Learning Outcomes and Student's Self-Regulation in Mathematics Using Online Interactive Multimedia

Harja Santana Purba[1], Mitra Pramita[2*], R. Ati Sukmawati[3],
Delsika Pramata Sari[4], Rizaldi Aprilian[5]
[1,2,3,4,5]Computer Science Education, Lambung Mangkurat University, Indonesia
harja.sp@ulm.ac.id[1], mitrapramita92@ulm.ac.id[2*], atisukmawati@ulm.ac.id[4], delsika@ulm.ac.id[4],
rizaldaprilian@gmail.com[5]

ABSTRACT

The policy of studying at home requires students to organize their learning. The ability of students to manage their own learning is also known as self-regulation learning (SRL) ability. Interactive multimedia in learning is expected to help students manage their learning independently. This study aims to describe student's SRL ability and learning outcomes in mathematics learning with the help of interactive multimedia. It is also to analyze the relationship between SRL and student learning outcomes after learning mathematics with the help of interactive multimedia. This research is descriptive that involved 274 of 7th grader students. Data were collected using tests and questionnaires. The data analysis technique used descriptive statistics and simple linear regression. The results showed that the students' average SRL in the medium category and student learning outcomes were enough. Student self-regulation learning has a positive effect on learning outcomes. Thus, interactive multimedia makes students more independent in learning to increase their self-regulation learning abilities and ultimately improve their learning outcomes. Therefore, to foster students' SRL skills, teachers can use interactive multimedia as an alternative media in learning mathematics.

———————————— ◆ ————————————

A. INTRODUCTION

The COVID-19 pandemic has caused changes in the system of life around the world, including in Indonesia. The Indonesian government has implemented a policy of studying from home, working from home, and praying at home, to reduce the spread of COVID-19. Regarding this policy, the Minister of Education and Culture said that the conditions of the COVID-19 pandemic did not allow teaching and learning activities to take place normally, so that hundreds of thousands of schools were closed to prevent the spread, and around 68 million students were carrying out learning activities from home, and around four million teachers conducting distance teaching activities. The COVID-19 pandemic is a problem for the education system. Education is required to increase capacity in teaching remotely. Schools and colleges should take advantage of asynchronous learning, which works best in digital formats (Daniel 2020).

Distance learning requires students to be able to organize their learning. The ability of students to manage their learning is also called self-regulation learning ability (Cetin 2015). Student self-regulation learning (SRL) is a student's ability to understand and control their

learning environment. Namely the ability to self-regulate learning includes goal setting, self-monitoring, self-instruction, and self-strengthening. SRL is a series of behaviors in which students change their mental abilities into skills and habits through a developmental process that arises from guided practice and feedback (Azevedo and Hadwin 2005). Self-regulation learning emphasizes the importance of autonomy and personal responsibility in learning activities. Students who have SRL will build their learning goals in the learning process. Then he will try to monitor, regulate, and control his cognition, motivation, and behavior to achieve the goals that have been made (Kusno and Setyaningsih 2021; Waldyr, Jos D., and Jose Jaimes 2018). Students who learn with self-regulation know their preferred learning style, what is accessible and challenging for themselves, how to deal with complicated parts, their interests and talents, and how to use their strengths to achieve their learning goals. So self-regulation learning is a combination of academic learning skills and self-control. With self-regulation learning students have the skills and willingness to learn, so they become more proficient in regulating their learning, which can improve their learning outcomes. The components of SRL for high school students according to (Yang 2005), consist of three components, namely cognitive regulation, motivation regulation, and behavior regulation. Meanwhile, based on (Effeney, Carroll, and Bahr 2013) and (Zimmerman and Pons 1986) the SRL components consist of self-evaluation, organizing and transforming, goal-setting and planning, seeking information, keeping records and monitoring, environmental structuring, self-consequences, rehearsing and memorizing, seeking social assistance, reviewing records, others.

