Hypermedia Learning Environment Development to Enhance Self-Regulated Learning Based on Self-Monitoring Skills

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Intan Sulistyaningrum Sakkinah[1], Rudy Hartanto[2], Adhistya Erna Permanasari[3]

***Abstract*—The use of learning media is currently growing rapidly. Today, many studies use computers as adaptive learning media for students; one example is the hypermedia learning environment (HLE). HLE media was developed to assist students in learning, such as the current situation of the Corona Virus Disease 2019 (COVID-19) pandemic which requires all learning activities to be carried out online. One of those affected fields is the education field, where all learning activities are transferred online, so HLE web-based learning can help students to keep learning from home. HLE is currently being developed to improve students' abilities in the self-regulated learning (SRL) process. In SRL, there is an important component in it, namely self-monitoring. However, in its development, the developed HLE is not based on self-monitoring. In this study, an adaptive HLE was developed based on students' self-monitoring abilities. In its development, the HLE system used the agile development method, namely Scrum. The initial data collection for student classification was the self-regulatory inventory (SRI). SRI was used as an instrument to measure students' self-monitoring ability. The data were then processed to classify students into three classes, namely high, medium, and low. Subsequently, the results of the classification of student abilities were used to develop learning aids in HLE. The development assistance provided was in the form of text and videos that were adjusted to the level of student self-monitoring. From the results of the development, it was found that all HLE functions could run well. The system was tested on twelve students to determine the level of usability by using the system usability scale (SUS). The results were classified as good category, with a score of 72.92. Further research can apply this method to students and measure the effectiveness of the system that has been developed.**

***Keywords*—Self-Monitoring, Hypermedia Learning Environment, Self-Regulated Learning.**

I. INTRODUCTION

In today's educational world, many students only study in class and are not aware of efficient learning methods. Along with the development of technology, conventional learning has subsequently developed into virtual learning. Virtual learning utilizes computer technology to assist students in the learning process. The concept of adaptability in virtual learning called intelligent tutoring system (ITS) can adapt to its users. A virtual learning system can be said to be adaptive if it meets three critical elements, namely (a) technology is designed and developed by people who have theoretical and empirical understanding of students, learning, and targeted materials; (b) the system provides high value and interactivity level; (c) the system can assess students [1].

In carrying out effective learning activities, everyone must be able to understand their own metacognition. Metacognition is the ability to understand how someone learns and develops learning strategies to deal with different teaching styles and understand how to use the right strategies through various learning materials [2], [3]. However, not all students can understand metacognition well, so a tool is needed to measure or identify student metacognition. Students are expected to be able to manage the learning process well based on the measurement results obtained with these tools. Focusing on the ability to regulate and control learning activities, what needs to be known or measured is the aspect of metacognitive regulation. Thus, it can be seen how each individual conducts self-regulated learning (SRL). SRL is a personal effort to organize oneself in learning involving cognition, affection, and personal behavior in achieving learning goals [2], [4]–[6]. An important component of SRL is self-monitoring [7], [8].

Self-monitoring is an individual's ability to control their behavior in social situations [9]. Self-monitoring in SRL is defined as the ability of students to control the learning process [7], [10]. Self-monitoring is an important part of the learning process with SRL as it can improve student skills in many ways, such as making students more focused when learning can help them determine whether the learning performance is effective. Students can select a strategy that works best for them so that time in learning is used efficiently and students' motivation is increased [7], [11], [12].

Hypermedia learning environment (HLE) is a learning medium that is currently being developed. The current COVID-19 pandemic has inevitably impacted all activities in many sectors, one of which is the educational sector. Due to this pandemic, all learning processes are conducted online; hence, learning with web based HLE can assist students to learn from home. Based on the background explanation, this study proposes a solution in developing HLE based on students' self-monitoring skills which have been categorized.

