JPPIPA 9(3) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Climate Change Interactive Teaching Materials to Enhance Students' Critical Thinking Skills and Science Attitude

Indarini Dwi Pursitasari[1]*, Bibin Rubini[1], Muhammad Iqbal Suriansyah[1], Siti Samsia[2], Nila Puspita[2]

[1] Prodi Pendidikan IPA, Universitas Pakuan, Bogor, Indonesia.
[2] SMP Negeri 1, Bogor, Indonesia.

Received: January 28, 2023
Revised: March 24, 2023
Accepted: March 28, 2023
Published: March 31, 2023

Corresponding Author:
Indarini Dwi Pursitasari
indarini.dp@unpak.ac.id

DOI: 10.29303/jppipa.v9i3.3196

Abstract: The skills needed in the 21st century are basic literacy, competence, and character. Critical thinking skills are one of the competencies and attitudes of science which is part of the character. The research aims to enhance students' critical thinking skills and science attitudes using interactive teaching materials on Climate Change. This quasi-experimental research was conducted in one of the junior high schools in Bogor involving 42 students in the experimental class and 41 students in the control class. Data collection uses critical thinking skills tests in the form of essays, science attitude questionnaires, and student response questionnaires. The data collected were analyzed descriptively and inferentially. The results showed that students who used interactive teaching materials had a higher average N-gain than the control class. The results of the t-test show that there are significant differences in critical thinking skills. The students' scientific attitude showed a meaning that was not much difference between students who used interactive teaching materials and those without them. Students gave a positive response to climate change interactive teaching materials in science learning.

Keywords: Critical Thinking Skills; Interactive Teaching Materials; Science Attitude

Introduction

The 21st century requires students to have critical, creative, collaborative, and communicative thinking skills (Iriani & Handoyo, 2020; Liesa-Orús et al., 2020; Magno et al., 2016; Yulianti et al., 2021). These 21st-century skills need to be possessed by students to face problems that arise in everyday life. Critical, creative, collaborative, and communicative thinking skills need to be trained and familiarized through the learning process as well as in everyday life. According to Wahyuddin et al. (2022), the learning process that takes place interactively is inspiring, fun, and full of challenges that will facilitate students to express their ideas, initiatives, and creatives.

In addition, the occurrence of Covid-19 Pandemic has caused changes in various activities in the world (Salzberger et al., 2020; Wang et al., 2021; Zhou et al., 2020). The implementation of policies to maintain distance and human interaction in various countries is recommended to reduce the impact of the spread of COVID-19. This also affects teaching and learning activities in schools. Learning that was originally carried out offline changed to online (Adedoyin & Soykan, 2020; Mukhtar et al., 2020). During online learning, teachers cannot observe student activities and students do not interact directly with teachers or other students (Salta et al., 2022). Online learning also has an impact on the need to use technology (Abriata, 2022; Sukendro et al., 2020; Winter et al., 2021). This change has had a considerable impact on teachers and students (Al Darayseh, 2020; Kim et al., 2019). Learning is carried out remotely using various facilities available including the change of teaching materials from printed teaching materials to digital and interactive teaching materials. that can be accessed easily (Mahmudah et al., 2022; Wahyuni et al., 2020; Warlinda et al., 2022) and students need the facilities to be able to keep up with technological developments in learning.

How to Cite:
Pursitasari, I. D., Rubini, B., Suriansyah, M.I., Samsia, S., & Puspita, N. (2023). Climate Change Interactive Teaching Materials to Enhance Students' Critical Thinking Skills and Science Attitude. *Jurnal Penelitian Pendidikan IPA*, *9*(3), 1360–1367. https://doi.org/10.29303/jppipa.v9i3.3196

The development of technology in the 21st century has also brought about a change in the balance of the environment. Therefore, environmental awareness needs to be instilled in the community from an early age (Abdillah et al., 2022; Kousar et al., 2022). One of the efforts to instill environmental awareness in students is to develop eco-literacy-based teaching materials that are expected to familiarize students with caring for the environment by asking questions, analyzing and solving problems, understanding readings/information well, being honest, open-minded, having great curiosity, and not easily believing in the information that has no evidence. Thus, critical thinking skills and scientific attitudes are necessary to maintain a sustainable life.