A survey of mathematics teachers showed various obstacles teachers face in implementing distance learning. Among them, student involvement is relatively low. They cannot organize their learning to achieve the expected learning outcomes. Students do not learn the material independently so that when online meetings are held there is no discussion between teachers and students. Less than 50 percent of students submitted their assignments either directly to school or online when given independent assignments. This finding shows that student self-regulation learning is still low. The results of this survey are in line with the results of research (Sukmawati et al. 2020) and (Pramita, Sukmawati, and Sari 2018) which state that the independence of students in blended learning still needs to be improved, as well as research (Nuruzzaman 2016). In fact, according to the results of research (Shaliha and Sawitri 2018) independence made an effective contribution to SRL by 22.8 percent. So a learning media is needed to help students be more independent in learning to increase students' SRL.

Interactive multimedia is an alternative learning media that teachers can use to assist in distance learning. Interactive multimedia is a medium that combines text, graphics, video, animation and sound, to convey a message and information (Ampa 2015). Through interactive multimedia, students can learn with or without a teacher. Students can actively interact with learning material. This media can provide a reply response to student learning activities. The media can act as a tutor for students in understanding the examples of questions. Besides that, the media can also respond to students' answers while doing exercises. With this, it is hoped that students can be more enthusiastic and interested in learning even without a teacher. As disclosed (Wiana 2017) interactive multimedia uses of computers to create and combine text, graphics, audio, moving images (video and animation) by combining links and tools that allow users to navigate, interact, create and communicate. So interactive multimedia is responsive media, where communication takes place in two directions between the media and users. The media can respond directly to user activity with the user's control. According to Malik & Agarwal (2012) and Sukmawati et al. (2021), interactive multimedia in learning will assist teachers in providing a technology-based constructivism learning environment. Students understand learning material through interaction with the media and are more independent in learning. However, it is unknown how student self-regulation learning uses interactive multimedia.

This research aims to find out SRL and student learning outcomes in mathematics learning with the help of interactive multimedia and to analyze the relationship between self-regulatory learning and student learning outcomes after learning assisted by interactive multimedia. The results of this study are helpful for teachers in determining alternative learning media that can foster self-regulation of student learning. So that in the end it can improve learning outcomes.

B. METHODS

This research is a descriptive study conducted at junior high school. The research subjects were 7th grader students, and the object of research was the students' learning outcomes and SRL after learning mathematics with the help of interactive multimedia. Data were collected using tests and questionnaires. The questionnaire was used to collect data about student self-regulation of learning in mathematics learning with the help of interactive multimedia.

The test is used to collect data about student learning outcomes. The test instrument is in the form of multiple-choice questions on numbers. The questionnaire consists of 14 statements adapted from (Effeney et al. 2013) and (Zimmerman and Pons 1986). Each answer was scored on a scale ranging from 4 to 1, where 4 represents "very often", 3 represents "often", 2 represent "rarely", and 1 represents "very rarely".

Table 1. Student's SRL Criteria

Score	Criteria
30-38	Low
39-47	Moderate
48-56	High

Adaptation: (Arikunto 2021)

Data on students' self-regulation learning abilities were qualified according to Table 1. The test results showed that the questionnaire was valid and reliable, with a reliability coefficient of 0.67. The validation results by three mathematics education experts indicate that the test instrument is valid and can be used to measure student learning outcomes. Qualified student learning outcomes are based on Table 2.

Table 2. Learning Outcome Criteria

Score	Criteria
20-47	Less
48-74	Enough
75-100	Well

Adaptation: (Arikunto 2021)

The collected data were analyzed using descriptive statistics to determine the SRL level and student learning outcomes. Meanwhile, a simple linear regression test was used to analyze the relationship between SRL and learning outcomes as independent variables and dependent variables. Interactive multimedia used is interactive multimedia on Numbers material, developed in the Computer Education Study Program. The material in multimedia consists of eight sections. Each section contains a description of the material, sample questions, and exercises. Material descriptions and exercises are presented interactively. At the end of the chapter, there is an evaluation that students can do if they have finished learning all the sections. Exercises and evaluations can be done repeatedly, as long as the scores obtained by students have not reached the completeness standard set by the school.

