JPII 9 (4) (2020) 477-488

Jurnal Pendidikan IPA Indonesia

http://journal.unnes.ac.id/index.php/jpii

THE EFFECT OF STUDENTS' METACOGNITION AND DIGITAL LITERACY IN VIRTUAL LECTURES DURING THE COVID-19 PANDEMIC ON ACHIEVEMENT IN THE "METHODS AND STRATEGIES ON PHYSICS LEARNING" COURSE

Sukarno*[1] and M. El Widdah[2]

[1]Science-Physic Education Department, Tarbiyah and Teacher Training Faculty, Islamic State University of Sulthan Thaha Saifuddin, Jambi-Indonesia
[2]Management Education Department, Tarbiyah and Teacher Training Faculty, Islamic State University of Sulthan Thaha Saifuddin, Jambi-Indonesia

DOI: 10.15294/jpii.v9i4.25332

Accepted: July 16th 2020. Approved: December 28th 2020. Published: December 31st 2020

ABSTRACT

This study aims to determine the effect of students' metacognition and digital literacy skills on virtual lectures in the COVID-19 pandemic on achievement in the "Methods and Strategy on Physic Learning (MSPL)" course. The data was collected using a survey method which involved all 42 physics education students. The data analysis was carried out in two stages, namely the categorization stage and the correlation stage. Based on the data and analysis, it is known that the metacognition skill of physics education students is dominated by the "high" category with 40.47%, followed by the "medium" category at 35.71%, and the remaining 23.82% are at "low" category. As for the digital literacy, the variable is not much different from the metacognition skill, which is dominated by students with high category digital literacy skills at 42.85%, "moderate" category at 33.33%, and the rest 23.82% are at "low" category. Likewise, in the variable conceptualization of the concept of physics and physics learning strategies, physics students who are in the "high" category is more dominant than the "medium" and "low" categories, which are 33.33% and 28.58%, respectively. Based on the ANOVA table, it is known that the value of sig. 0,000, which is less than (<) 0.05. It can be said that X1 (metacognition) and X2 (digital literacy) simultaneously affect the Y variable (mastery of the MSPL concept). This is also reinforced by the calculated F value of 313.111> F table 3.22. It means that the two variables X1 and X2, simultaneously affect the Y variable (mastery of the MSPL concept).

Keywords: metacognition; digital literacy; MSPL

INTRODUCTION

One crucial factor in the success of learning physics is the mastery of methods and strategies in learning of physics. The use and application of an appropriate model and strategy in learning, including physics learning, will be able to optimize the learning outcomes of students (Alcina, 2011; Kuspriyanto & Siagian, 2013). This is also reinforced by previous research by Halim (2012), Mariko, (2015), Darmayanti and Sulisworo (2016), Halim (2017), and Dewi (2019) about learning strategies on learning outcomes in physics. Appropriate methods, techniques and strategies in learning can increase understanding of the subject (Jarzabkowski & Whittington, 2008; Johnson et al., 2017). Thus the mastery of methods and strategies in physics learning must be mastered by teachers and prospective physics teachers so that the results of the physics learning process are optimal.

***Correspondence Address**
E-mail: sukarno@uinjambi.ac.id

Bearing in mind that physics is one of the sciences, which is the basis of the development of science and technology, so success in learning also means success in mastering future science and technology. Science and technology are continually moving from an emerging field to more established and interdisciplinary (Dhillon et al., 2017). This is in line with the opinion Sohibun and Ade (2017) that an increased inability in the context of adjusting to changes and entering the era of globalization can be done, among others, through improving the skill of students in learning physics. Therefore, mastery of physics learning methods and strategies is a necessity to prepare qualified human resources, especially in terms of mastering science and technology. This is because the approach to teaching and learning in schools has been and continues to develop rapidly over the past 50 years (Meltzer & Thornton, 2012; Slavich & Zimbardo, 2012). This is in line with the suggestion from Sunarno (2019) that the science learning strategy in the classroom must contribute to the formation of creative characters for future generations who are reliable in the future. The expected generation is superior, innovative, which gives reinforcement to the creative economy.

Seeing the urgency of the science-physics learning process, the introduction of various factors related to it must be a serious concern. Physics instruction academics have established various instructional strategies to improve physics learners' theoretical education (Von Korff et al., 2016). Appropriate learning strategies can also reduce student misconceptions in learning physics (Akmam et al., 2018) and increase students' understanding of the subject matter (Azlan et al., 2020). The introduction and knowledge of supporting factors and obstacles to the success of the physics learning process will create an effective and efficient learning process of physics so that the productivity of learning physics will increase. This is in line with the explanation of Fakhrurrazi (2018) that to improve effective learning, the right strategy is needed so that learning can run optimally and effectively. Besides, Daulae (2014) also explained that effective learning is what produces learning that is useful and aims to students through the use of appropriate procedures. Therefore, by knowing the supporting and inhibiting factors of the learning process, an appropriate physics learning process, procedure, and strategy will be obtained.

According to Setyosari (2017), effective learning can be defined as learning that successfully achieves students' learning goals as expected by the teacher. According to Dunlosky et al. (2013), effective learning is influenced by learning conditions (methods, strategies and techniques), student characteristics, material, and criteria assignments. This is reinforced by Eysenck (2012) and Harris (2019) opinion that the use of learning plans (methods, techniques and strategies) is beneficial in achieving learning objectives.

For physics education students to be able to develop effective learning that can achieve results by the targets set, the students are required to follow the course "physics learning methods and strategies" that are mandatory. This course aims to equip students with the skill to create and develop dynamic, effective, and efficient learning processes. All students who take courses are introduced to various models, methods, strategies, and technical learning of physics, both through lectures, discussions, and feedback as well as through teaching practice by implementing the models, methods, strategies, and technical learning of physics. In essence, the course equips students to have more effective classroom management skills. This is as Erwinsyah's (2017) opinion that the implementation of classroom management can improve the effectiveness of the teaching and learning process which includes: planning learning, directing, arranging classrooms, communication; and control.

