



Metacognitive Skills of Junior High School Students in a Pandemic Period Based on the Enriched Virtual Model of PjBL

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ABSTRAK

Saat ini, pandemi Covid-19 telah menjadi permasalahan utama yang dihadapi oleh dunia Pendidikan. Kehadiran Covid-19 telah mempengaruhi proses belajar mengajar di berbagai negara. Hampir seluruh negara menerapkan kebijakan physical distancing sehingga banyak sekolah yang terpaksa mengganti pembelajaran tatap muka menjadi pembelajaran dalam jaringan (daring) berbasis teknologi informasi dan komunikasi. Keterbatasan kegiatan tatap muka dalam pembelajaran daring menjadi kendala bagi dunia pendidikan khususnya di era pandemi. Terlebih lagi perkembangan sains dan teknologi pada Abad 21 memberikan tantangan baru bagi dunia pendidikan yang menuntut siswa tidak hanya memiliki keterampilan kognitif melainkan juga keterampilan metakognitif. Studi kuantitatif ini bertujuan menyelidiki pengaruh model pembelajaran enriched virtual berbasis project-based learning terhadap keterampilan metakognitif siswa. Rancangan penelitian berupa quasi eksperimen dengan desain nonequivalent control group yang melibatkan 40 siswa (22 siswa laki-laki dan 18 siswa perempuan) kelas VII. Keterampilan metakognitif diukur menggunakan rubrik metakognitif. Pengumpulan data dilakukan dengan menggunakan pre test, post test dan penugasan. Secara berturut-turut, uji yang digunakan untuk menganalisis data keterampilan metakognitif adalah One-Way ANCOVA. Hasil penelitian menunjukkan bahwa model pembelajaran enriched virtual berbasis project-based learning berpengaruh signifikan terhadap keterampilan metakognitif (Sig = 0,000). Secara keseluruhan, siswa memperoleh pengalaman yang sangat berkesan saat mengikuti tahapan pembelajaran sehingga model tersebut dapat dijadikan referensi untuk digunakan pada pembelajaran IPA berikutnya.

ABSTRACT

Currently, the Covid-19 pandemic has become a significant problem faced by the world of education. The presence of Covid-19 has affected the teaching and learning process in various countries. Almost all countries implement physical distancing policies so that many schools are forced to replace face-to-face learning with online learning based on information and communication technology. The limitations of face-to-face activities in online learning are an obstacle for education, especially in the pandemic era. Moreover, the development of science and technology in the 21st century provides new challenges for the world of education, requiring students to have cognitive skills and metacognitive skills. This quantitative study investigates the effect of the project-based learning-based enriched virtual learning model on students' metacognitive skills. The research design was quasi-experimental with a nonequivalent control group design involving 40 students (22 male students and 18 female students) in class VII. Metacognitive skills were measured using a metacognitive rubric. Data collection is done by using pre-test, post-test, and assignment. Successively, the test used to analyze the metacognitive skills data was One-Way ANCOVA. The results showed that the project-based learning-based enriched virtual learning model significantly affected metacognitive skills (Sig = 0.000). Overall, students got a very memorable experience when following the learning stages so that the model can be used as a reference for use in the following science lesson.

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1. INTRODUCTION

Currently, the Covid-19 pandemic has become a significant problem faced by the world of education. The presence of Covid-19 has affected the teaching and learning process in various countries (Burki, 2020; Dhawan, 2020; Verma, Campbell, Melville, & Park, 2020). Almost all countries implement physical distancing policies (Chu et al., 2020; N. Islam et al., 2020; Jay et al., 2020); thus, many schools are forced to replace face-to-face learning with online learning based on information technology and communication (Humphrey & Wiles, 2021; Thapa et al., 2020; Xie, Siau, & Nah, 2020). The sudden transformation of learning forms causes the

learning process during the pandemic to be less than optimal and has many limitations (Adnan, 2020; Agarwal & Kaushik, 2020; Dong, Cao, & Li, 2020). These limitations have arisen from various factors, teachers, students, and people. These limitations, among others, relate to teacher competence, economic factors of parents of students, limited internet availability, and the absence of guidance (Dhawan, 2020; Siddiquei & Kathpal, 2021). Online learning during the pandemic also affects the learning climate created by the situation. The learning atmosphere created in online learning can often reduce students' self-awareness and attachment to learning (Adnan, 2020; Alawamleh, Al-Twait, & Al-Saht, 2020). In offline learning, teachers can create a conducive classroom atmosphere to maintain student motivation (Alawamleh et al., 2020; Zaccoletti et al., 2020). On the other hand, teachers find it difficult to control and maintain the learning atmosphere in online learning because they are limited in virtual space. This condition can reduce students' self-awareness (Cahyani, Listiana, & Larasati, 2020; Yuliani & Rista, 2021) and their learning motivation. Teachers also find it challenging to work with parents (Moerdijat, 2020; Sarwa, 2021). Many parents cannot facilitate and accompany their children thoroughly through the process as they have to work. Students need to be accompanied and facilitated by their parents during distance learning activities. Therefore, teachers must strive to empower students to become independent learners.