The application will store all practice and student evaluation scores, which can be used by the teacher as a cognitive assessment result. For this research, the value used is the value in the first experiment.

C. RESULT AND DISCUSSION

1. Result

Learning is carried out from August to September 2020, conducted online nine meetings and one meeting for evaluation. Learning material is provided in interactive multimedia, which is hosted on the web so that teachers and students from anywhere can access it. Communication between teachers and students is done through the WhatsApp group. Learning is carried out following the lesson schedule at school, with the duration of each meeting for 90 minutes. The teacher is at school during learning while the students are at home. At the beginning of each lesson, the teacher informs the material description link through the WhatsApp group accompanied by instructions on what students should do. At the end of the lesson the teacher will open a link for the exercise. Students can do exercises at any time after learning is complete. Students can also repeat learning without being accompanied by the teacher by re-accessing the material link that the teacher has shared. Almost all students follow learning. Figure 1 shows the percentage of students who do the exercises independently in learning.
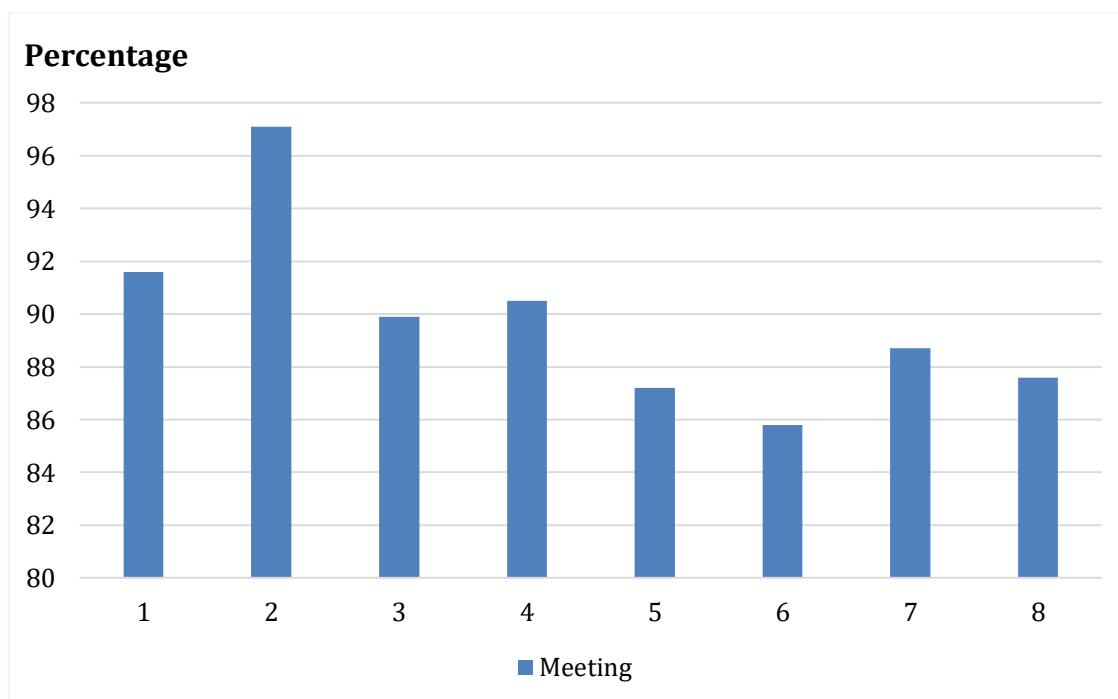