During the COVID-19 pandemic, the process of lecturing on methods and strategies for learning physics and physics was done through virtual learning by utilizing computer technology and the internet network. Virtual learning models occur throughout all levels of education in Indonesia, from elementary schools to tertiary institutions (Bao, 2020; Pujilestari, 2020; Yustina et al., 2020). Virtual learning is carried out in the context of implementing government policy as an effort to prevent and spread the COVID-19 disease which has now become a global epidemic (Almarzooq et al., 2020; Widyaningrum, 2020; Zuo et al., 2020). For this reason, the implementation of virtual learning is a necessity that must be followed by all physics students at Sulthan Thaha Saifuddin-Jambi State Islamic University, and both domiciled in cities and villages.

During the COVID-19 outbreak and virtual lectures, there were many obstacles or obstacles faced by physics students. Psychologically, the obstacles or constraints to implementing virtual lectures, for example, are the concern over COVID-19 disease itself, during which physical access was limited by the government with social policies and physical distancing so that psychologically became a separate obstacle. One form of psychological barriers to learning is anxiety. According to Kurniawati & Siswono's (2014) research, that students' anxiety and self-efficacy together influence the skill to problem-solve with a coefficient of determination of 31.15%. Besides, Wicaksono & Saufi (2013) also found that more anxious students would try harder, but their understanding would worsen, making them more anxious.

Also, geographically, Jambi province is one of the provinces with relatively large areas and is dominated by rural areas. This is also reinforced by the results of Riduan et al. (2015) research that in Jambi province, there are still many relatively underdeveloped villages. In general, the rural areas of Jambi province, where many physics students live, do not yet have an internet network and there are even many villages that have limited and no electricity networks. Wibowo & Asvaliantina (2018) mentioned that one of the regencies in Jambi Province (Tanjung Jabung Barat) at this time to meet the electricity needs of the government launched a 10,000 MegaWatt of power plant development program as it is understood that the internet and electricity networks are the main requirements in implementing virtual lectures. If the facilities are not available or are very limited, it will increase the psychological barriers of students in conducting virtual lectures.

Economically, rural areas in Jambi province have relatively low incomes. Most of their sources of income come from farming and gardening and a small proportion of raising livestock. During the COVID-19 pandemic, the community's economic sector in Jambi was severely affected. Economic production and income, in general, have declined. This situation (the decline in the community's economy) indirectly or directly contributed to the psychological impact on students, where they had to provide (buy) an internet package at a price that was still relatively expensive to follow virtual lectures. The price is relatively high with limited availability, of course, brings its anxiety for students.

Besides, psychological barriers also arise because of the anxiety experienced by students over their skill to attend a virtual lecture program for the first time. Where virtual lecture implementation uses and utilizes a variety of learning applications that were previously rarely used and have never even been used at all. Therefore, to be successful in attending virtual lectures in the COVID-19 pandemic, physics students must be familiar with and be able to operate a variety of digital applications used by lecturers, such as zoom applications, Google classroom, quizzes and others. In short, to successfully follow the lecture process virtually, every student must have digital literacy skills. Various obstacles in virtual learning are also experienced by students and students, even teachers and lecturers. This is as a result of research (Purwanto et al., 2020) that there are several obstacles experienced by students, teachers, and parents in online teaching and learning activities. Mastery of technology is still lacking, the addition of internet quota costs, the existence of additional work for parents in assisting child learning, communication and socialization between students, teachers, and parents is reduced and working hours are becoming unlimited for teachers because they have to communicate.

Digital literacy is the ability to know and use various digital information to solve the problem at hand. Donaldson & Alker (2019) and Wahono & Effrisanti (2018) mentioned that digital literacy is a concept that talks about relevant literacy and literacy based on competence and technology, communication skills, but emphasize the skill to evaluate information better. According to Bawden (2008), Ng (2012), and Maulana (2019), digital literacy is a skill to use and understand the use of communication and information technology, for example in supporting education and the economy. As for Gillen (2014), A'yuni (2015), and Julien (2018), digital literacy is the skill to understand and use information from various digital sources. So we can understand that digital literacy is the skill to support a better and advanced life.

With this digital literacy skill too, the COVID-19 pandemic problem and virtual recovery can be reduced by its negative impact (psychological impact of student anxiety). Through digital literacy, they will obtain accurate digital information as material for decision making. This is in line with the Eshet (2004), Lankshear & Knobel (2015), and Maulana (2019) opinion that digital literacy has many benefits, for example, being able to find valuable information to make better decisions.

Likewise related to virtual recovery, digital literacy will play a role in recognizing, understanding, and using the right applications to support virtual lecturing. This is in line with the results of Nurjanah et al. (2017) research that overall digital literacy has a significant relationship with the quality of the use of e-resources, with the category of very high correlation, meaning that digital literacy is a very decisive factor for the high quality of use e-resources. The results of Akbar & Anggraeni's research (2017) also mentioned that students who have good digital literacy skills would have better scientific writing skills (final thesis), so they have better chances of graduating. Besides, digital literacy also allows teachers and lecturers to create creative, innovative, and contemporary learning innovations (Puspito, 2017). For this reason, digital literacy has a vital role in the success of students in following virtual recovery during the COVID-19 pandemic. According to Kurniawati and Baroroh (2016) that one of the factors affecting the level of digital media literacy is primarily a family environment.

In addition to digital literacy skills, in the COVID-19 pandemic situation with various problems that arise as described above, students must also have good metacognition skills. Metacognition is related to a person's awareness of his thinking and skill to regulate his thinking in learning or solving problems (Anggo, 2012). According to Fleming et al. (2012) and Anggo (2011), metacognition is an awareness of cognition and the regulation of one's cognition. Flavell, as quoted by Hong (2020), stated that metacognition includes areas of metacognitive knowledge, metacognitive experience, activation of strategies, and goals. Fox & Riconscente (2008) states that metacognition is a person's skill to regulate himself. Fletcher and Carruthers (2012) also mentioned that metacognition is a shared skill consisting of a variety of self-management strategies obtained through individual and cultural learning.

According to Kuhn (2000), Lai (2011) and Hong (2020), metacognitive knowledge includes knowledge about oneself as a learner and the factors that can influence performance, knowledge of strategy, and knowledge of when and why to use strategy. In short (Mahmood & Batool, 2016) said that metacognition refers to the knowledge that people have about their thought processes. Also in the metacognitive handbook in education that includes understanding strategies, metacognitive strategiesn and understanding, writing, science and mathematics, individual differences, self-regulated learning, technology, guidance, and measurement are important resources for researchers, lecturers, students, curriculum developers, teachers, and are included in educational practice (Hacker et al., 2009). This is in line with Garrison & Akyol (2015) that metacognition is the cognitive skill needed to achieve deep and meaningful learning.