One of the competencies related to becoming an independent learner is metacognition. Through metacognition, students will realize themselves as learners who must continue to learn under any conditions (Efrilla, Amnah, & Suryanti, 2018; Sholihah, Zubaidah, & Mahanal, 2016). Good metacognition will enable students to plan, monitor, and evaluate their thinking processes while studying (Akturk & Sahin, 2011; Lai, 2011). In addition, metacognition is also a predictor of student learning outcomes (Sari, Sunarmi, & Tenzer, 2018). Not surprisingly, metacognition empowerment is recommended for the current pandemic (Anthonysamy, 2021). The challenge for this suggestion is that the previous research reported the low metacognition of students in Indonesia (Fauzi & Sa'diyah, 2019). Therefore, teachers need to apply specific learning models optimally to empower students' metacognition. One learning model that can empower metacognitive skills is project-based learning (PjBL). This statement is reinforced by several previous studies reporting that this model significantly affected students' metacognition (Nurwidodo, Aisyah, & Fauzi, 2021; Pratiwi, 2018; Zarouk, Olivera, & Khaldi, 2020). PjBL learning stages that require students to present their works can improve their metacognition (Zarouk et al., 2020). In addition, PjBL is a project-based learning model that is suitable for science learning because it can increase students' self-efficacy in terms of strong belief and confidence in carrying out a task (Gunawan, Sahidu, Harjono, & Suranti, 2017; Samsudin, Jamali, Zain, & Ebrahim, 2020). Unfortunately, in the current pandemic era, the conventional implementation of PjBL will be challenging due to the time limit for face-to-face learning. Thus, teachers must design project-based learning that can still be applicable during the pandemic.

One recommended form of learning applicable during the pandemic era is blended learning. Blended learning has four models: rotation, flex, self-blended, and enriched virtual (Nida, Usodo, & Saputro, 2020; Yahya, Ummah, & Effendi, 2020). Blended learning refers to six indicators of independent learning, including independence from others, self-confidence, being disciplined, sense of responsibility, self-initiative based behavior, and exercising self-control, so that they will be able to grow self-awareness in students (Aslamiyah, Setyosari, & Praherdhiono, 2019; Diana, Wirawati, & Rosalia, 2020). Students do not have to be physically present in class; they can study teaching materials and work on learning assignments online by applying blended learning (Efgivia, 2019; Sucipto, 2017). Considering the potential of PjBL implementation in empowering students' metacognition and the opportunity to apply blended learning in the pandemic era, it is necessary to conduct research that analyzes the combination of PjBL with blended learning. There have been many studies examining the effect of PjBL, such as the effect of PjBL on learning outcomes (Rusnawati, Santyasa, & Tegeh, 2021; Syakur, Musyarofah, Sulistiyaningsih, & Wike, 2020), critical thinking skills (Sasson, Yehuda, & Malkinson, 2018), to student creativity (Rambely et al., 2013; Yamin, Permanasari, Redjeki, & Sopandi, 2020). Other studies have also analyzed the effect of PjBL on students' metacognition (Lukitasari, Hasan, Sukri, & Handhika, 2021). However, these various studies have not investigated the effect of this particular learning model in the pandemic era. Several other studies have also specified their scope to analyze the application of blended learning in the pandemic era, such as the effect of blended learning on learning achievement (Çiftçi, 2020; S. Islam et al., 2018) to higher-order thinking skills (Hasanah & Malik, 2020; Kashefi, Ismail, & Yusof, 2012). However, no research has designed blended learning using an enriched virtual model based on PjBL. Therefore, this study aimed to analyze the effect of enriched virtual-PjBL on students' metacognitive skills.

2. METHOD

This quasi-experimental research uses a nonequivalent control group design. This study involved two classes based on the research design: one experimental class and one control class. The two classes apply different forms of learning: the learning model studied in the experimental class; and the comparative learning model in the control class. Before implementing each learning model, there was a pretest to measure the

students' initial competence. After the learning model, a post-test was used to measure the students' final competencies. This research was conducted at SMP Aisyiyah Muhammadiyah 3 Malang from August to October 2021. The object of this research was all seventh-grade students of SMP Aisyiyah Muhammadiyah 3 Malang, which consisted of 40 students and was divided into two classes with the homogeneous distribution. The sampling technique used in this research is simple random sampling regardless of the existing strata. The sample in this study included 20 students of class VII A as the control class with details of eleven male students and nine female students studying without treatment (nonenriched virtual-PjBL). Furthermore, 20 students of class VII B as the experimental class with details of eleven male students and nine female students were given treatment using the non-enriched virtual-PjBL learning model.

This study uses the learning model as its independent variable, while the dependent variable is metacognitive skills, and the control variables are school grades and ages. The research stages include carrying out a pre-test before giving treatment to the experimental class and control class; the learning process practice (giving treatment using enriched virtual-PjBL in the experimental class and non-enriched virtual-PjBL in the control class); and a post-test to determine the metacognitive skills in the experimental class and control class. The data collection instrument used in this study was a pre-test sheet, a post-test using an essay test that consisted of 5 questions, and an assignment in the form of a poster-making project in the Science and Observation Object chapter, which had previously been tested for suitability. The data analysis technique used the One-Way ANCOVA test. The instrument used in this study was a rubric used to measure metacognitive skills developed by (Corebima, 2009) in Tabel 1.