Figure 1. Percentage of Students Doing The Exercises

Based on Figure 1, it can be seen that the average student who does the exercises in learning reaches 89.8 percent. Even though it has not reached one hundred percent, the average student involvement in learning has increased. Students stated that they became more enthusiastic about learning and 90.5 percent of students stated that learning with the help of interactive learning media was more fun, so they became motivated to learn. Figure 2 shows student self-regulation learning after mathematics learning with the help of interactive multimedia.
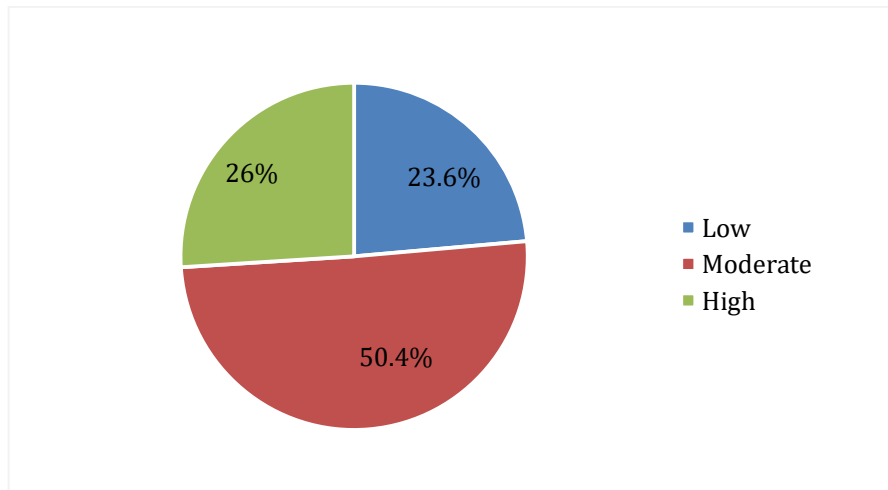
Figure 2. Distribution of Student's SRL Percentage

Based on Figure 2, it is known that there is still 23.6 percent of students with low SRL. The low student SRL is because students are still not used to online discussions. Even though the teacher provided the opportunity for discussion in the WA group or the google classroom, no students took advantage of this opportunity. When they had difficulty learning mathematics with the help of interactive multimedia, they said they did not dare to ask their friends or the teacher. However, the use of interactive multimedia makes students more independent in learning. The response given by the application motivates them to repeat studying the material or do practice questions whenever they want. This finding is in line with the research results by (Lee, Yusoff, and Tan 2019) and the research results by (Indah Septiani et al. 2020), which states that the use of interactive multimedia makes students not bored, face and most importantly, students are more motivated to learn. We can see that the average SRL student is in moderate qualification. An independent attitude learning it will increase students' SRL so that in the end it is hoped that it will improve their learning outcomes. Figure 3 shows the percentage of student learning outcomes (SLO).
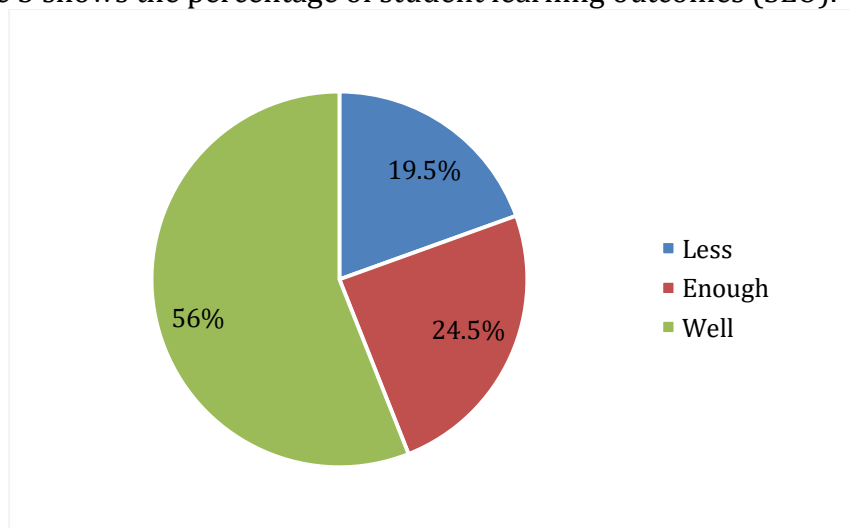