Based on the description above, it can be understood that metacognition is closely related to a person's skill to manage themselves, including in terms of using the strategies they have to achieve their goals. With this metacognition skill, they will be able to understand themselves and manage or control themselves in dealing with anxiety both during the COVID-19 pandemic and in other situations. With this metacognition skill too, a person will be able to optimize his full potential in dealing with existing situations, namely the COVID-19 pandemic and virtual lectures. Those with good metacognition skills will have a variety of strategies to solve the problems faced and be the driving force to be more productive. According to research conducted by Riyadi et al. (2018) shows that metacognition is closely related to student's self-efficacy and chemical literacy. According to Hong (2020), metacognition is also related to the learning process, motivation, thought journey, and creativity. Magno (2010) also mentioned that metacognition is closely related to one's critical thinking skills. Metacognition also affects a person's skill to do social interactions (Frith, 2012) and make a decision (Yeung & Summerfield, 2012).

Based on the description above, the research focus is to see the extent of the influence of the skill of metacognition and digital literacy of physics students in mastering concepts in the physics teaching methods and strategies course. This becomes very important, considering that the three variables are interrelated parts, both in the COVID-19 pandemic and the future. By knowing the influence of the metacognition and digital literacy skills of physics students in mastering concepts in this physics learning method and strategy course, universities can take appropriate policies for the future. Likewise, lecturers can better prepare this course by seeing and involving the skill of digital literacy and metacognition skills of students, so that the virtual lecturing process in the future can run more optimally.

METHODS

The survey method was chosen because it was considered the most appropriate way to collect the required data related to all variables in this study. This is consistent with the opinion of Story & Tait (2019) that survey researchers provide evidence about practice, attitudes, and knowledge. Besides, Fink (2010) also mentioned that surveys are a system for collecting valid information from or about people to describe, compare, or explain respondent's knowledge, attitudes, and behavior. Therefore the data collected and collected in this study are the skill of metacognition, digital literacy, and mastery of concepts in the physics teaching methods and strategies.

The respondents involved in this study were 42 physics education students at the Tarbiyah and Teacher Training faculties at Sulthan Thaha Saifuddin State Islamic University, Jambi, Indonesia, from class A and B. All students involved were 4th-semester students who participated in the lecture on "physics learning methods and strategies" during the COVID-19 pandemic, which was between January-June 2020. Respondents, most of them majoring in physics, were 90% domiciled in Jambi province and spread almost all districts, both in urban and rural areas. The remaining 10% comes from other provinces in Indonesia.

Variable measurements are carried out using instruments arranged in such a way that the validity and reliability of the instruments are highly guaranteed. Each instrument is arranged based on indicators on each variable, and judgment experts are carried out before being used to collect data. This is in line with the opinion of Yusup (2018) that to obtain correct data for conclusions that are by the actual situation, a valid and consistent and appropriate instrument is needed in providing data on research results. The data collection is done at the end of the semester examination so that all respondents collect data virtually at the same time.

After all the data has been collected, an analysis is carried out in two stages. The first stage is to group all variables (metacognition skills, digital literacy, and mastery of concepts of physics learning methods and strategies) into high, medium and low categories. The categorization is done based on the score obtained by each student after taking the test, the final semester exam. It aims to see how the tendency of physics students in each of these variables. Then in the second stage, a bivariate correlation test is performed, which is to see how the effect of digital metacognition and literacy on the mastery of the concepts of methods and strategies for learning physics? Besides, to find out or predict how far the influence between the independent variable and the dependent variable is, a regression test is performed. After completing the data analysis, the next step is to discuss and draw conclusions.

RESULTS AND DISCUSSION

Based on the measurement of research variables, namely metacognition, digital literacy, and mastery of the concepts of Physics Learning Methods and strategies during the COVID-19 period performed virtually to all respondents. After the data is analyzed, it is known that the skill of physics education students as respondents varies, some are in the "high", "medium" and "low" categories. In more detail, the categories of skills of physics education students (respondent) can be seen in Table 1 below.

Table 1. Skill Categories of Physics Education Department Students

Variables	Score	Number of Respondents	Percentage (%)	Category
Meta-cognitions	14-20	17	40,47	High
	7-13	15	35,71	Moderate
	0-6	10	23,82	Low
	Total	42	100	
Digital Literacy	14-20	18	42,85	High
	7-13	14	33,33	Moderate
	0-6	10	23,82	Low
	Total	42	100	
MSPL Concept	14-20	16	38,09	High
	7-13	14	33,33	Moderate
	0-6	12	28,58	Low
	Total	42	100	

MSPL: Methods and Strategies on Physics Learning

Based on Table 1 above, it can be understood that the metacognition skill of physics education students is dominated by the "high" category with 40.47%, followed by the "medium" category at 35.71%, and the remaining 23.82% are at "low" category. As for the digital literacy, the variable is not much different from the metacognition skill, which is dominated by students with high category digital literacy skills at 42.85%, "moderate" category at 33.33%, and the rest 23.82% are at "low" category. Likewise, in the variable conceptualization of the concept of physics and physics learning strategies, physics students who are in the "high" category also appear to be more dominant than the "medium" and "low" categories, which are 33.33% and 28.58%, respectively. Therefore, if existing data is preferred, the skill of physics students in all three aspects/variables is good enough in general. However, if the category "medium" and "low" (middle to lower category) then the skill of physics students is still relatively low in general because more than 50% are in the lower middle class.

Table 2. Description of Correlation Analysis Results for all Variables

		Meta-cognition	Digital Literacy	MSPL
Meta-cognition	Pearson Correlation	1	.945**	.970**
	Sig. (2-tailed)		.000	.000
	N	42	42	42
Digital Literacy	Pearson Correlation	.945**	1	.918**
	Sig. (2-tailed)	.000		.000
	N	42	42	42
MSPL	Pearson Correlation	.970**	.918**	1
	Sig. (2-tailed)	.000	.000	
	N	42	42	42

**. Correlation is significant at the 0.01 level (2-tailed).

Based on the value of sig. (2-tailed) between the Metacognition variable and MSPL is 0,000 <0.05; thus, it can be understood that there is a significant correlation between variable X1 (metacognition) and Y variable (MSPL). Furthermore, for the Digital Literacy variable, the value of sig. (2-tailed) is 0,000 <0.5. That means there is also a significant correlation between X2 (digital literacy) and Y (MSPL).