Table 1. Metakognitif Skills Scoring Rubric

Scor	Description
7	Using personal answers, the order of answers is coherent and systematic, logical, with correct grammar (language), with reasons (analysis/evaluation/creation), and correct answers.
6	Using personal answers, the order of exposure to the answer is coherent and systematic, logical, with less correct grammar (language), equipped with reasons (analysis/evaluation/creation), and the answer is correct.
5	Using personal answers, the order of exposure to answers is less/uncoordinated and systematic, lacking/illogical, with less correct grammar (language), equipped with reasons (analysis/evaluation/creation), and correct answers.
4	Using personal answers, the order of exposure to the answer is coherent and systematic, logical, with correct grammar (language), equipped with reasons (analysis/evaluation/creation), and the answer is correct.
3	Not using personal answers, the order of exposure to the answer is less/uncoordinated and systematic, lacking/illogical, with less correct grammar (language), equipped with reasons (analysis/evaluation/creation), and correct answers.
2	Not using personal answers, the order of exposure to the answer is less/uncoordinated and systematic, lacking/illogical, with less correct grammar (language), not equipped with reasons (analysis/evaluation/creation), and incorrect answers.
1	Not using personal answers, the order of exposure to the answer is less/uncoordinated and systematic, lacking/illogical, with incorrect grammar (language), not equipped with reasons (analysis/evaluation/creation), and incorrect answers.
0	No answer at all.

Parameters related to the skill rubric component are declarative knowledge, conditional knowledge, information management strategies, monitoring, and understanding evaluation. The data from the calculation results were then analyzed using the metacognition level categories as shown in Table 2.

Table 2. Metacognition Category

Interval	Category
81-100	Very Good
61-80	Good
41-60	Moderate
21-40	Low
< 21	Very low

(Yusuf & Widyaningsih, 2020)

3. RESULT AND DISCUSSION

Result

Before testing the hypothesis, a normality test is carried out to fulfill the requirement in inferential analysis. The normality test aims to see whether the data in the two groups are normally distributed (Purwanto, Hendri, & Susanti, 2016; Sujarwo & Oktaviana, 2017). Then the homogeneity test aims to see whether the data in the two groups come from a homogeneous population (Hr & Surianti, 2019; Putri, Sumardani, Rahayu, & Hajizah, 2020; Putri, Sumardani, Rahayu, Hajizah, & Rahman, 2020). Metacognitive skills data were tested using Kolmogorov-Smirnov and Levene. The analysis results of the two tests reported that the metacognitive skills data met the assumptions of normality [$D(40) = 0.138$, $p = 0.053$] and homogeneity [$F(1.38) = 4.067$, $p = 0.051$]. Therefore, the data can be analyzed using the One-Way ANCOVA test. One-Way ANCOVA test results show a significant difference in students' metacognitive skills between one class and another by controlling for students' initial metacognitive skills [$F(1.37) = 60.053$, $p = 0.001$, $p_2 = 0.619$]. Furthermore, descriptive analysis of the data results can be presented in a comparison of learning outcomes scores as shown in Table 3.

Table 3. Learning result score comparison

Learning Models		Pre Test	Post Test
<i>Enriched virtual-PjBL</i>	Minimum	12	43
	Maximum	57	96
	<i>M</i>	30.75	59.45
	<i>SD</i>	9.76	12.73
<i>Non Enriched virtual-PjBL</i>	Minimum	12	18
	Maximum	53	57
	<i>M</i>	30.20	39.20
	<i>SD</i>	10.43	9.90

Table 3 shows that the comparison of learning outcomes in the experimental class (Enriched virtual-PjBL) were [pre test: $M = 30.75$, $SD = 9.76$; post test: $M = 59.45$, $SD = 12.73$], while in the control class (Non Enriched virtual-PjBL) were [pre test: $M = 30.20$, $SD = 10.43$; post test : $M = 39.20$, $SD = 9.90$]. Furthermore, the results are included in the metacognitive category data for the experimental class and the control class which are presented in Table 4.

Table 4. Metacognitive category of experimental and control classes

Category	Interval	Frequency, percentage and category of metacognitive skills			
		Experiment		Control	
		Frequency	%	Frequency	%
Very Good	81-100	1	5%	-	-
Good	61-80	7	35%	-	-
Moderate	41-60	12	60%	10	50%
Low	21-40	-	-	9	45%
Very Low	< 21	-	-	1	5%
Total		20	100	20	100

Discussion

Based on the comparison of learning outcomes scores, students who received the enriched virtual-PjBL had higher metacognitive skills scores when compared to students in the control class. The hypothesis test results also inform that the application of enriched virtual-PjBL has a significant effect on empowering students' metacognitive skills. The findings of this study are in line with several previous studies that also analyzed the effect of implementing PjBL on students' metacognition before the pandemic occurred (Lukitasari et al., 2021; Pratiwi, 2018; Rumahlatu & Sangur, 2019). In addition, this study also strengthens the findings of previous studies that reveal the potential of blended learning in developing students' metacognition (Suwono, Susanti, & Lestari, 2017; Yuan, Aftoni, & Çobanoğlu, 2020). Blended learning is the most likely form of learning applied in the pandemic era. The application of this learning type is to minimize the spread of COVID-19; thus, face-to-face learning is not as possible as usual (Humphrey & Wiles, 2021; Thapa et al., 2020; Xie et al., 2020). On the other hand, learning may not always be carried out online because online learning has many limitations (Adnan, 2020; Agarwal & Kaushik, 2020; Dong et al., 2020). Not surprisingly, various publications recommend the application of blended learning in the pandemic era (Mali & Lim, 2021; Megahed & Hassan, 2021; Ożadowicz, 2020; Singh, Steele, & Singh, 2021). Blended learning is expected to continue to be applied post-pandemic as a

response to the world of education towards the development of the times towards a 21st Century-based digital era (Eagleton, 2017; McGrath, Palmgren, & Liljedahl, 2021).