The results of observations on teaching materials used in science learning in one of the cities in West Java have not facilitated students develop critical thinking skills. The teaching materials available are in the form of printed teaching materials that are content-charged, monotonous, and look less interactive. This is also the case in several other schools (Hamid et al., 2020). The results of the research on the use of printed teaching materials can only improve the critical thinking skills of students with moderate categories (Fitriana & Kaniawati, 2017; Pursitasari et al., 2019). Therefore, it is necessary to further develop interactive teaching materials that can be accessed easily and are expected to improve students' critical thinking skills. Critical thinking skills are one of the aspects needed by students to solve problems with various alternative problem-solving (Husnah, 2017).

Based on the problem and literature review that have been stated, the purpose of this study is to produce interactive teaching materials that can improve students' critical thinking skills and science attitudes. Teaching materials are learning resources that contain materials, methods, boundaries, and ways of evaluating that are systematically designed and interesting to enhance critical thinking skills and science attitudes.

Method

Climate change teaching materials used to improve critical thinking skills and science attitudes have been developed with the Analysis-Design-Development-Implementation-Evaluation (ADDIE) stage. This study is the stage of implementation of the teaching materials produced and has been tested for feasibility by experts and assessments of junior high school science teachers.

The resulting teaching materials are then implemented in class VII students in one of the junior high schools in the city of Bogor. Learning is carried out online and offline because there is still a Covid 19 Pandemic. The number of students was 46 in the experiential class and 38 in the control class with the age between 13-14 years. The research method used during implementation is a quasi-experiment with pre-test and post-test control group design (Table 1).

Table 1. Pre-test and post-test control group design

Experimental Class	$O_{E.1}$	X	$O_{E.2}$
Control Class	$O_{C.1}$	C	$O_{C.2}$

The implementation is carried out using two classes, namely the control class and the experimental class. The control class is a class that in climate change learning does not use developed teaching materials (O), while the experimental class uses digital climate change teaching materials (R). Before and after climate change learning, pre-tests ($O_{E.1}$; $O_{C.1}$) and post-tests ($O_{E.2;}$ $O_{C.2}$) are carried out to measure students' critical thinking skills and science attitudes. The research instrument is in the form of a critical thinking skills test in the form of an essay with 13 valid questions with a reliability coefficient of 0.825. Exploring students' scientific attitudes is carried out using questionnaires with the judging criteria for positive statements as strongly agree = 4; agree = 3; disagree = 2; and strongly disagree = 1. As for positive statements, they get the opposite score. The data of critical thinking skills obtained are then carried out scoring and analysis to determine N-gain using Formula (1). The N-gain values obtained are further categorized as high, medium, and low based on Table 2. The assessment of students' science attitudes is carried out only after the student has studied the teaching materials. Furthermore, a significance test of the difference between the two averages was carried out using Mann-Whitney's statistical test.

$$< g > = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Score maximum} - \text{Pretest Score}} \quad (1)$$

Table 2. Critical thinking Improvement Criteria

Range	Category
$g \geq 0.7$	High
$0.3 \leq g \leq 0.7$	Medium
$g < 0.3$	Low

Result and Discussion

The climate change material presented in the interactive digital teaching material contains weather and climate types, climate change, greenhouse effects, global warming, causes of climate change, the impact of climate change on ecosystems, and climate change mitigation (Figure 1). The interactive digital teaching material is packaged in such a way as to have an attractive appearance and presentation of material that is easy for students to understand and contains

components of eco-literacy which will promote students' critical thinking skills and science attitudes.

Figure 1. Display of interactive teaching materials on Climate Change to Ecosystems.

Students' Critical Thinking Skills

The application of interactive teaching materials with the topic of Climate Change (Figure 1) at SMP Negeri 1 Bogor is carried out online both in experimental classes and control classes using zoom meetings and classical meetings according to a predetermined lesson schedule. Students can use interactive teaching materials using laptops, computers, or smartphones. This can make it easier for students to learn Climate Change material because it can be accessed using equipment owned by students and schools. According to Gikas & Grant (2013), the use of mobile technology *such as* smartphones or android phones, laptops, computers, tablets, and I-phones can be used to access information anytime and anywhere, and has a large contribution to educational institutions, including the achievement of distance learning goals (Korucu & Alkan, 2011).