II. HYPERMEDIA LEARNING ENVIRONMENT (HLE) AND SELF-MONITORING

Several self-monitoring studies have been conducted. A study measured the effects of self-monitoring on the student

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performance and use of learning strategies, attitudes, self-justification, and knowledge representation [13]. This study demonstrated that self-monitoring improved student learning and provided a prototype of self-monitoring protocol with the potential to improve students' performance in the courses taken. Reference [14] applied self-monitoring to improve task behavior with high school students as respondents. The respondents of this study were two students aged 14 and 15 years old with a diagnosis of learning disability (student 1) and attention deficit hyperactivity disorder (ADHD). This research was conducted by practicing self-monitoring of students using a self-monitoring application called I-Connect which was delivered via a handheld tablet. The results of the intervention yielded a positive and stable increase in the main dependent variable of task behavior for both students and a less significant increase in the generalization variable of the disruptive behavior. The results of research showed that self-monitoring could improve student monitoring and performance development [15].

Another study has developed a HLE used as a student learning media, such as eDalgo which developed learning using the SRL system with HLE. The developed system allows users from various universities to use it. eDalgo is a basic programming learning system providing features such as learning theory, exercises, and interactive games. The system development results showed that this system had a shortcoming, namely the built system was not adaptive to the user's cognitive level [16]. Other systems have been developed under the names of self-regulated learning system with rule-based learning diagnostic scheme (SRLS-RLDS) [17] and adaptive HLE [18], [19]. The two systems developed adopted an adaptive concept, using scaffolding. In SRLS-RLDS [17], a rule-based inference algorithm was used to determine the scaffolding for each student's learning process with SRL. The initial ability assessment of students was based on the evaluation obtained by the teacher so that a predetermined rule set was obtained; meanwhile, the HLE adaptive system [18], [19] developed adaptive scaffolding based on the categorization of students' metacognitive abilities and a prior knowledge activation (PKA). Metacognitive skills were obtained from filling out MAI (metacognitive awareness inventory) questionnaires and PKA scores at the beginning of students using the system. After that, the students were categorized using the fuzzy Tahani model algorithm.

Based on several HLE systems that have been developed, there has been no adaptive HLE development that focuses on students' self-monitoring abilities providing different treatment for each student based on their level of self-monitoring. The HLE developed can classify the level of students' self-monitoring. Students will subsequently enter the learning process with the SRL concept and get scaffolding on the learning steps according to the level of self-monitoring. To fulfill this goal, this research developed a web based HLE system by implementing SRL steps in it.

III. METHODS

This session explains the methods used and the research process.

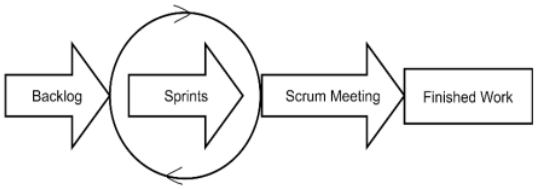

Fig. 1 Scrum model.

TABLE I
SCAFFOLDING RULES

Topics	Self-Monitoring Low	Self-Monitoring Medium	Self-Monitoring High
Topic I (Struct and Union)	L1	M1	H1
Topic II (Pointer and Linked List)	L2	M2	H2

A. System Development Methods

In this research, a web based HLE was built by implementing the SRL flow in its development. In its development, HLE was developed with the PHP programming language and MySQL as the database. The system development model used in this research was agile software development methods, using the Scrum model. The stages of development with the Scrum model are shown in Fig. 1.

B. Data Collecting and Processing

In this study, the data collection technique used was to give SRI (self-regulatory inventory) questionnaires to undergraduate students of Informatics Engineering and Electrical Engineering who were taking Basic Programming courses. A research instrument in the form of a survey is considered to be of high quality if it has a high validity and reliability value in terms of the accuracy of the method used to collect data. Data were collected by giving a questionnaire consisting of 26 questions using a 4-point Likert scale (1-4). Data processing was carried out using SPSS and WEKA software. SPSS was used as a tool to test the validity and reliability of research instruments, while WEKA was used to categorize students based on data obtained through SRI.