Figure 3. Student Learning Outcome

Based on Figure 3, it can be seen that there are still 19.5 percent of students whose learning outcomes are still lacking. The average score of student learning outcomes is 70.4, sufficient qualification. Although the average learning outcomes have not reached the completeness criteria set by the school, more than 50 percent of students achieve learning outcomes with good criteria. The simple linear regression test results can be seen in Table 3.

Table 3. The Output of The Simple Linear Regression Test

Regresion Statistics	
Multiple	0.31963
R. Square	.102163
Adjusted R Square	0.092712
Standard Error	20.53844
Observations	97

ANOVA test results show that the p-value is 0.001416 less than alpha (5%), so H0 is rejected. This finding means a significant relationship between student SRL and their learning outcomes. The regression equation obtained is: Y = 14.55049 + 1.320311X. With R Square 0.102163, it means that SRL of 10.2163% influences learning outcomes, and the rest is influenced by other things that are not the focus of this study.

2. Discussion

The results of this study are in line with the results of research (Kim and Seo 2013), (Zheng and Li 2016), (So, Chen, and Wan 2019), and (Shing and Rameli 2020) which showed that SRL had a positive effect on student academic achievement. Likewise (Ekhlas and Shangarffam 2013) found that academically regulated SRL influenced 17.5% of IELTS reading skills. Meanwhile, the results of research (Agustiani, Cahyad, and Musa 2016) on a university students showed a correlation between SRL and learning outcomes, with a correlation coefficient of 0.394. While, the results of research (Cetin 2015) found a positive correlation between goal setting, which is one of the sub-factors of SRL, and learning outcomes. It is thought that goal setting is an essential determinant of student academic performance.

Interactive multimedia consists of several components combined to produce learning media that are more interesting and easy for students to understand (Aris, Putri, and Susanti 2017; Gunawan, Harjono, and Sutrio 2017; Sulistianingsih and Mukminan 2019; Sumantri and Rachmadtullah 2016) With the help of interactive multimedia, students are trained to independently build their knowledge. Interactive media acts as tutors who ask questions that guide students to understand concepts. When students answer a question, interactive media will provide a return immediately. So that students can change the answer every time the application assesses their answer incorrectly, until the correct answer is obtained. Thus students become more active in learning, and motivated to complete all given tasks. In addition, interactive multimedia is web-based, so it can facilitate by students to learn independently. As explained by (Lestari and Yudhanegara 2017) that the overuse of multimedia in the learning process is not limited to space-time thus allowing students to learn on their own anytime and anywhere. Thus in addition to motivating and practicing independence in learning, students will be trained to be able to organize their own learning, thus improving their SRL abilities, which will ultimately improve their learning outcomes.

Based on study results, the control of distance learning from the teacher is essential. Although online learning, the learning steps are the same as offline learning. Apperception at the beginning of learning and checking students' understanding at the end of learning is very important. Thus, the teacher will find out which students are learning independently and not. In addition, it is hoped that this will motivate students to manage their learning better.

D. CONCLUSION AND SUGGESTIONS

The students' self-regulation learning after learning mathematics with the help of interactive multimedia is in moderate qualifications, and their learning outcomes are sufficient qualifications. Student self-regulation learning affects learning outcomes by 10.2163%. Interactive multimedia makes learning mathematics more fun and motivating to

learn. Thus, the use of interactive multimedia makes students more independent in learning to improve their self-regulation learning skills and ultimately improve their learning outcomes. However, control from the teacher is still needed to manage their learning better.