As a result of observations during the Zoom meeting (Figure 2), students seemed enthusiastic and serious about opening and studying slide after slide related to material on climate change. Some natural phenomena are displayed as a result of climate change such as global warming, depletion of the ozone layer, melting of polar ice caps, etc. Based on the phenomenon they see students write down and answer the questions contained in the teaching materials. This can familiarize students to get used to criticizing every problem they face and solving the problem appropriately. When learning, students also dare to ask questions if there are things that are not yet understood. Students can also answer the teacher's questions well.

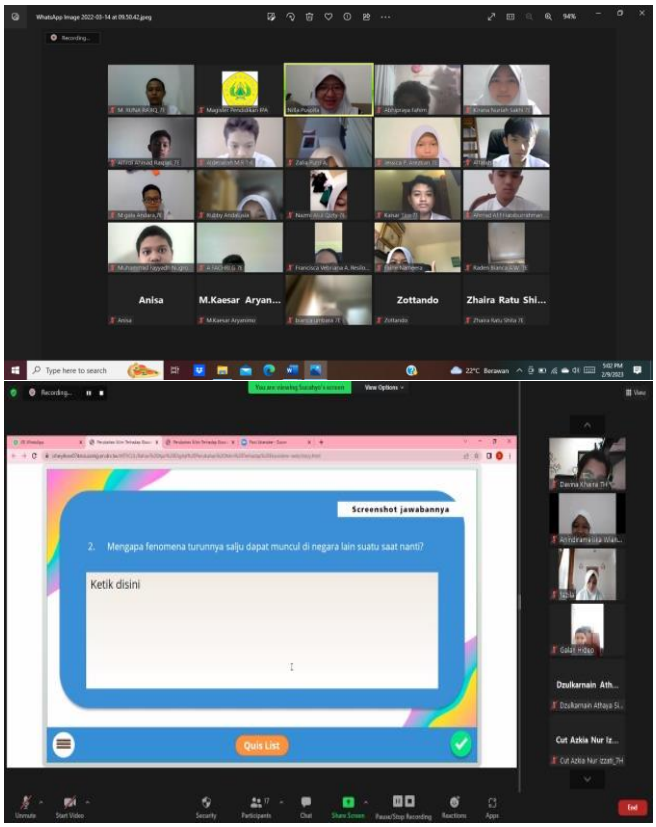

Figure 2. Learning Climate Change with Zoom Meeting

According to Nosics (2012), the three activity of students should do to think critically are: (1) involvement in asking questions; (2) answering questions through logical reasoning; and (3) believing that the answers given are the result of his reasoning. The results of research on the implementation of teaching materials in science learning in junior high school grade VII showed an increase in N-gain of 0.47 in experimental classes with the "moderate" category and 0.22 in the control class with the "low" category (Table 3).

Table 3. Students' critical thinking

Description	Experiment	Control
Number of students	46	38
Highest N-gain	0.77	0.40
Lowest N-gain	0.21	0.10
Average N-gain	0.47	0.22
Standard deviation	0.12	0.077

The difference in N-gain obtained is due to different teaching materials used in learning, but the models, methods, and infrastructure are all conditioned the same. The N-gain in the experimental class is greater than in the control class. This is because the interactive teaching materials used have the characteristics of having an attractive and fun appearance, a complete menu variety, and demanding active student

involvement, facilitating students to solve problems based on the results of analysis of contextual issues. An example of student involvement in the e-teaching material is that students can directly answer questions by filling in the answers in the space provided and matching quizzes (Figure 3), and other activities in the teaching materials. Various learning activities in the e-module contain aspects of critical thinking skills, namely building basic classification, concluding, providing a further explanation, and managing strategies, and tactics (Ennis, 1985).