C. Student Classification and Scaffolding Rule

At the student classification stage, data were obtained from filling out the SRI questionnaire. The data were then processed to classify students into three classes, namely, high, medium, and low. After that, the results of the classification of student abilities were used to develop learning aids in HLE. The classification of student self-monitoring abilities with WEKA software was conducted using the Bayesian Network algorithm. Bayesian Network is an improved classification method from the Naïve Bayes method so that it has a higher level of accuracy since the Bayesian network attribute algorithm used is interrelated. The classification results showed that the high level of accuracy was 94% [20]. The results of the classification were then used as knowledge-based for the development of scaffolding rules aiming to create adaptability in the HLE

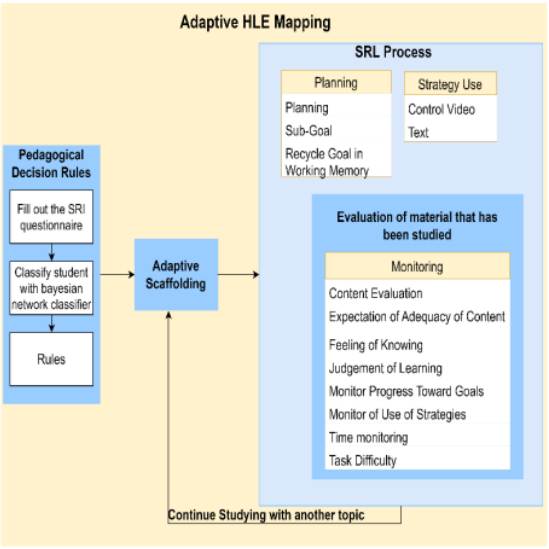

Fig. 2 HLE mapping.

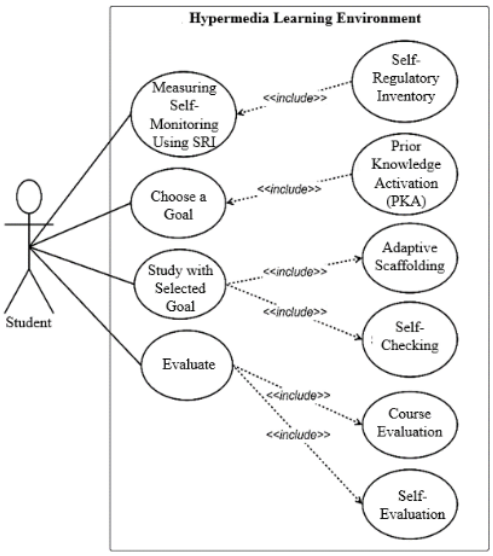

Fig. 3 Use case diagram of HLE.

system. Table I are the rules developed and validated by education experts.

Assistance or scaffolding given to students quantitatively was assistance provided based on the level of student self-monitoring skills (low, medium, high). The assistance provided was additional material explanations in the form of texts that were delivered by the virtual agent on the HLE being developed. The provision of assistance in the form of additional explanations was adjusted to the level of students' self-monitoring. When the level of students' self-monitoring was high, the explanation given was less since students were considered to have good abilities in learning. In contrast, when students had a low level of self-monitoring, more additional explanations were given. Assistance (scaffolding) in the HLE based on self-monitoring ability has not been available in previous studies. This study assumed that students with high self-monitoring ability understood the material better than students with low self-monitoring ability. This assumption was formed based on research conducted by [15] which examined the effect of using self-monitoring strategies on learning in social science subjects. The results of the research conducted indicate that self-monitoring has a significant effect on student performance. Students with high self-monitoring ability realize their weaknesses, so they will try to overcome them.

D. HLE Mapping

Based on Fig. 2, the main flows and components in the developed HLE adaptive system are as follows.

1) Pedagogical Decision Rules: The pedagogical decision rules component consisted of students' self-monitoring ability measurement using SRI. The SRI given consisted of 26 questions that included three main components, viz., problem solving, planning, and self-checking. The results of the questionnaire given to students were then processed using the Bayesian Network classifier.