ACKNOWLEDGEMENT

REFERENCES

Agustiani, Hendriati, Surya Cahyad, and Muwaga Musa. 2016. "Self-Efficacy and Self-Regulated Learning as Predictors of Students Academic Performance." *The Open Psychology Journal* 9(1):1–6. doi: 10.2174/1874350101609010001.

Ampa, Andi Tenri. 2015. "The Implementation of Interactive Multimedia Learning Materials in Teaching Listening Skills." *English Language Teaching* 8(12):56. doi: 10.5539/elt.v8n12p56.

Arikunto, Suharsimi. 2021. *Dasar-Dasar Evaluasi Pendidikan Edisi 3.*

Aris, Rendi Muhammad, Ratu Ilma Indra Putri, and Ely Susanti. 2017. "Design Study: Integer Subtraction Operation Teaching Learning Using Multimedia in Primary School." *Journal on Mathematics Education* 8(1):95–102. doi: 10.22342/jme.8.1.3233.95-102.

Azevedo, Roger, and Allyson F. Hadwin. 2005. "Scaffolding Self-Regulated Learning and Metacognition - Implications for the Design of Computer-Based Scaffolds." *Instructional Science* 33(5–6):367–79. doi: 10.1007/s11251-005-1272-9.

Cetin, Baris. 2015. "Academic Motivation And Self-Regulated Learning In Predicting Academic Achievement in College." *Journal of International Education Research (JIER)* 11(2):95–106. doi: 10.19030/jier.v11i2.9190.

Daniel, Sir John. 2020. "Education and the COVID-19 Pandemic." *Prospects* 49(1–2):91–96. doi: 10.1007/s11125-020-09464-3.

Effeney, Gerard, Annemaree Carroll, and Nan Bahr. 2013. "Self-Regulated Learning: Key Strategies and Their Sources in a Sample of Adolescent Males1." *Australian Journal of Educational and Developmental Psychology* 13:58–74.

Ekhlas, Nasrin Nabavi, and Nassim Shangarffam. 2013. "The Relationship between Determinant Factors of Self-Regulation Strategies and Main Language Skills and Overall Proficiency." *Procedia - Social and Behavioral Sciences* 70:137–47. doi: 10.1016/j.sbspro.2013.01.049.

Gunawan, Gunawan, Ahmad Harjono, and Sutrio Sutrio. 2017. "Multimedia Interaktif Dalam Pembelajaran Konsep Listrik Bagi Calon Guru." *Jurnal Pendidikan Fisika Dan Teknologi* 1(1):9. doi: 10.29303/jpft.v1i1.230.

Indah Septiani, An nisa Nur Sholihah, Indah Septiani, Triana Rejekiningsih, Triyanto, and Rusnaini. 2020. "Development of Interactive Multimedia Learning Courseware to Strengthen Students' Character." *European Journal of Educational Research* 9(3):1267–79. doi: 10.12973/eu-jer.9.3.1267.

Kim, Eunkyung, and Eun Hee Seo. 2013. "The Relationship of Flow and Self-Regulated Learning to Active Procrastination." 41(7):1099–1114.

Kusno, Kusno, and Eka Setyaningsih. 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. doi: 10.31764/jtam.v5i1.3911.

Lee, Ming Foong, Siti Nursaadah Mat Yusoff, and King Hyiang Tan. 2019. "Needham Model Based Instructional Multimedia Material for Teaching Digital Logic Gates." *Journal of Technical Education and Training* 11(1):54–62. doi: 10.30880/jtet.2019.11.01.007.

Lestari, Karunia Eka, and Mokhammad Ridwan Yudhanegara. 2017. *Penelitian Pendidikan Matematika.* Bandung: PT Refika Aditama.

Malik, S., and A. Agarwal. 2012. "Use of Multimedia as a New Educational Technology Tool–A Study." *International Journal of Information and Education Technology* 2(5):468–71. doi: 10.7763/ijiet.2012.v2.181.