The calculated R-value is between the variable X1 (metacognition) of 0.970> from the R table, which is 0.304 (for n = 42 is 0.304 with 5% significance). It shows that there is a significant correlation between variable X1 (metacognition) and Y variable (MSPL). The calculated R-value on the variable X2 (digital literacy) against the Y variable (MSPL) is 0.918> from the R table, which is 0.304 (for n = 42 is 0.304 with 5% significance). Thus it can be said that there is a significant correlation between variable X2 (digital literacy) and Y variable (MSPL).

Table 3. Description of Correlation Analysis Results Between Variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.970[a]	.941	.938	1.191

a. Predictors: (Constant), Digital Literacy, Metacognition

Based on the Summary model Table 3 above, the calculated R-value is 0.970> from the R table, which is 0.304 (for n = 42 is 0.304 with a significance of 5%). It shows that there is a significant contribution between variable X1 (metacognition) and X2 (digital literacy) with Y variable (MSPL). Thus it can be said that metacognition skills and digital literacy skills influence 97% mastery of MSPL concepts in physics students through virtual learning during the COVID-19 pandemic, and other factors influence the remaining 3%.

Table 4. Description of the Analysis of Simultaneous Test of Independent Variables against Bound Variables (Analysis of Variants)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	888.297	2	444.149	313.111	.000[a]
	Residual	55.322	39	1.419		
	Total	943.619	41			

a. Predictors: (Constant), Digital Literacy, Metacognition
b. Dependent Variable: MSPL

Based on Table 4 above, it is known that the value of sig. 0,000, which means less than (<) 0.05, it can be said that X1 (metacognition) and X2 (digital literacy) simultaneously affect the variable Y (mastery of the MSPL concept). This is also reinforced by the calculated F value of 313.111> F table 3.22. This means that the two variables X1 and X2, simultaneously affect the Y variable (mastery of the MSPL concept).

Based on the research and analysis data, it is known that in general the metacognition skills of physics students are dominated by the "high" category with 40.47%, followed by the skill of the "medium" category with 35.71%, and the remaining 23.82 % is in the "low" category. This shows that in general, the skill of physics students in controlling their thinking skills, the strategy of implementing lecture assignments is relatively good. As explained by (Fleming & Lau, 2014), metacognition is the skill to recognize one's successful cognitive processes, for example, perceptual tasks or memory. Likewise, the opinion of Mahmood & Batool (2016) stated that metacognition refers to the knowledge people have about their thinking processes.

Besides, the data on metacognition above also shows that in general, (40.47%) physics education students were able to regulate themselves in the learning process during the COVID-19 pandemic. This is as said by Händel et al. (2013) that metacognition is a central component in a self-regulated learning process. Because metacognition is also closely related to critical thinking skills (Magno, 2010), the skill to interact socially (Frith, 2012), the success of students in science learning processes including physics (Zohar & Barzilai, 2013), one's skill to regulate himself for himself study independently, the data above also means that the skill of physics students, in this case, is relatively good.

Based on the metacognition data, the lecturer or teacher can carry out the learning or recovery process by involving various media and learning resources by metacognition. Besides, teachers and lecturers also need to use learning models and strategies that provide opportunities for student learning independently and with good metacognition skills. Thus the virtual learning pattern in the COVID-19 pandemic, although it had an impact on the emergence of dissatisfaction with students and students, could still be overcome and resolved well by around 40.47% of physics education students.

For the group of students with metacognition skills in the "medium" category of 35.71%, and the remaining 23.82% are in the "low" category, teachers/lecturers need to pay relatively serious attention. This is considering their skill to control themselves in terms of independent learning is still relatively not optimal. Therefore, teachers and lecturers need to apply learning models that encourage the development of student/student metacognition, for example with problem-based learning (Amir, 2018), or learning that is oriented towards problem-solving (Romli, 2010). Also, teachers/lecturers should use learning models that have been scientifically proven to improve the metacognition of students, for example, discovery learning (Mawaddah & Suyitno., 2015), HOCS learning models (Leou et al., 2006) or the use of specific teaching materials, for example, based on constructivist (Hapsari & Widodo, 2016), or using teaching materials concerning their use (Kramarski & Kohen, 2017). The use of learning structures and models, media, and specific learning resources to improve students' metacognition skills are also in line with the opinions of Rao et al. (2017) that learning and pedagogical environments can foster student metacognition.

The variable digital literacy is not much different from the skill of metacognition, which is dominated by students with digital literacy skills with the category of "high" with 42.85%. This shows that in general physics education students at the Faculty of Tarbiyah and Teacher Training at the Sulthan Thaha Saifuddin Jambi State Islamic University have relatively good digital information access skills. This is in line with the results of research (Nurjanah et al., 2017) that the basic skill of digital literacy has a significant relationship with the quality of the use of e-resources. This means that 42.85% of students are better able to use digital learning resources to support their learning process during the COVID-19 pandemic.

For students (students) with good digital literacy skills (42.85%) teachers and lecturers can carry out virtual learning more optimally. With their excellent digital literacy skills, students will be able to access a variety of learning resources, including the use of learning applications more optimally. Therefore, these teachers can combine several virtual learning resources, using different learning applications and various virtual learning models. The diversity of learning resources, virtual learning models, and learning applications used will further encourage student creativity in virtual learning. This can precisely improve students' digital literacy skills more optimally.

Still referring to the research data on Table 1, it was stated that the students' digital literacy skill is in the "medium" category with 33.33% and the rest 23.82% are in the "low" category. Therefore it can be said that there are around 57.15% of physics education students have low to medium digital literacy skills. Concerning this group, lecturers and teachers should take concrete steps so that these skills can be immediately improved so that they do not have an impact on student learning processes and outcomes. Also, efforts to increase digital literacy skills are significant because they are also closely related to life today, for example in understanding of all types of cybercrime such as online theft via credit cards (carding), recognizing the characteristics of fake sites (phishing), fraud via email, and others (Maulana, 2019), including to avoid hoaxes or news (Gumilar, 2017).