TABLE II
CATEGORY OF SUS AVERAGE SCORE

Worst	Awful	Poor	OK	Good	Excellent	Best
<20.3	>20.3	>35.7	>50.9	>71.4	>85.5	>90.9

2) Metacognitive Instructions: Metacognitive instructions given by students were arranged according to the category of students' self-monitoring, which was processed using the rule-based method. These rules determined the self-study process and interventions that were given to students based on the level of self-monitoring.

3) Self-Regulated Learning (SRL) Process: The HLE developed is an adaptive HLE adopting the SRL process. The SRL process included planning, strategy use, and monitoring. The three components in the SRL were the main components in the learning process, where students arranged plans for learning activities to be carried out, followed by the selection of learning strategies used, and the final stage was monitoring, which was the evaluation stage of the learning taken place. SRL phases were implemented into HLE and then intervention was added to students in the form of instructions based on the level of self-monitoring ability of each student.

E. Use Case Diagram

Based on Fig. 3, there are four main processes that must be carried out by students as users of the HLE system, which are explained as follows:

1) Measuring Self-Monitoring Skills: Every student who used HLE for the first time was required to fill out an SRI questionnaire, then the data obtained by the system were

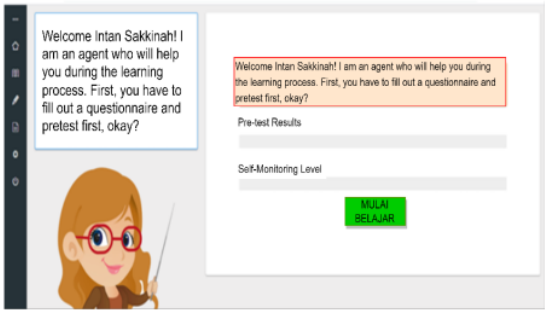

Fig. 4 Dashboard of HLE.

processed to obtain a categorization of student self-monitoring, namely low, medium, and high.

2) Selecting Goals: Before students started learning, students selected a goal. The goal in this case was the student determined which material was studied first.

3) Study with Selected Goals: Followed by student learning with the topic selected, virtual agents helped students if they have difficulty understanding the material, like providing assistance and additional material in the form of videos.

4) Evaluation: After students finished reading and understanding the material, the next stage was evaluation. Evaluation in this case was divided into two, namely self-checking and overall material evaluation (posttest). Evaluation by self-checking helped students to know whether they understand the basic concepts of the material they have learned. If the students' answer revealed that they did not understand the material, the system provided a recommendation to repeat the material or proceed to the posttest stage. The system displayed the pretest and posttest scores made by students based on the posttest results. From these two scores, the system provided recommendations based on the scores obtained. Following that, students evaluated their learning by answering several self-evaluation questions.

F. Usability Testing

The HLE system that has been developed was then tested on students to get a usability evaluation. The usability evaluation in this study used the system usability scale (SUS). The test was carried out on twelve students who had taken Basic Programming courses. The SUS consisted of ten questions using a Likert scale of 1-5. System usability testing (usability testing) served to measure how well users learned and used the developed system. The results of the usability evaluation were used to predict the success of the product (application/system) after it was released in the market [21]. In the SUS instrument, the system measurement scale consisted of two things, namely usable (items 1, 2, 3, 5, 6, 7, 8, and 9) and learnable (items 4 and 10). The final SUS score was obtained from calculating the average SUS score of each respondent.