This study chose the enriched virtual as a blended learning model applied in the learning process. The selection of the enriched virtual model is based on the potential of this model in developing students' metacognition. In the enriched virtual, students have the freedom to manage their learning time and speed in learning. Students are also directed to divide their time between online and offline learning (Hrastinski, 2019). Indirectly, this condition is in line with the principles of metacognition-based learning. When developing metacognition, students are trained to monitor, evaluate, and control their learning process independently (Akturk & Sahin, 2011; Lai, 2011). Furthermore, enriched virtual-PjBL can significantly affect metacognitive skills because the PjBL syntax is composed of various activities that improve students' higher-order thinking skills (Pratama, Sopandi, Hidayah, & Trihatusti, 2020; Rahman, Wahyuni, & Noviani, 2018). These metacognitive skills are reflected in the PjBL syntax stages, including: (1) students ask basic questions, (2) students develop projects, (3) students plan projects, (4) students work on projects, (5) teachers monitor, (6) evaluation (Novianto, Masykuri, & Sukarmin, 2018; Sularmi, Utomo, & Ruja, 2018). These stages train students to monitor their learning process because they are trained to work on all stages from beginning to end.

In the first stage, students are directed to ask basic questions. This activity can train students to plan their learning process by training them to prepare themselves before carrying out learning (Daniel, 2016; Darmawan, Brasilita, Zubaidah, & Saptasari, 2018). In the second stage, students are asked to develop a project. Through this activity, students are encouraged to learn how to understand the information presented in a simplified book and take the main idea of the material up to compile a project (Daniel, 2016; Darmawan et al., 2018). In the third stage, students are asked to plan a project. This activity requires students to plan using a cognitive model, such as activating prior knowledge and organizing the material to be read. When students use declarative, procedural, knowledge, and conditional planning skills, students have been involved in using metacognitive skills (Daniel, 2016; Juanengsih, Mahmudah, & Ruri, 2018). From the three stages, students consciously have prepared to work. Students are exposed to various skills and competencies such as collaboration, project planning, decision making, and time management (Daniel, 2016; Juanengsih et al., 2018).

In the fourth stage, students are asked to work on a project which is the main stage of PjBL. By carrying out projects, students memorize facts and connect and think about how to apply their knowledge to the real world and shape students' work attitudes. In working on projects, students are invited to listen to each other's opinions and negotiate to find solutions to improve communication and social skills, improve problem-solving skills, improve students' skills in using information with several disciplines they have, increase students' self-confidence, improve students' abilities in using technology in learning (Daniel, 2016; Juanengsih et al., 2018). In the fifth and sixth stages, the teacher and students monitor and evaluate the students' projects. Monitoring and evaluation is essential component in metacognition. This finding is in line with the opinion (Darmawan et al., 2018; Dirgantoro, 2018; Purnomo, 2019), that metacognitive skills occur in controlling, monitoring, and self-regulation activities when learning and solving a problem.

This research has found essential findings that contribute to the world. The PjBL model combined with enriched virtual blended learning is proven to have a significant effect on students' metacognitive empowerment even in a pandemic. These findings include findings that have high urgency because metacognitive skills can be positioned as one of the primary keys to successful learning in the pandemic era (Anthonysamy, 2021). The reason is that the main factor in the success of learning in the pandemic era is the maintenance of learning motivation and self-awareness of students to take part in distance learning (Hartnett, 2016). Self-awareness will increase if students can be directed to become independent learners. Furthermore, independent learning is one of the characteristics reflected in students who have good metacognition. Apart from the essential findings obtained, this study also has some limitations that need to be considered: The research subjects involved in this study were only junior high school students. There is an urgency to conduct further research that applies enriched virtual-PjBL to high school and college students in response to this. These studies will confirm the role of this model at different levels of education. Enriched virtual-PjBL is only implemented in one of the materials in SMP. Thus, it is necessary to have research with more diverse materials To analyze the consistency of the influence of this learning model. This research does not pay attention to other variables, such as gender and academic ability. Therefore, further research that positions these variables as factors to be investigated is essential.

4. CONCLUSION

The application of the enriched virtual-PjBL learning model is reported to have a significant effect on students' metacognition. Therefore, the metacognitive skills of students who are taught using the enriched virtual-PjBL learning model are higher than those who do not receive learning. Therefore, it is recommended that the enriched virtual-PjBL be implemented in various schools in Indonesia, especially during the current

pandemic. By applying this learning model, it is hoped that students can become independent learners aware of the importance of learning even though the learning conditions have many limitations.

