated learning, It turns out to present interesting things about the relationship with metacognitive abilities. Aspects of learning independence described by Zimmerman in [2] can be seen in relation to metacognitive abilities in all aspects, including cognitive, motivational, and behavioral. This is the background for the discussion of metacognitive abilities in the following neuroscience studies. This discussion can be used as an initial stage in conducting further research.

The research method used in this study is descriptive qualitative according to [10] with data collection techniques carried out by merging and inductive data analysis. This study wants to describe self-regulated learning and metacognitive abilities in neuroscience studies. Data collection in this study uses documentation techniques through a literature review as well as analysis of interview results and filling out questionnaires that have been carried out in previous research on neuroscience studies in self-regulated learning for science teacher candidates through optimizing the Learning Management (LMS) with the SPADA feature.

2 Self-regulated Learning from Cognitive Aspects

Self-regulated learning in the cognitive aspect explains the stages of information processing in neuroscience studies, namely the indicators of repetition (rehearsal), elaboration (elaboration), an organization (organization). The repetition strategy (rehearsal) which is indicated by the ability of students to remember the material by repeating it continuously according to the results of research by [13] is included in the maintenance rehearsal (repetition of maintenance) with literal memorization repeatedly as explained also by [11]. The repetition strategy according to [11] is carried out in various ways, including by summarizing the material using their own sentences as shown in the elaboration indicator or including in elaboration rehearsal (elaborative repetition). Another

iteration strategy is to use various tactics such as taking notes, drawing diagrams or charts to organize the subject matter in several ways such as in organizational indicators or including in deep processing according to [11].

The next indicator describes planning, monitoring, and strategies to regulate learning which are included in the indicators of regulating metacognition (metacognition regulation). This explains that the fourth indicator on the cognitive aspect is related to metacognitive ability. The previous explanation described that students need strategies to find the information needed and use these strategies in different situations [1]. This confirms the importance of the planning stage in self-cognition (self-knowledge). The next sub-indicator is about monitoring understanding to find out one's own strengths and weaknesses in relation to cognition and learning which is then used in determining strategies to regulate learning or further improvement steps.

According to [1], self-regulated learning in cognitive aspects is included in metacognitive knowledge about learning and thinking strategies (strategic knowledge). [5] also explains that cognitive strategy is a special intellectual skill that is very important in learning and thinking that involves a control process to choose and change ways of paying attention to learning, remembering, and thinking. Learning strategies carried out by students are related to challenging mental exercises and as a learning environment that stimulates the brain. Eric Jensen in [12] explains that mental exercises include reading and language techniques, motor stimulation, art, thinking, and problem-solving. The use of reading and language techniques according to Barbara Given in [12] develops the ability to empathize with the purpose of why the information is conveyed, interact with a wider new world, sharpen problem-solving skills, encourage planning to take productive actions, and arouse curiosity. For exploration and experimentation. Other things about motor stimulation techniques according to [12], namely the smooth movement of the eyes are the ability to pay attention to small letters on book pages so that they are able to think about new things or new problems that stimulate noradrenaline, create dendritic growth thereby increasing neural networks. The involvement of the learning environment that stimulates the brain based on the explanation of Eric Jensen in [12] relates to the senses in presenting useful stimulants for further information processing.

3 Self-regulated Learning from Motivational Aspects

Self-regulated learning in the motivational aspect consists of several indicators, namely indicators of mastery of self-talk, indicators of extrinsic self-talk, relative indicators of self-talk, indicators of relevant improvement (relevance enhancement), indicators of increasing situational interest (situational interest enhancement), consequences indicators intrinsic and indicators of environmental structuring strategies. Self-regulated learning on these various indicators explains further about self-knowledge which according to [1] is related to self-efficacy beliefs, beliefs about goals or reasons they have for doing certain tasks about values and interests belief regarding personal interest (liking) in a task and student decisions about how important or useful the task is [7] adds this aspect of motivation is also related about what people want (goals), why they want it (motives) and how to achieve those goals (process). This awareness of motivation according to [1] will enable students to monitor and regulate their behavior in learning activities more

adaptively. This is exemplified according to [4] how students are able to read effectively if they are able to set reading goals, determine the order of reading parts of books, and establish reading strategies.

4 Self-regulated Learning from Behavioral Aspects

The next aspect of self-regulated learning is behavior which consists of effort regulation indicators, time/study environment indicators, and help-seeking indicators. Self-regulated learning in this behavioral aspect is a follow-up to student learning independence in the previous motivational aspect, which includes behavioral regulation in adaptive learning activities according to [1]. The arrangement of efforts carried out on this indicator is related to the strategies that have been discussed in the motivational aspect. The strategy is motivated by the goals to be achieved and the reasons why these goals are achieved by each student as described by [7]. This explanation is in accordance with [5] which views soft skills as the basis for learning with a metacognitive approach because a person's metacognitive ability is influenced by individual conditions, knowledge, experience, and thinking strategies. The individual conditions in question are related to learning styles and student interests because based on the results of research by [8], learning styles and interests provide a relationship with both strong and strong categories of learning outcomes. [8] explain further that interest is an aspect of personality that is closely related to thoughts and feelings. The involvement of these thoughts and feelings encourages students' ability to exercise control to choose and change ways of paying attention to learning as explained by [5] about cognitive strategies.

Schunk and Zimmerman in [6] also explain that behavior is part of self-regulated learning in achieving a goal, in addition to thoughts, feelings, and strategies generated by the learner himself. Zimmerman and Risemberg in [6] further explain that it is related to self-initiated which includes goal setting and efforts to achieve goals, time management, and setting the physical and social environment. The results of Corno's research in [6] show several characteristics of learners who learn self-regulated, one of which is planning and controlling time, the effort used for tasks, knowing how to create and build a good learning environment, such as finding a suitable place to study matching and help-seeking when encountering difficulties. The whole explanation is corroborated by the results of research by [3] that the metacognitive approach is able to develop independent learning so that it is recommended in its use.

5 Conclusions

The discussion about self-regulated learning and metacognitive ability in the following article is a follow-up result of research that has been done previously. The results of this discussion become the basis for further research, such as the development of ability-based self-regulated learning instruments and metacognitive skills, the effect of metacognitive approaches on self-regulated learning, and optimization of learning styles with a metacognitive approach to learning outcomes and others. Learning independence is made possible no longer just a global issue with online learning, but includes all aspects of learning, including offline learning, so that learning innovation is absolutely necessary for conducting an in-depth study for it.

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