Each question had a contribution value of 0 to 4. For positive questions with odd numbers (1,3,5,7, and 9), the contribution value was the position of the scale minus 1. As for negative

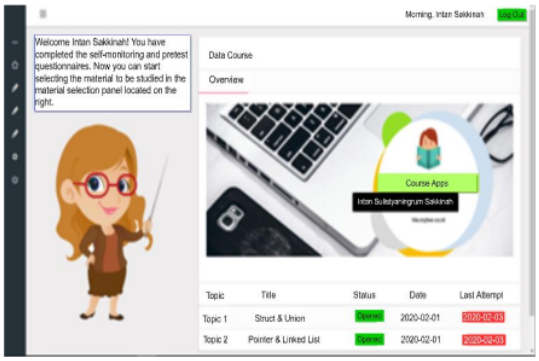

Fig. 5 Topic selection.

questions with even numbers (2,4,6, 8, and 10), the contribution value was 5 minus the scale position. Then, the total value of the contribution from each question was multiplied by 2.5 to get the final score of SUS. The following is the formula for calculating the SUS score for each respondent.

$$\text{SUS Score} = (((Q1-1)+(5-Q2)+(Q3-1)+(5-Q4)+(Q5-1)+(5-Q6)+(Q7-1)+(5-Q8)+(Q9-1)+(5-Q10)) * 2{,}5) \quad (1)$$

Based on [22], the average value of SUS below 20.3 is in the worst category, the average value above 20.3 is in the awful category, the average value above 35.7 is in the poor category, the value above 50.9 is in the ok category, the value above 71.4 is in the good category, the value above 85.5 is in the excellent category, and the value above 90.9 is in the best category. The grouping of SUS mean score categories can be seen in Table II.

IV. Results

A. Dashboard

Dashboard is the main page of the developed HLE system. On this page, users can see the level of self-monitoring and the results of pretests carried out. If they used HLE for the first time, on the start learning button, the user was asked to fill out a questionnaire and answer pretest questions. The pretest problems ware problems in the previous material, namely the array material. After completing the survey and pretest, the user could start learning. The results of self-monitoring skills were displayed in the bar. The green color indicates a high level, yellow indicates a medium level, and red indicates a low level. The dashboard display on the HLE can be seen in Fig. 4.

B. Topic Selection

Fig. 5 exhibit page display for selecting learning materials as desired. Virtual agents helped students during the learning process. The material selection page displayed the materials from which students could select and histories that showed students' previous attempt to study the materials. The material status in green color indicates that the material has been opened. Still in the same page, students could select the material to be studied.

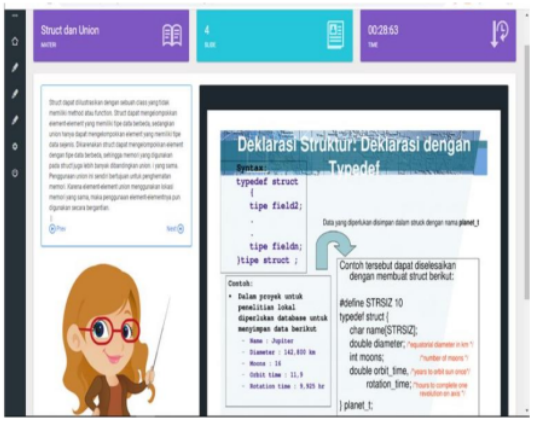

Fig. 6 Topic display.

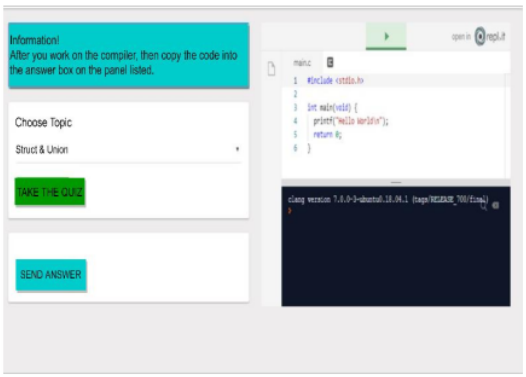

Fig. 7 Practical skills.

C. Topic Display

Fig. 6 shows the display of the learning page with the material that has been selected by students. In this learning process, virtual agents aided students in the form of material explanations that were tailored to the student's self-monitoring category. In addition to explaining the material, the virtual agent also provided additional explanation videos if students still did not understand the material. Three boxes above the material show the selected material, page number, and time. Time indicates how long students would complete one material.