5. REFERENCES

- Adnan, M. (2020). Online learning amid the COVID-19 pandemic: Students perspectives. *Journal of Pedagogical Sociology and Psychology*, 1(2), 45–51. <https://doi.org/10.33902/JPSP.2020261309>.
- Agarwal, S., & Kaushik, J. S. (2020). Student's perception of online learning during COVID pandemic. *The Indian Journal of Pediatrics*, 87(7), 554–554. <https://doi.org/10.1007/s12098-020-03327-7>.
- Akturk, A. O., & Sahin, I. (2011). Literature review on metacognition and its measurement. *Procedia - Social and Behavioral Sciences*, 15, 3731–3736. <https://doi.org/10.1016/j.sbspro.2011.04.364>.
- Alawamleh, M., Al-Twait, L. M., & Al-Saht, G. R. (2020). The effect of online learning on communication between instructors and students during Covid-19 pandemic. *Asian Education and Development Studies, ahead-of-p*(ahead-of-print). <https://doi.org/10.1108/AEDS-06-2020-0131>.
- Anthonyssamy, L. (2021). The use of metacognitive strategies for undisrupted online learning: Preparing university students in the age of pandemic. *Education and Information Technologies*, 26(6), 6881–6899. <https://doi.org/10.1007/s10639-021-10518-y>.
- Aslamiyah, T. Al, Setyosari, P., & Praherdhiono, H. (2019). Blended Learning Dan Kemandirian Belajar Mahasiswa Teknologi Pendidikan. *JKTP: Jurnal Kajian Teknologi Pendidikan*, 2(2), 109–114. <https://doi.org/10.17977/um038v2i22019p109>.
- Burki, T. K. (2020). COVID-19: Consequences for higher education. *The Lancet Oncology*, 21(6), 758. [https://doi.org/10.1016/S1470-2045\(20\)30287-4](https://doi.org/10.1016/S1470-2045(20)30287-4).
- Cahyani, A., Listiana, I. D., & Larasati, S. P. D. (2020). Motivasi Belajar Siswa SMA pada Pembelajaran Daring di Masa Pandemi Covid-19. *IQ (Ilmu Al-Qur'an): Jurnal Pendidikan Islam*, 3(01), 123–140. <https://doi.org/10.37542/iq.v3i01.57>.
- Chu, D. K., Akl, E. A., Duda, S., Solo, K., Yaacoub, S., Schünemann, H. J., ... Schünemann, H. J. (2020). Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. *The Lancet*, 395(10242), 1973–1987. [https://doi.org/10.1016/S0140-6736\(20\)31142-9](https://doi.org/10.1016/S0140-6736(20)31142-9).
- Çiftçi, B. (2020). The effect of blended learning on academic Achievement and attitudes at social studies courses. *Open Journal for Educational Research*, 4(2), 143–150. <https://doi.org/10.32591/coas.ojer.0402.05143c>.
- Corebima, A. D. (2009). *Metacognitive Skill Measure-ment Integrated in Achievement Test*. In *Third International Conference on Science and Math-ematics Education(CoSMEd)*. Retrieved from https://scholar.google.co.id/citations?view_op=view_citation&hl=id&user=EobB1ssAAAAJ&citation_f_or_view=EobB1ssAAAAJ:5MTHONV0fEkC.
- Daniel, F. (2016). Kemampuan Berpikir Kritis Siswa Pada Implementasi Project Based Learning (PjBL) Berpendekatan Saintifik. *JPMI (Jurnal Pendidikan Matematika Indonesia)*, 1(1), 7–13. <https://doi.org/10.26737/jpmi.v1i1.76>.
- Darmawan, E., Brasilita, Y., Zubaidah, S., & Saptasari, M. (2018). Enhancing metacognitive skills of students with different gender using simas eric learning model at state senior high school 6 Malang. *BIOSFER: Jurnal Pendidikan Biologi (BIOSFERJPB)*, 11(1), 47–56. <https://doi.org/10.21009/biosferjpb.11-1.5>.
- Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems*, 49(1), 5–22. <https://doi.org/10.1177/0047239520934018>.
- Diana, P. Z., Wirawati, D., & Rosalia, S. (2020). Blended Learning dalam Pembentukan Kemandirian Belajar. *Alinea: Jurnal Bahasa, Sastra, Dan Pengajaran*, 9(1), 16–22. <https://doi.org/10.35194/alinea.v9i1.763>.
- Dirgantoro, K. P. S. (2018). Pendekatan Keterampilan Metakognitif Dalam Pembelajaran Matematika. *M A T H L I N E: Jurnal Matematika Dan Pendidikan Matematika*, 3(1), 1–10. <https://doi.org/10.31943/mathline.v3i1.78>.
- Dong, C., Cao, S., & Li, H. (2020). Young children's online learning during COVID-19 pandemic: Chinese parents' beliefs and attitudes. *Children and Youth Services Review*, 118, 105440. <https://doi.org/10.1016/j.childyouth.2020.105440>.
- Eagleton, S. (2017). Designing blended learning interventions for the 21st century student. *Advances in Physiology Education*, 41(2), 203–211. <https://doi.org/10.1152/advan.00149.2016>.
- Efgivia, M. G. (2019). Pengaruh Media Blanded Dan E-Learning Terhadap Hasil Belajar Mahasiswa Pengembangan Media Audio Mahasiswa Semester IV TP UIKA Bogor. *Educate: Jurnal Teknologi Pendidikan*, 4(2), 85–96. Retrieved from. <http://ejournal.uika-bogor.ac.id/index.php/EDUCATE/article/view/2172>.