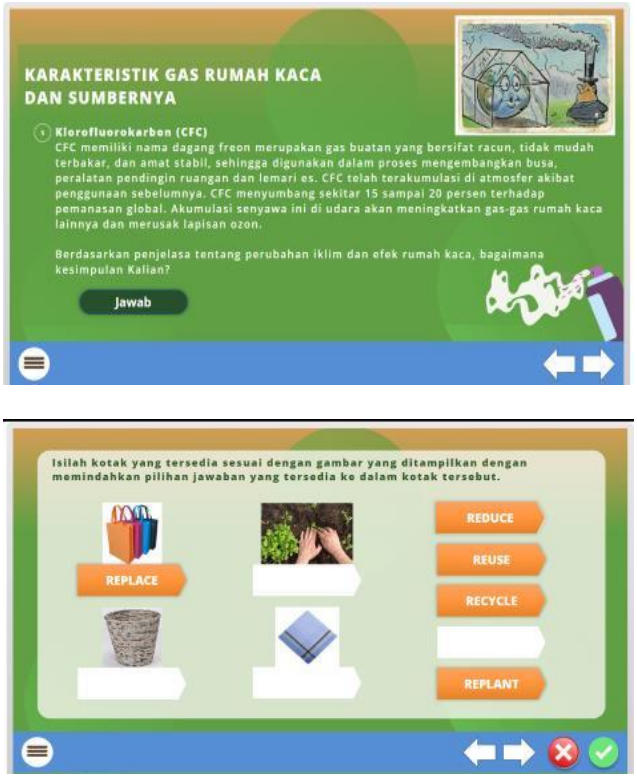

Figure 3. Examples of questions that ask students to conclude and find a suitable answer

The significance test of differences in improving students' critical thinking skills was carried out using inferential statistics after normality and homogeneity tests were carried out. The results of normality and homogeneity conclude that the data are normal and homogeneous distributed (Table 4).

Table 4. Normality and Homogeneity Test Results of Critical Thinking Skills

Class	Normality Test		Homogeneity Test	
	sig.	Conclusion	sig.	Conclusion
Control	0.168	Normal distribution	0.226	Homogeneous groups
Experiment	0.464	Normal distribution		

Because the data is distributed normally and homogeneously, the signification test uses an independent t-test with the test results showing a sig value of 0.00. These results show that the null hypothesis is rejected, so it can be concluded that there are differences in the improvement of critical thinking skills.

This is in line with the results of research by Santoso et al. (2018) which concluded that the effectiveness of using e-books was higher than that of printed books. Interactive teaching materials can also be easily accessed by students and teachers using appropriate tools. Interactive teaching materials consist of practical learning materials, methods, and evaluations, to attract students' learning interests (Elvarita et al., 2020). Interactive teaching materials used in learning can be accessed using smartphones. The use of smartphones for learning has the following advantages: (1) learning does not depend on place and time; (2) learning is more varied; and (3) increases student motivation with a variety of multimedia resources that make learning enjoyable (Sirwan & Nurkhamid, 2021). Using interactive teaching materials generates interest in students. This high interest can be seen from the enthusiasm of students when learning using interactive teaching materials in science learning on Climate Change during offline learning (Figure 4).

Figure 4. Enthusiastic students when using interactive teaching materials.

The high enthusiasm of the students causes students to be more motivated to study climate change material and build critical thinking skills. In addition to facilitating students to develop critical thinking skills, the interactive teaching materials are also designed to build students' science attitudes.

Science Attitudes

Science attitudes play a role in learning because they will affect student learning outcomes and skills (Fitriani

et al., 2020). The attitude of science has the following characteristics not being easy to believe and open-minded, critical, logical, honest, and unyielding (Ali et al., 2013). Students who have a good scientific attitude will not easily believe in something without evidence and logical explanation (John & Ademola, 2014). The results of the post-test of students' science attitudes in the experimental and control class after studying interactive teaching materials on climate change material descriptively are found in Table 5.

Table 5. Students' science attitudes

Description	Experiment	Control
Highest score	3.6	3.5
Lowest score	2.7	1.9
Average score	3.1	2.8
Standard deviation	0.23	0.28
Range	0.9	1.90

Table 4 shows the average science attitude scores of students in the experimental class are greater than those of the control class. The result of the normality test showed data on science attitudes in the control class are normality non-distributed (Table 6). Therefor the significance test uses the Mann-Whitney test. The results of the significance test showed that there was a significant difference in the average science attitude of students with sig. = 0.00.