D. Quiz on Subtopic

The mini quiz page is a basic question about each sub material in learning. For example, in struct and union materials, there were two sub materials, namely struct and union. After students finished reading the struct material, a mini quiz given by the virtual agent appeared. It aimed to measure students' comprehension of the sub materials studied in the hope that students would gain a better understanding of the material being studied. If students achieved low scores (only one correct answer out of three), the virtual agent suggested students to reread the sub material. At the same time, when students

Fig. 8 Report card.

achieved sufficient marks (at least two correct answers out of three), the virtual agent would allow students to continue studying until the posttest stage.

E. Posttest

The posttest page was the stage after students learned the material. The posttest aimed to assess students' understanding after studying a material. The posttest contained five questions that assessed students' understanding of the material. The results were displayed in the report menu.

F. Self-Evaluation

On the self-evaluation page, students were instructed to fill out six questions aiming to evaluate themselves after studying a material. The results of the self-evaluation were used to produce learning recommendations given to students. This question would appear after students completed the posttest stage.

G. Practical Skill

In the practical skills menu, students were given assignments requiring them to implement the material they learned into a program. In this menu, a compiler and notepad allowed students to upload the program code done. The practical skills menu display has a material menu to display the questions given according to the selected material. The practical skills menu display is shown in Fig. 7.

H. Report Card

The report card shown in Fig. 8 is the summary results of the assessments completed by students along with the recommendations given by the system to students regarding the learning that has been done. The color of the bar indicates the level of the score. The green color indicates that the student got a high score, while the yellow color indicates a medium score. For practical skill scores, the teacher entered grades manually through the admin account. When the score had been added, it appeared on the report card.

I. Usability Testing Using SUS

The usability testing of the HLE system used the System SUS. The test was conducted online using the SUS questionnaire. The respondents for the usability test were

TABLE III
USABILITY TESTING RESULTS USING SUS

Student's Code	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUS Score
M1	3	1	4	1	5	2	5	1	3	2	82.5
M2	4	1	5	1	4	1	5	1	4	1	92.5
M3	4	2	5	5	5	5	2	5	3	5	42.5
M4	4	2	5	2	4	2	4	2	4	2	77.5
M5	3	2	5	2	4	1	5	2	4	2	80.0
M6	4	1	5	1	5	2	4	1	5	5	82.5
M7	3	2	4	2	4	3	4	2	3	4	62.5
M8	4	2	4	2	4	2	4	2	4	2	75.0
M9	3	2	4	1	4	1	4	2	3	2	75.0
M10	4	2	4	5	4	3	4	3	4	2	62.5
M11	3	2	4	1	4	2	5	2	4	4	72.5
M12	2	2	4	1	4	2	4	3	4	2	70.0
Average Score											72.92

undergraduate students from the Department of Electrical Engineering and Information Technology, Universitas Gadjah Mada in the 2019 academic year.

The testing was conducted online by distributing questionnaire links to respondents. Prior to completing the questionnaire, respondents were initially asked to try using HLE and its features. In this test, twelve students were asked to be respondents. The results of the questionnaire are shown in Table III.

Based on Table III, the results of each respondent's answer were calculated with the SUS score using equation (1). The SUS scores of each respondent were then added up and calculated to obtain the average SUS score. The HLE application generated an average SUS score of 72.92. Based on this average value, the HLE application was included in the good category obtained based on the grouping of SUS score value categories in Table II [22]. A product is considered to have good usability if the overall SUS score is equal to or above 68. Thus, the HLE developed is feasible and acceptable.

V. CONCLUSION

This study carried out the adaptive development of HLE, which was developed based on the SRL measures. From the developed system, metacognitive scaffolding was obtained from the categorization of students' self-monitoring skills when they first used the system. Based on the development results of the HLE system, all functions in the system could run well. The system development results suggest that the classification of students' self-monitoring abilities can determine the assistance that the system will provide to students during the HLE learning process.