In the current education field, digital literacy skills are essential. This is as said by Harjono (2018) that mastery of digital literacy in the context of learning can streamline, facilitate, and strengthen the process and results of education. For this reason, increasing the digital literacy skill of students and students is a necessity. Some efforts to improve students' digital literacy skills include, among others, incorporating digital literacy as a structured learning mechanism in the curriculum, or at least integrated with the learning process (Puspito, 2017). Also, as an effort to increase digital literacy teachers and lecturers can use specific learning models, for example, blended learning (Masitoh, 2018) and their learning tools (Mustakim et al., 2019), virtual-based inquiry learning (Saputra et al., 2017) and literacy-oriented learning (Ibda, 2020).

As another alternative to improve digital literacy skills is the use of digital-based equipment, for example, android. As said by Balya et al. (2018) that the use of android in learning can also encourage increased digital literacy of students and students, as well as the use of digital learning resources (Aprilia et al., 2017). Enhancing digital literacy skills can also be done with various internet-based activities, such as webinar activities (Sugiyo et al., 2018) or through special training oriented to digital media (Prasanti & Indriani, 2017), (Rahmawan, 2018) digital teaching materials development (Smaragdina et al., 2020). The existence of various innovations in learning-oriented to digital literacy is expected to improve the digital literacy skills of physics students, especially during the COVID-19 pandemic.

As for the variables related to the concept of physics learning methods and strategies, physics students who are in the "high" category of 38.09% also appear to be more dominant than the "medium" and "low" categories, respectively 33.33% and 28.58%. Therefore, if existing data is preferred, the skill of physics students in all three aspects/variables is good enough in general. However, if the category "medium" and "low" (middle to lower category) then the skill of physics students is still relatively low in general because more than 50% are in the lower middle class. Therefore, optimizing student learning outcomes in this course still needs to be improved. This is because this course has become one of the ways to improve the competence (pedagogy) of prospective teacher students.

With the increase in pedagogical skills, especially the skill in terms of using appropriate learning methods and structures, the implementation of media and teaching materials, and others until the skill of teachers to assess learning outcomes, the quality of human resources from education will also improve. Some previous research has proven that innovation and creativity of the learning process through specific methods and learning structures can improve the quality of the process and student learning outcomes. Some of the research, for example, conducted by Halim (2012) which concluded that there is an influence of learning strategies on learning outcomes in physics. The results of Komariyah & Syam (2016) , Sari (2016), and Hosnah (2017) research also show that specific learning models (STAD and inquiry types) can improve science process skills and student learning outcomes. The point is that learning methods and strategies are essential to create a quality learning process and must be mastered by teachers and prospective teachers.

In this study, it was found that the skill of metacognition and digital literacy significantly affected the mastery of concepts in the "physics-MSPL learning methods and strategies", as presented in Table 2 above. In the table, it is stated that based on the R-value, it is known that the calculated R-value between X1 variable (metacognition) of 0.970> from R table, which is 0.304 (for n = 42 is 0.304 with a significance of 5%). It shows that there is a significant correlation between variable X1 (metacognition) and Y variable (MSPL). The calculated R-value on the variable X2 (digital literacy) against the Y variable (MSPL) is 0.918> from the R table, which is 0.304 (for n = 42 is 0.304 with a significance of 5%). Thus it can be said that there is a significant correlation between variable X2 (digital literacy) and Y variable (MSPL). Also, tables 3 and 4 show that together (metacognition and digital literacy skills) affect the skill of students to master the course. With this finding, improving the skill of prospective physics teacher students can be done through developing metacognition skills and digital literacy skills. This is because the three variables significantly influence each other.

Although the three variables (metacognition, digital literacy, and mastery of MSPL concepts) are interrelated, students of physics education who can master the concept in the "high" category are only 38.09% and the remaining 61.91% (Table 1) in the "moderate" category and "low" (lower middle category). This shows that there are other factors outside of metacognition and digital literacy that affect learning outcomes. One of the factors that are strongly suspected is the existence of constraints in facilities and infrastructure, namely electricity and internet networks. This is based on the results of more in-depth data analysis, and it is known that students with mastery of the MSPL concept are of low category, in general, they are domiciled in rural areas with relatively difficult access to electricity and internet networks, both in quality and quantity. Even to follow the virtual learning process, they have to go to certain areas, and in some cases, some students climb trees to get internet signals. The situation certainly has an impact on mastering the MSPL concept, because the MSPL lecture itself is implemented virtually so that the internet and electricity networks are vital and decisive.

Referring to the results of this study, efforts to improve learning outcomes in general, including skills, knowledge, and attitudes can be made by involving digital metacognition and literacy together. The skill of metacognition, allows students to manage, control themselves in the learning process and they are also able to reduce psychological barriers from various problems that arise in certain situations, such as the COVID-19 pandemic as it is today. Whereas with their digital literacy skills, they can utilize virtual learning resources optimally so that the limitations and shortcomings of learning resources and media can be overcome properly. Thus, further studies need to be carried out whether digital metacognition and literacy also significantly influence student and student learning outcomes related to subjects that require specific learning assistance, for example learning experimentally, learning to grow catacombs, and in children with special needs.

CONCLUSION

Based on the data and analysis, it can be understood that the metacognition skill of physics education students is dominated by the "high" category with 40.47%, followed by the "medium" category at 35.71%, and the remaining 23.82% are at "low" category. As for the digital literacy, the variable is not much different from the metacognition skill, which is dominated by students with high category digital literacy skills at 42.85%, "moderate" category at 33.33%, and the rest 23.82% are at "low" category. Likewise, in the variable conceptualization of the concept of physics and physics learning strategies, physics students who are in the "high" category also appear to be more dominant than the "medium" and "low" categories, which are 33.33% and 28.58%, respectively. Based on the ANOVA table, it is known that the value of sig. 0,000, which means less than (<) 0.05. It can be said that X1 (metacognition) and X2 (digital literacy) simultaneously affect the Y variable (mastery of the MSPL concept). This is also reinforced by the calculated F value of 313.111> F table 3.22. This means that the two variables X1 and X2, simultaneously affect the Y variable (mastery of the MSPL concept).

REFERENCES

A'yuni, Q. Q. (2015). Literasi digital remaja di kota Surabaya. *Jurnal Fakultas Ilmu Sosial dan Ilmu Politik, Universitas Airlangga Surabaya*.