- Efrilla, G., Amnah, S., & Suryanti, E. (2018). Profil Kesadaran dan Strategi Metakognisi Siswa SMP Negeri SeLecamatan Kampar. *Journal of Natural Science and Integration*, 1(1), 69–77. <https://doi.org/10.24014/jnsi.v1i1.5197>.
- Fauzi, A., & Sa'diyah, W. (2019). Students' metacognitive skills from the viewpoint of answering biological questions: Is it already good? *Jurnal Pendidikan IPA Indonesia*, 8(3), 317–327. <https://doi.org/10.15294/jpii.v8i3.19457>.
- Gunawan, Sahidu, H., Harjono, A., & Suranti, N. M. Y. (2017). The Effect of Project Based Learning With Virtual Media Assistance on Student's Creativity in Physics. *Jurnal Cakrawala Pendidikan*, 36(2), 167–179. <https://doi.org/10.21831/cp.v36i2.13514>.
- Hartnett, M. (2016). The importance of motivation in online learning. In *Motivation in Online Education* (pp. 5–32). https://doi.org/10.1007/978-981-10-0700-2_2.
- Hasanah, H., & Malik, M. N. (2020). Blended learning in improving students' critical thinking and communication skills at University. *Cypriot Journal of Educational Sciences*, 15(5), 1295–1306. <https://doi.org/10.18844/cjes.v15i5.5168>.
- Hidayat, A. A. (2015). *Metode Penelitian Paradigma Kuantitatif*. Retrieved from https://www.google.co.id/books/edition/Metode_Penelitian_Kesehatan_Paradigma_Ku/voATEAAAQB-AJ?hl=id&gbpv=1.
- Hr, S., & Surianti. (2019). Pengaruh Pemberdayaan, Kompetensi, Dan Kepuasan Kerja Terhadap Kinerja Dosen Universitas Wiralodra Indramayu. *Jurnal Investasi*, 5(1), 79–104. <https://doi.org/10.31943/investasi.v5i1.20>.
- Hrastinski, S. (2019). What Do We Mean by Blended Learning? *TechTrends*, 63, 564–569. <https://doi.org/10.1007/s11528-019-00375-5>.
- Huda, M. (2018). Blended Learning: Improvisasi dalam Pembelajaran Menulis Pengalaman. *Jurnal Lensa: Kajian Kebahasaan, Kesusastraan, Dan Budaya*, 8(2), 117–130. Retrieved from <https://core.ac.uk/download/pdf/270176538.pdf>.
- Humphrey, E. A., & Wiles, J. R. (2021). Lessons learned through listening to biology students during a transition to online learning in the wake of the COVID-19 pandemic. *Ecology and Evolution*, 11(8), 3450–3458. <https://doi.org/10.1002/ece3.7303>.
- Islam, N., Sharp, S. J., Chowell, G., Shabnam, S., Kawachi, I., Lacey, B., ... White, M. (2020). Physical distancing interventions and incidence of coronavirus disease 2019: natural experiment in 149 countries. *BMJ*, m2743. <https://doi.org/10.1136/bmj.m2743>.
- Islam, S., Baharun, H., Muali, C., Ghufron, M. I., Bali, M. el I., Wijaya, M., & Marzuki, I. (2018). To boost students' motivation and achievement through blended learning. *Journal of Physics: Conference Series*, 1114, 012046. <https://doi.org/10.1088/1742-6596/1114/1/012046>.
- Jay, J., Bor, J., Nsoesie, E. O., Lipson, S. K., Jones, D. K., Galea, S., & Raifman, J. (2020). Neighbourhood income and physical distancing during the COVID-19 pandemic in the United States. *Nature Human Behaviour*, 4(12), 1294–1302. <https://doi.org/10.1038/s41562-020-00998-2>.
- Juanengsih, N., Mahmudah, L., & Ruri, R. (2018). Enhancing of Students' Learning Outcomes in the Environment Pollution Concept through Project Based Learning (PjBL). *Jurnal Penelitian Dan Pembelajaran IPA*, 4(2), 127–134. <https://doi.org/10.30870/jppi.v4i2.3385>.
- Kashefi, H., Ismail, Z., & Yusof, Y. M. (2012). Supporting engineering students' thinking and creative problem solving through blended learning. *Procedia - Social and Behavioral Sciences*, 56, 117–125. <https://doi.org/10.1016/j.sbspro.2012.09.638>.
- Lai, E. R. (2011). Metacognition: A literature review. In *Pearson's Research Report*.
- Lukitasari, M., Hasan, R., Sukri, A., & Handhika, J. (2021). Developing student's metacognitive ability in science through project-based learning with e-portfolio. *International Journal of Evaluation and Research in Education (IJERE)*, 10(3), 948–955. <https://doi.org/10.11591/ijere.v10i3.21370>.
- Mali, D., & Lim, H. (2021). How do students perceive face-to-face/blended learning as a result of the Covid-19 pandemic? *The International Journal of Management Education*, 19(3), 100552. <https://doi.org/10.1016/j.ijme.2021.100552>.
- McGrath, C., Palmgren, P. J., & Liljedahl, M. (2021). Beyond brick and mortar: Staying connected in post-pandemic blended learning environments. *Medical Education*, 55(8), 890–891. <https://doi.org/10.1111/medu.14546>.
- Megahed, N., & Hassan, A. (2021). A blended learning strategy: reimagining the post-Covid-19 architectural education. *Archnet-IJAR: International Journal of Architectural Research*. <https://doi.org/10.1108/ARCH-04-2021-0081>.
- Moerdijat, L. (2020). Penerapan The Fifth Discipline Pada Pendidikan Di Indonesia Saat Pandemi Covid-19. *Sukma: Jurnal Pendidikan*, 4(2), 89–120. <https://123dok.com/document/zg331dnq-penerapan-fifth-discipline-pada-pendidikan-indonesia-pandemi-covid.html>.