Nuruzzaman, Agha. 2016. "The Pedagogy of Blended Learning: A Brief Review." *IRA International Journal of Education and Multidisciplinary Studies (ISSN 2455–2526)* 4(1):125–34. doi:

10.21013/jems.v4.n1.p14.

Pramita, Mitra, R. Ati Sukmawati, and Delsika Pramata Sari. 2018. "The Implementation of Flipped Classroom Assisted by Learning Management System for Numerical Method Courses." 274:158–62. doi: 10.2991/iccite-18.2018.36.

Shaliha, Nadia, and Dian Ratna Sawitri. 2018. "Hubungan antara Kemandirian dengan Self-Regukated Learning (SRL) pada Santri Kelas VIII di Pondok Pesantren Ibnu Abbas Klaten." Doctoral dissertation, Universitas Diponogoro.

Shing, Lo Sook, and Mohd Rustam Mohd Rameli. 2020. "The Influence of Self-Regulation towards Academic Achievement in English among Malaysian Upper Primary Students." *Universal Journal of Educational Research* 8(5 A):1–11. doi: 10.13189/ujer.2020.081901.

So, Winnie Wing Mui, Yu Chen, and Zhi Hong Wan. 2019. "Multimedia E-Learning and Self-Regulated Science Learning: A Study of Primary School Learners' Experiences and Perceptions." *Journal of Science Education and Technology* 28(5):508–22. doi: 10.1007/s10956-019-09782-y.

Sukmawati, R. A., M. Ridhani, M. H. Adini, M. Pramita, and D. P. Sari. 2021. "Students' Self-Regulation Learning Ability in Learning Algebraic Forms in Wetland Context with the Help of Interactive Multimedia." *IOP Conference Series: Earth and Environmental Science* 758(1). doi: 10.1088/1755-1315/758/1/012018.

Sukmawati, R. Ati, Mitra Pramita, Harja Santana Purba, and Bekti Utami. 2020. "The Use of Blended Cooperative Learning Model in Introduction to Digital Systems Learning." *Indonesian Journal on Learning and Advanced Education (IJOLAE)* 2(2):75–81. doi: 10.23917/ijolae.v2i2.9263.

Sulistianingsih, Ellese, and M. Mukminan. 2019. "The Development of Web-Based Learning Multimedia for High School Students' Lithosphere Material." *Geosfera Indonesia* 4(1):11. doi: 10.19184/geosi.v4i1.9882.

Sumantri, Mohamad Syarif, and Reza Rachmadtullah. 2016. "The Effect of Learning Media and Self Regulation to Elementary Students' History Learning Outcome." *Advanced Science Letters* 22(12):4104–8.

Waldyr, Fong Silva, Patino Moncada Jos D., and Morales Jose Jaimes. 2018. "Self-Regulation of Learning and Its Association with Motivation and Attitude in Engineering Students." *Indian Journal of Science and Technology* 11(33):1–7. doi: 10.17485/ijst/2018/v11i33/119198.

Wiana, Winwin. 2017. "Application Design Of Interactive Multimedia Development Based Motion Graphic On Making Fashion Design Learning In Digital Format." *International Journal of Scientific & Technology Research* 6(05):102–8.

Yang, Myonghee. 2005. "Investigating the Structure and the Pattern in Self-Regulated Learning by High School Students." *Asia Pacific Education Review*. doi: 10.1007/BF03026784.

Zheng, Lanqin, and Xin Li. 2016. "The Effects of Motivation, Academic Emotions, and Self-Regulated Learning Strategies on Academic Achievements in Technology-Enhanced Learning Environment." *Proceedings - IEEE 16th International Conference on Advanced Learning Technologies, ICALT 2016* 376–80. doi: 10.1109/ICALT.2016.128.

Zimmerman, Barry J., and Manuel Martinez Pons. 1986. "Development of a Structured Interview for Assessing Student Use of Self-Regulated Learning Strategies." *American Educational Research Journal* 23(4):614–28. doi: 10.3102/00028312023004614.