Akbar, M. F., & Anggaraeni, F. D. (2017). Teknologi dalam pendidikan: Literasi digital dan self-directed learning pada mahasiswa skripsi. *Indigenous: Jurnal Ilmiah Psikologi*, *2*(1).

Akmam, A., Anshari, R., Amir, H., Jalinus, N., & Amran, A. (2018, April). Influence of learning strategy of cognitive conflict on student misconception in computational physics course. In *IOP Conf. Series: Materials Science and Engineering* (Vol. 335, pp. 1-7).

Amir, M. F. (2018). Pengembangan perangkat pembelajaran berbasis masalah kontekstual untuk meningkatkan kemampuan metakognisi siswa sekolah dasar. *Journal of Medives: Journal of Mathematics Education IKIP Veteran Semarang*, *2*(1), 117-128.

Anggo, M. (2011). Pelibatan metakognisi dalam pemecahan masalah matematika. *Edumatica: Jurnal Pendidikan Matematika*.

Anggo, M. (2012). Metakognisi dan usaha mengatasi kesulitan dalam memecahkan masalah matematika kontekstual. *Aksioma*, *1*(01).

Alcina, A. (Ed.). (2011). *Teaching and learning terminology: new strategies and methods* (Vol. 35). John Benjamins Publishing.

Almarzooq, Z., Lopes, M., & Kochar, A. (2020). Virtual learning during the COVID-19 pandemic: a disruptive technology in graduate medical education.

Aprilia, T., Sunardi, S., & Djono, D. Pemanfaatan Media Buku Digital berbasis Kontekstual dalam Pembelajaran IPA. In *Seminar Nasional Teknologi Pendidikan 2017*. Sebelas Maret University.

Azlan, C. A., Wong, J. H. D., Tan, L. K., Huri, M. S. N. A., Ung, N. M., Pallath, V., ... & Ng, K. H. (2020). Teaching and learning of postgraduate medical physics using Internet-based e-learning during the COVID-19 pandemic–A case study from Malaysia. *Physica Medica*, *80*, 10-16.

Balya, T., Pratiwi, S., & Prabudi, R. (2018). Literasi Media Digital pada Penggunaan Gadget (Studi Deskriptif Penggunaan Gadget Pada Siswa SMK Broadcasting Bina Creative Medan Yang

Berdampak Pada Pergeseran Nilai Kearifan Lokal). *Jurnal Simbolika: Research and Learning in Communication Study*, *4*(2), 173-187.

Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technologies*, *2*(2), 113-115.

Bawden, D. (2008). Origins and concepts of digital literacy. *Digital literacies: Concepts, policies and practices*, *30*(2008), 17-32.

Darmayanti, D., & Sulisworo, D. (2016). Pengaruh Strategi Pembelajaran Inkuiri Terbimbing dengan Kegiatan Laboratorium untuk meningkatkan Pemahaman Konsep Siswa Kelas XI SMAN 1 Srandakan Pokok Bahasan Fluida Statis. *JRKPF UAD,(3)*, *1*.

Daulae, T. H. (2014). Menciptakan pembelajaran yang efektif. In *Forum Paedagogik* (Vol. 6, No. 02).

Dewi, H. (2019). Penerapan Metode Problem Based Learning untuk Meningkatkan Ketuntasan Belajar Fisika Berbantuan Evaluasi Quizizz di Sekolah Bersistem Kredit Semester. *e-Jurnal Mitra Pendidikan*, *3*(10), 1298-1313.

Dhillon, S. S., Vitiello, M. S., Linfield, E. H., Davies, A. G., Hoffmann, M. C., Booske, J., ... & Castro-Camus, E. (2017). The 2017 terahertz science and technology roadmap. *Journal of Physics D: Applied Physics*, *50*(4), 043001.

Donaldson, C., & Alker, Z. (2019). Digital Literacy. *Journal of Victorian Culture*, *24*(3), 329-330.

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, *14*(1), 4-58.

Erwinsyah, A. (2017). Manajemen kelas dalam meningkatkan efektifitas proses belajar mengajar. *TADBIR: Jurnal Manajemen Pendidikan Islam*, *5*(2), 87-105.

Eshet, Y. (2004). Digital literacy: A conceptual framework for survival skills in the digital era. *Journal of educational multimedia and hypermedia*, *13*(1), 93-106.

Eysenck, M. W. (2012). *Simply psychology*. Psychology Press.

Fakhrurrazi, F. (2018). Hakikat pembelajaran yang efektif. *At-Tafkir*, *11*(1), 85-99.

Fink, A. (2010). Survey research methods.

Fleming, S. M., & Lau, H. C. (2014). How to measure metacognition. *Frontiers in human neuroscience*, *8*, 443.

Fleming, S. M., Huijgen, J., & Dolan, R. J. (2012). Prefrontal contributions to metacognition in perceptual decision making. *Journal of Neuroscience*, *32(*18), 6117-6125.

Fletcher, L., & Carruthers, P. (2012). Metacognition and reasoning. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *367*(1594), 1366-1378.

Fox, E., & Riconscente, M. (2008). Metacognition and self-regulation in James, Piaget, and Vygotsky. *Educational Psychology Review*, *20*(4), 373-389.

Frith, C. D. (2012). The role of metacognition in human social interactions. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *367*(1599), 2213-2223.

Garrison, D. R., & Akyol, Z. (2015). Toward the development of a metacognition construct for communities of inquiry. *The Internet and Higher Education*, *24*, 66-71.

Gillen, J. (2014). *Digital literacies*. Routledge.

Gumilar, G. (2017). Literasi media: Cerdas menggunakan media sosial dalam menanggulangi berita palsu (hoax) oleh siswa SMA. *Jurnal Pengabdian Kepada Masyarakat*, *1*(1).

Hacker, D. J., Dunlosky, J., & Graesser, A. C. (Eds.). (2009). *Handbook of metacognition in education*. Routledge.

Halim, A. (2012). Pengaruh strategi pembelajaran dan gaya belajar terhadap hasil belajar fisika siswa SMP N 2 Secanggang Kabupaten Langkat. *Jurnal Tabularasa*, *9*(2), 141-158.

Halim, A. (2017). Pengaruh Strategi Pembelajaran dan Gaya Belajar terhadap Hasil Belajar Fisika. *Jurnal Teknologi Pendidikan (JTP)*, *10*(2), 114-126.