The usability test using the SUS questionnaire on twelve respondents generated an average SUS score of 72.92. Based on the average of SUS scores, the HLE application is categorized in the good category, meaning that the application is feasible and acceptable.

This research only focuses on developing the adaptive HLE based on students' self-monitoring skills, so that further research is needed to determine the effectiveness of the system.

CONFLICT OF INTEREST

Authors declare no conflict of interest in this research.

AUTHOR CONTRIBUTION

Intan Sulistyaningrum Sakkinah: results, methods, conclusions; Rudy Hartanto: hypermedia learning environment and self-monitoring; Ashistya Erna Permanasari: introduction.

REFERENCES

[1] V. Aleven, "A is for Adaptivity, but What is Adaptivity? Re-Defining the Field of AIED Intuitively," *Proc. Workshop 17th Int. Conf. Artif. Intell. Educ. AIED 2015*, 2015, hal. 11–20.

[2] G. Schraw and D. Moshman, "Metacognitive Theories," *Educ. Psychol. Rev.*, Vol. 7, No. 4, pp. 351–371, 1995.

[3] L. Bacon and L. Mackinnon, "A Flexible Framework for Metacognitive Modeling and Development," *Proc. Int. Conf. e-Learn. (ICEL)*, 2014, pp. 7–14.

[4] E.G. Poitras and S.P. Lajoie, "A Domain-Specific Account of Self-Regulated Learning: The Cognitive and Metacognitive Activities Involved in Learning Through Historical Inquiry," *Metacogn. Learn.*, Vol. 8, No. 12, pp. 213–234, 2013.

[5] S. Sanchez-Alonso and Y. Vovides, "Integration of Metacognitive Skills in the Design of Learning Objects," *Comput. Human Behav.*, Vol. 23, No. 6, pp. 2585–2595, 2007.

[6] J. Kalenda, "Self-Regulated Learning in Students of Helping Professions," *Procedia Soc. Behav. Sci.*, Vol. 217, pp. 282–292, 2016.

[7] B.J. Zimmerman and A.S. Paulsen, "Self-Monitoring During Collegiate Studying: An Invaluable Tool for Academic Self-Regulation," *New Direction Teach. Learn.*, Vol. 1995, No. 63, pp. 13–27, 1995.

[8] M. Martinez-Pons and B.J. Zimmerman, "Construct Validation of a Strategy Model of Student Self-Regulated Learning," *J. Educ. Psychol.*, Vol. 80, No. 3, pp. 284–290, 1988.

[9] M. Snyder, "Self-Monitoring of Expressive Behavior," *J. Pers., Soc. Psychol.*, Vol. 30, No. 4, pp. 526–537, 1974.

[10] P.R. Pintrich, C.A. Wolters, and G.P. Baxter, "Assessing Metacognition and Self-Regulated Learning," in *Issues in the Measurement of Metacognition,* G. Schraw and J.C. Impara, Eds., Nebraska, USA: Buros Institute of Mental Measurement, 2000, pp. 43–97, 2000.

[11] E.S. Shapiro and C.L. Cole, "Self-Monitoring in Assessing Children's Problems," Vol. 11, No. 4, pp. 448–457, 1999.

[12] D.H. Schunk, "Goal Setting and Self-Efficacy During Self-Regulated Learning," *Educ. Psychol.*, Vol. 25, No. 1, pp. 71–86, 1990.

[13] W.Y. Lan, "The Effects of Self-Monitoring on Students' Course Performance, Use of Learning Strategies, Attitude, Self-Judgment Ability," *J. Exp. Educ.*, Vol. 64, No. 2, pp. 101–115, 1996.

[14] H.P. Wills and B.A. Mason, "Implementation of a Self-Monitoring Application to Improve On-Task Behavior: A High School Pilot Study," *J. Behav. Educ.*, Vol. 23, No. 4, pp. 421–434, 2014.