- Nida, N. K., Usodo, B., & Saputro, D. R. S. (2020). The Blended Learning With Whatsapp Media On Mathematics Creative Thinking Skills And Math Anxiety. *Journal of Education and Learning (EduLearn)*, 14(2), 307–314. <https://doi.org/10.11591/edulearn.v14i2.16233>.
- Novianto, N. K., Masykuri, M., & Sukarmin, S. (2018). Pengembangan Modul Pembelajaran Fisika Berbasis Proyek (Project Based Learning) Pada Materi Fluida Statis Untuk Meningkatkan Kreativitas Belajar Siswa Kelas X Sma/ Ma. *INKUIRI: Jurnal Pendidikan IPA*, 7(1), 81–92. <https://doi.org/10.20961/inkuiri.v7i1.19792>.
- Nurwidodo, Aisyah, D. F. N., & Fauzi, A. (2021). Kesadaran metakognitif siswa setelah mengikuti pembelajaran modifikasi cooperative script dipadu Hybrid-PjBl. *JINoP (Jurnal Inovasi Pembelajaran)*, 7(1), 10–18. Retrieved from <https://ejournal.umm.ac.id/index.php/jinop/article/view/10376>.
- Ożadowicz, A. (2020). Modified blended learning in engineering higher education during the COVID-19 lockdown—building automation courses case study. *Education Sciences*, 10(10), 292. <https://doi.org/10.3390/educsci10100292>.
- Pratama, Y. A., Sopandi, W., Hidayah, Y., & Trihatusti, M. (2020). Pengaruh Model Pembelajaran RADEC Terhadap Keterampilan Berpikir Tingkat Tinggi Siswa Sekolah Dasar. *JINoP (Jurnal Inovasi Pembelajaran)*, 6(2), 191–203. <https://doi.org/10.22219/jinop.v6i2.12653>.
- Pratiwi, M. E. (2018). Effects of project-based learning strategy on student metacognitive skill to learning biology. *Pancaran Pendidikan*, 7(2), 43–50. <https://doi.org/10.25037/pancaran.v7i2.165>.
- Purnomo, D. (2019). Analisis Kemampuan Mahasiswa Dalam Memecahkan Masalah Melalui Aktivitas Metakognisi Matematis. *Pi: Mathematics Education Journal*, 2(1), 40–53. <https://doi.org/10.21067/pmej.v2i1.2939>.
- Purwanto, A. E., Hendri, M., & Susanti, N. (2016). Studi Perbandingan Hasil Belajar Siswa Menggunakan Media PhET Simulations dengan Alat Peraga pada Pokok Bahasan Listrik Magnet di Kelas IX SMPN Kabupaten Tebo. *Edufisika: Jurnal Pendidikan Fisika*, 01(01), 22–27. <https://online-journal.unja.ac.id/EDP/article/view/2954>.
- Putri, A., Sumardani, D., Rahayu, W., & Hajizah, M. N. (2020). Kemampuan Berpikir Kritis Matematis Menggunakan Model Generative Learning Dan Connecting, Organizing, Reflecting, Extending (CORE). *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 9(1), 108–117. <https://doi.org/10.24127/ajpm.v9i1.2617>.
- Putri, A., Sumardani, D., Rahayu, W., Hajizah, M. N., & Rahman, A. (2020). Kemampuan Literasi Matematika Menggunakan Bar Model Pada Materi Aljabar. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 9(2), 338–347. <https://doi.org/10.24127/ajpm.v9i2.2744>.
- Rahman, A., Wahyuni, I., & Noviani, A. (2018). Profil Kemampuan Berpikir Kritis Dan Kemampuan Metakognitif Siswa Berdasarkan Jenis Kelamin. *Jurnal Pendidikan Biologi*, 10(1), 28–43. <https://doi.org/10.17977/um052v10i1p28-43>.
- Rambely, A. S., Ahmad, R. R., Majid, N., M-Suradi, N. R., Din, U. K. S., A-Rahman, I., ... Abu-Hanifah, S. (2013). Project-based activity: Root of research and creative thinking. *International Education Studies*, 6(6), 66–71. <https://doi.org/10.5539/ies.v6n6p8>.
- Rumahlatu, D., & Sangur, K. (2019). The influence of project-based learning strategies on the metacognitive skills, concept understanding and retention of senior high school students. *Journal of Education and Learning (EduLearn)*, 13(1), 104. <https://doi.org/10.11591/edulearn.v13i1.11189>.
- Rusnawati, M., Santyasa, I. W., & Tegeh, I. M. (2021). The effect of project based e-learning models toward learning outcomes and critical thinking skills of vocational high schoolstudents. *JPP (Jurnal Pendidikan Dan Pembelajaran)*, 27(2), 57–64. <https://doi.org/10.17977/um047v27i22020p057>.
- Samsudin, M. A., Jamali, S. M., Zain, A. N. M., & Ebrahim, N. A. (2020). The Effect Of STEM Project based Learning On Self-Efficacy Among High-School Physics Students. *Journal of Turkish Science Education*, 16(1), 94–108. <https://doi.org/10.36681/tused.2020.15>.
- Saputri, W. (2017). Keterampilan Metakognitif Mahasiswa Calon Guru dan Hubungannya dengan Pola Pembelajaran Dosen. *Didaktika Biologi: Jurnal Penelitian Pendidikan Biologi*, 1(2), 113–121. <https://jurnal.um-palembang.ac.id/dikbio/article/view/688>.
- Sari, M. S., Sunarmi, S., & Tenzer, A. (2018). The relationship between metacognitive skills and cognitive learning outcomes through guided inquiry model. *Advances in Social Science, Education and Humanities Research*, 218(ICoMSE 2017), 221–224. <https://doi.org/10.2991/icomse-17.2018.39>.
- Sasson, I., Yehuda, I., & Malkinson, N. (2018). Fostering the skills of critical thinking and question-posing in a project-based learning environment. *Thinking Skills and Creativity*, 29, 203–212. <https://doi.org/10.1016/j.tsc.2018.08.001>.
- Sholihah, M., Zubaidah, S., & Mahanal, S. (2016). Memberdayakan Keterampilan Metakognitif dan Hasil Belajar Kognitif Siswa dengan Model Pembelajaran Reading Concept Map-Reciprocal Teaching