Händel, M., Artelt, C., & Weinert, S. (2013). Assessing metacognitive knowledge: Development and evaluation of a test instrument. *Journal for educational research online*, *5*(2), 162-188.

Hapsari, N. D., & Widodo, A. (2016). Meningkatkan pengetahuan dan keterampilan metakognisi siswa melalui bahan ajar berbasis konstruktivis-metakognitif.

Harjono, H. S. (2018). Literasi digital: Prospek dan implikasinya dalam pembelajaran bahasa. *PENA: Jurnal Pendidikan Bahasa dan Sastra*, *8*(1), 1-7.

Harris, A. (2019). *Teaching and learning in the effective school*. Routledge.

Hong, E. (2020). Metacognition. *The Curated Reference Collection in Neuroscience and Biobehavioral Psychology*.

Hosnah, W. M. (2017). Pengaruh Model Pembelajaran Inkuiri Terbimbing Terhadap Hasil Belajar Fisika di SMA. *Jurnal Pembelajaran Fisika*, *6*(2), 196-200.

Ibda, H. (2020). Pembelajaran bahasa indonesia berwawasan literasi baru di perguruan tinggi dalam menjawab tantangan era revolusi industri 4.0. *Jalabahasa*, *15*(1), 48-64.

Jarzabkowski, P., & Whittington, R. (2008). A strategy-as-practice approach to strategy research and education. *Journal of Management Inquiry*, *17*(4), 282-286.

Johnson, G., Whittington, R., Scholes, K., Angwin, D. N., & Regnér, P. (2017). *Exploring strategy* (No. 11th e). Pearson.

Julien, H. (2018). Digital literacy in theory and practice. In *Encyclopedia of Information Science and Technology, Fourth Edition* (pp. 2243-2252). IGI Global.

Komariyah, L., & Syam, M. (2016). Pengaruh Model Pembelajaran Inkuiri Terbimbing (Guided In-

quiry) dan Motivasi terhadap Hasil Belajar Fisika Siswa. *Saintifika*, *18*(1).
Kramarski, B., & Kohen, Z. (2017). Promoting pre-service teachers' dual self-regulation roles as learners and as teachers: Effects of generic vs. specific prompts. *Metacognition and Learning*, *12*(2), 157-191.
Kuhn, D. (2000). Metacognitive development. *Current directions in psychological science*, *9*(5), 178-181.
Kurniawati, A. D., & Siswono, T. Y. E. (2014). Pengaruh Kecemasan dan Self Efficacy Siswa terhadap Kemampuan Pemecahan Masalah Materi Segiempat Siswa Kelas VII MTs Negeri Ponorogo. *MATHEdunesa, Jurnal Ilmiah Pendidikan Matematika*.
Kurniawati, J., & Baroroh, S. (2016). Literasi Media Digital Mahasiswa Universitas Muhammadiyah Bengkulu. *Jurnal Komunikator*, *8*(2), 51-66.
Kuspriyanto, B., & Siagian, S. (2013). Strategi pembelajaran dan kemampuan berpikir kreatif terhadap hasil belajar fisika. *Jurnal Teknologi Pendidikan*, *6*(1), 134-258.
Lai, E. R. (2011). Metacognition: a literature review research report. *Research Reports*, 1-40.
Lankshear, C., & Knobel, M. (2015). Digital literacy and digital literacies: Policy, pedagogy and research considerations for education. *Nordic Journal of Digital Literacy*, *9*, 8-20.
Leou, M., Abder, P., Riordan, M., & Zoller, U. (2006). Using 'HOCS-centered learning'as a pathway to promote science teachers' metacognitive development. *Research in Science Education*, *36*(1-2), 69-84.
Magno, C. (2010). The role of metacognitive skills in developing critical thinking. *Metacognition and learning*, *5*(2), 137-156.
Mahmood, S., & Batool, I. N. (2016). Metacognition. *Rawal Medical Journal*, *41*(4), 467-470.
Mariko, S. (2015). Pengaruh Strategi Pembelajaran Berbasis Multimedia Interaktif Terhadap Hasil Belajar Fisika pada Materi Optika Geometri. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *4*(2).
Masitoh, S. (2018). Blended Learning berwawasan literasi digital suatu upaya meningkatkan kualitas pembelajaran dan membangun generasi emas 2045. *Proceedings of the ICECRS*, *1*(3).
Maulana, M. (2019). „Definisi, Manfaat Dan Elemen Penting Literasi Digital". *Diunduh tanggal*, *20*.
Mawaddah, N. E., & Suyitno, H. (2015). Model Pembelajaran Discovery Learning dengan Pendekatan Metakognitif untuk Meningkatkan Metakognisi dan Kemampuan Berpikir Kreatif Matematis. *Unnes Journal of Mathematics Education Research*, *4*(1).
Meltzer, D. E., & Thornton, R. K. (2012). Resource letter ALIP–1: active-learning instruction in physics. *American journal of physics*, *80*(6), 478-496.
Mustakim, M., Shoffa, S., & Hidayatullah, A. (2019). Pengembangan perangkat pembelajaran blended learning berbasis schoology untuk meningkatkan literasi digital matematika. *JUMLAHKU: Jurnal Matematika Ilmiah STKIP Muhammadiyah Kuningan*, *5*(1), 88-99.
Ng, W. (2012). Can we teach digital natives digital literacy?. *Computers & education*, *59*(3), 1065-1078.
Nurjanah, E., Rusmana, A., & Yanto, A. (2017). Hubungan literasi digital dengan kualitas penggunaan e-resources. *Lentera Pustaka: Jurnal Kajian Ilmu Perpustakaan, Informasi Dan Kearsipan*, *3*(2), 117-140.
Prasanti, D., & Indriani, S. S. (2017). Pelatihan literasi media digital bagi murid-murid armidale english college (AEC) di Soreang Kabupaten Bandung Selatan. *JPPM (Jurnal Pendidikan dan Pemberdayaan Masyarakat)*, *4*(2), 157-165.
Pujilestari, Y. (2020). Dampak Positif Pembelajaran Online Dalam Sistem Pendidikan Indonesia Pasca Pandemi Covid-19. *'ADALAH*, *4*(1).
Purwanto, A., Pramono, R., Asbari, M., Santoso, P. B., Wijayanti, L. M., Choi, C. H., & Putri, R. S. (2020). Studi eksploratif dampak pandemi Covid-19 terhadap proses pembelajaran online di sekolah dasar. *EduPsyCouns: Journal of Education, Psychology and Counseling*, *2* (1), 1–12.
Puspito, D. W. (2017, October). Implementasi Literasi Digital dalam Gerakan Literasi Sekolah. In *Konferensi Bahasa dan Sastra II International Conference on Language, Literature, and Teaching, Universitas Negeri Semarang, Semarang* (Vol. 10).
Rahmawan, D. (2018). Pelatihan Literasi Media Sosial Terkait Penanggulangan Hoaks Bagi Siswa SMA. *Jurnal Pengabdian Kepada Masyarakat*, *2*(12), 1021-1024.
Rao, A. S., Tarr, T. A., & Varma-Nelson, P. (2017). Promoting metacognitive practices in faculty and students. In *Metacognition in Chemistry Education: Connecting Research and Practice* (pp. 81-99). American Chemical Society.
Riduan, A., Rainiyati, & Yusnaini. (2015). Aplikasi Penggunaan Pupuk Organik Budidaya Ubi Jalar di Desa. Jurnal Pengabdian pada Masyarakat Volume 30, Nomor 2 April – Juni 2015. *Pengabdian Masyarakat Volume 30*.
Riyadi, T., Sunyono, S., & Efkar, T. (2018). Hubungan Kemampuan Metakognisi dan Self Efficacy dengan Literasi Kimia Siswa Menggunakan Model SiMaYang. *Jurnal pendidikan dan pembelajaran kimia*, *7*(2), 251-263.
Romli, M. (2010). Strategi membangun metakognisi siswa SMA dalam pemecahan masalah matematika. *AKSIOMA: Jurnal Matematika Dan Pendidikan Matematika*, *1*(2/Septembe).
Saputra, H., Al Auwal, T. R., & Mustika, D. (2017). Pembelajaran inkuiri berbasis virtual laboratory untuk meningkatkan kemampuan literasi sains mahasiswa calon guru pendidikan fisika Universitas Samudra. *JIPI (Jurnal IPA & Pembelajaran IPA)*, *1*(2), 143-148.
Sari, H. K. (2016). Peningkatan Keterampilan Proses Sains dan Hasil Belajar Fisika Siswa pada Model Pembelajaran Kooperatif Tipe Student Team Achievement Division. *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah*, *1*(1), 15-22.