[15] S. Arslantas and A. Kurnaz, "The Effect of Using Self-Monitoring Strategies in Social Studies Course on Self-Monitoring, Self-Regulation and Academic Achievement," *Int. J. Res. Educ. Sci.*, Vol. 3, No. 2, pp. 452–463, 2017.

[16] A. Benmimoun and P. Trigano, "Self Regulated Learning Provided by Hypermedia and the Use of Technology Enhanced Learning Environments," *Int. Conf. Web Intell., Intell. Agent Technol.*, 2009, pp. 211–214.

[17] J.M. Su, "A Self-Regulated Learning System to Support Adaptive Scaffolding in Hypermedia-Based Learning Environments," *Proc. - 2014 7th Int. Conf. Ubi-Media Comput. Work. U-MEDIA 2014*, 2014, pp. 326–331.

[18] A. Nurlayli, "Adaptive HLE untuk Mendukung Self-Regulated Learning (Studi Kasus: Matakuliah Algoritme dan Struktur Data)," Master's thesis, Universitas Gadjah Mada, Yogyakarta, Indonesia, 2018.

[19] A. Nurlayli, T. B. Adji, A. E. Permanasari, and I. Hidayah, "Tahani Model of Fuzzy Database for an Adaptive Metacognitive Scaffolding in Hypermedia Learning Environment (Case: Algorithm and Structure Data Course)," *2017 Int. Conf. Sustain. Inf. Eng., Technol. (SIET)*, 2017, pp. 358–363.

[20] I.S. Sakkinah, R. Hartanto, and A.E. Permanasari, "Students' Self-Monitoring Skill Classification in Learning Activities," *Adv. Soc. Sci. Educ. Humanit. Res.*, Vol. 440, pp. 66–69, 2020.

[21] J. Brooke, "SUS - A Quick and Dirty Usability Scale," in *Usability Evaluation in Industry*, P.W. Jordan, B. Thomas, I.L. McClelland, B. Weerdmeester, Eds., London, England: CRC Press, 1996, ch. 21, pp. 189–194.

[22] A. Bangor, et al., "Determining What Individual SUS Scores Mean: Adding an Adjective Rating Scale," *J. Usability Scales*, Vol. 4, No. 3, pp. 114–123, 2009.

Appendix
Self-Regulatory Inventory Questionnaire

Problem Solving					
No.	**Question**	**Answer**			
		1	**2**	**3**	**4**
1.	I consider of several ways to solve the given problem and select the best one				
2.	I review the questions given to ensure my answers are correct				
3.	I read the given questions several times				
4.	I use different learning strategies depending on the questions given				
5.	I feel that I can do well on the given difficult questions				
6.	I review and check my work				
7.	I feel that I am able to learn new things quickly				
8.	I identify all the essential parts of the given problem				
9.	I try to understand the questions given first, so I know what to do				
10.	I choose the steps I need to work on the given problem				
11.	I try to break down the given problem to get the necessary information				
12.	I try more than one way to learn something				
Self-Monitoring					
A. Planning					
No.	**Question**	**Answer**			
		1	**2**	**3**	**4**
1.	When given a Basic Programming problem, I determine the steps to solve the problem before starting to work on it				
2.	I try to understand the questions that are asked before answering				
3.	I carefully plan my actions to solve the given problem				
4.	I plan my actions to solve the given problem				
5.	I think of the steps of the plan that I should follow				
6.	I know what I have to do before starting to work on the given problem				
7.	I know the purpose of the material and what is needed to achieve it				
8.	From the plan that I have made, I develop a plan for the solution of the given problem				
9.	I know the part of the problem I have to complete first				
B. Self-Checking					
No.	**Question**	**Answer**			
		1	**2**	**3**	**4**
1.	I check my work while I am working on it				
2.	I correct how good I am in solving the given problem				
3.	When working on questions, I can work according to the steps of the plan that has been made				
4.	I know how many tasks to complete				
5.	I correct the results of the work that has been completed to ensure the answers are correct and in accordance with the order of the questions				

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