- (Remap RT). *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, 1(4), 628–633. <https://media.neliti.com/media/publications/210497-memberdayakan-keterampilan-metakognitif.pdf>.
- Siddiquei, M. I., & Kathpal, S. (2021). Challenges of online teaching during Covid-19: An exploratory factor analysis. *Human Behavior and Emerging Technologies*. <https://doi.org/10.1002/hbe2.300>.
- Singh, J., Steele, K., & Singh, L. (2021). Combining the best of online and face-to-face learning: Hybrid and blended learning approach for COVID-19, post vaccine, & post-pandemic world. *Journal of Educational Technology Systems*, 50(2), 140–171. <https://doi.org/10.1177/00472395211047865>.
- Sucipto. (2017). Peningkatan Self Regulated Learning Mahasiswa Di Era Digital Melalui Pembelajaran Blended Learning. *Jurnal Ilmiah Soulmath: Jurnal Edukasi Pendidikan Matematika*, 5(1), 31–41. <https://doi.org/10.25139/sm.v5i1.455>.
- Sujarwo, S., & Oktaviana, R. (2017). Pengaruh Warna Terhadap Short Term Memory Pada Siswa Kelas Viii Smp N 37 Palembang. *Psikis: Jurnal Psikologi Islami*, 3(1), 33–42. <https://doi.org/10.19109/psikis.v3i1.1391>.
- Sularmi, Utomo, D. H., & Ruja, I. N. (2018). Pengaruh project-based learning terhadap kemampuan berpikir kritis. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, 3(4), 475–479. <http://journal.um.ac.id/index.php/jptpp/>.
- Suwono, H., Susanti, S., & Lestari, U. (2017). Guided inquiry facilitated blended learning to Improve metacognitive and learning outcome of high school students. *Journal of Physics: Conference Series*, 824, 012068. <https://doi.org/10.1088/1742-6596/824/1/012068>.
- Syakur, A., Musyarofah, L., Sulistiyarningsih, S., & Wike, W. (2020). The effect of Project Based Learning (PjBL) continuing learning innovation on learning outcomes of English in higher education. *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal*, 3(1), 625–630. <https://doi.org/10.33258/birle.v3i1.860>.
- Thapa, S., Sotang, N., Adhikari, J., Ghimire, A., Limbu, A. K., Joshi, A., & Adhikari, S. (2020). Impact of COVID-19 lockdown on agriculture education in Nepal: An online survey. *Pedagogical Research*, 5(4), em0076. <https://doi.org/10.29333/pr/8465>.
- Verma, G., Campbell, T., Melville, W., & Park, B. Y. (2020). Science teacher education in the times of the COVID-19 pandemic. *Journal of Science Teacher Education*, 31(5), 483–490. <https://doi.org/10.1080/1046560X.2020.1771514>.
- Xie, X., Siau, K., & Nah, F. F. H. (2020). COVID-19 pandemic–online education in the new normal and the next normal. *Journal of Information Technology Case and Application Research*, 22(3), 175–187. <https://doi.org/10.1080/15228053.2020.1824884>.
- Yahya, R., Ummah, S. K., & Effendi, M. M. (2020). Pengembangan Perangkat Pembelajaran Flipped Classroom Bercirikan Mini-Project. *SJME (Supremum Journal of Mathematics Education)*, 4(1), 78–91. <https://pdfs.semanticscholar.org/a891/e7c4af473f5f8c4b85717a8abc0caef8a815.pdf>.
- Yamin, Y., Permasari, A., Redjeki, S., & Sopandi, W. (2020). Implementing project-based learning to enhance creative thinking skills on water pollution topic. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 6(2), 225–232. <https://doi.org/10.22219/jpbi.v6i2.12202>.
- Yuan, K., Aftoni, A., & Çobanoğlu, Ö. (2020). The effect of problem-based learning model and blended learning model to metacognitive awareness as a reflection towards a New Normal Era. *Jurnal Pendidikan Teknologi Dan Kejuruan*, 26(2), 183–188. <https://doi.org/10.21831/jptk.v26i2.32783>.
- Yuliani, K., & Rista, N. (2021). Pengaruh Kinerja Guru Terhadap Motivasi Belajar Siswa Dalam Pembelajaran Jarak Jauh Selama Pandemi Covid-19 Di SMP Negeri 20 Bekasi. *Jurnal Ilmu Pendidikan Ahlussunnah*, 4(2), 304–314. <http://ojs.stkip-ahlussunnah.ac.id/index.php/jipa/article/view/164>.
- Yusuf, I., & Widyaningsih, S. W. (2020). Implementing E-Learning-Based Virtual Laboratory Media to Students' Metacognitive Skills. *International Journal of Emerging Technologies in Learning*, 15(5), 63–74. <https://doi.org/10.3991/ijet.v15i05.12029>.
- Zaccoletti, S., Camacho, A., Correia, N., Aguiar, C., Mason, L., Alves, R. A., & Daniel, J. R. (2020). Parents' perceptions of student academic motivation during the COVID-19 lockdown: A cross-country comparison. *Frontiers in Psychology*, 11. <https://doi.org/10.3389/fpsyg.2020.592670>.
- Zarouk, M. Y., Olivera, E., & Khaldi, M. (2020). The Impact Of Flipped Project-based Learning On Self-Regulation In Higher Education. *International Journal of Emerging Technologies in Learning*, 15(17), 127–147. <https://doi.org/10.3991/ijet.v15i17.14135>.