Setyosari, P. (2017). Menciptakan pembelajaran yang efektif dan berkualitas. *JINOTEP (Jurnal Inovasi dan Teknologi Pembelajaran): Kajian dan Riset Dalam Teknologi Pembelajaran*, *1*(1), 20-30.

Slavich, G. M., & Zimbardo, P. G. (2012). Transformational teaching: Theoretical underpinnings, basic principles, and core methods. *Educational psychology review*, *24*(4), 569-608.

Smaragdina, A. A., Nidhom, A. M., Soraya, D. U., & Fauzi, R. (2020). Pelatihan Pemanfaatan dan Pengembangan Bahan Ajar Digital Berbasis Multimedia Interaktif untuk Menghadapi Era Revolusi Industri 4.0. *Jurnal KARINOV*, *3*(1), 53-57.

Sohibun, S., & Ade, F. Y. (2017). Pengembangan media pembelajaran berbasis virtual class berbantuan Google Drive. *Tadris: Jurnal Keguruan Dan Ilmu TarbiyahJurnal Keguruan Dan Ilmu Tarbiyah*, *2*.

Story, D. A., & Tait, A. R. (2019). Survey research. *Anesthesiology: The Journal of the American Society of Anesthesiologists*, *130*(2), 192-202.

Sugiyo, Y. K., Zulfika, S., & Widayanti, W. (2018). Evaluasi Program Webinar (Web-Based Seminar) Parenting Education Sebagai Upaya Meningkatkan Literasi Media Digital Dalam Mendidik Generasi Z di Kota Semarang. *Journal of Studies in Early Childhood Education (J-SECE)*, *1*(2), 108-117.

Sunarno, W. (2019, December). Pembelajaran IPA di Era Revolusi Industri 4.0. In *Prosiding SNPF (Seminar Nasional Pendidikan Fisika).*

Von Korff, J., Archibeque, B., Gomez, K. A., Heckendorf, T., McKagan, S. B., Sayre, E. C., ... & Sorell, L. (2016). Secondary analysis of teaching methods in introductory physics: A 50 k-student study. *American Journal of physics*, *84*(12), 969-974.

Wahono, H. T. T., & Effrisanti, Y. (2018). Literasi digital di era millenial. *Journal Proceeding*, *4*(1).

Wibowo, M., & Asvaliantina, V. (2018). Kajian Dispersi Panas Akibat Air Limbah Rencana Pembangunan PLTU Kuala Tungkal-Provinsi Jambi. *Jurnal Teknologi Lingkungan*, *19*(1), 1-12.

Wicaksono, A. B., & Saufi, M. (2013, November). Mengelola kecemasan siswa dalam pembelajaran matematika. In *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika* (Vol. 9).

Widyaningrum, G. L. (2020). WHO tetapkan COVID-19 sebagai pandemi global, apa maksudnya. *National Geographic Indonesia*.

Yeung, N., & Summerfield, C. (2012). Metacognition in human decision-making: confidence and error monitoring. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *367*(1594), 1310-1321.

Yusup, F. (2018). Uji validitas dan reliabilitas instrumen penelitian kuantitatif. *Tarbiyah: Jurnal Ilmiah Kependidikan*, *7*(1).

Yustina, Y., Halim, L., & Mahadi, I. (2020). The Effect of 'Fish Diversity' Book in Kampar District on the Learning Motivation and Obstacles of Kampar High School Students through Online Learning during the COVID-19 Period. *Journal of Innovation in Educational and Cultural Research*, *1*(1), 7-14.

Zohar, A., & Barzilai, S. (2013). A review of research on metacognition in science education: Current and future directions. *Studies in Science education*, *49*(2), 121-169.

Zuo, L., Dillman, D., & Miller Juve, A. (2020). Learning at-home during COVID-19: a multi-institutional virtual learning collaboration. *Medical education*.