Table 6. Results of the Normality Test of Students' Science Attitudes

Group	Kolmogorov-Smirnov		Shapiro-Wilk	
	Statistic	Sig.	Statistic	Sig.
Experiment	0.112	0.200	0.967	0.292
Control	0.159	0.011	0.918	0.006

The results in Table 4 and Table 5 show that the use of teaching materials in climate change teaching materials causes students to have a good science attitude. This is because teaching materials contain activities that can promote student attitudes, for example in matchmaking activities, let's experiments with the title "Modeling the Greenhouse Effect, and Yook Creating" through the use of paper waste into crafts that have artistic and selling value. A further review of each aspect of students' science attitudes with the following indicators: curiosity, responsible. openness, criticality, interest in science, meticulousness, honesty, and empathy are found in Figure 5. The average science attitudes of students in the experimental class and control class were 3.1 and 2.8, respectively.

Figure 5 shows that the science attitudes of students in the experimental class are higher than the control class on all aspects of science attitudes. The highest score on the empathy and curiosity aspects. This is because the interactive climate change teaching materials contain videos about environmental conditions that occur due to climate change. After listening carefully to the content of the video, students are asked to ask questions or express related opinions. Some of the students' questions and opinions show students' curiosity and concern for the phenomenon of climate change in the world presented virtually. Schutte (2019) concluded that virtual reality can be used as a vehicle to awaken curiosity and other positive characters. Curiosity is a great desire to know something (Noordewier & Dijk, 2017). According to Kashdan et al. (2018), curiosity consists of joyous exploration, stress tolerance, and social curiosity. Virtual reality can also facilitate the emergence of empathy (Bertrand et al., 2018) and the recognition of emotions (Ke & Moon, 2018).

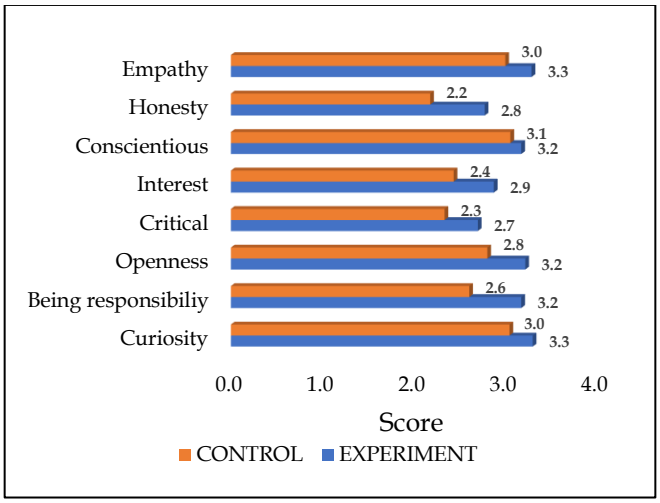

Figure 5. The science attitude of junior high school students.

Conclusion

Based on the results of the study, it can be concluded that the interactive climate change teaching materials have succeeded in enhancing critical thinking skills with a moderate category with an N-gain of 0.47 and science attitude achievement with an average of 3.1. The test results showed that the average difference in students' critical thinking skills and science attitudes concluded that there was a significant difference between the gains in the experimental class and the control class. The highest attitude toward science is obtained in the aspect of curiosity and empathy with excellent categories. Students respond positively to climate change interactive teaching materials in science learning.

Acknowledgments

The researcher's gratitude is conveyed to the Ministry of Education and Culture, Research and Technology through the funding of the Higher Education Superior Applied Research Grant for the fiscal year 2022 with a decree number 018/E5/PG.02.00/2022 and headmaster of SMP Negeri 1 Bogor.

References

Abdillah, A., Mastuti, A. G., Rijal, M., & Sehuwaky, N. (2022). Islamic Integrated Information Communication Technology Mathematics Learning Model for Students' Creativity and Environmental Awareness. *JTAM (Jurnal Teori Dan Aplikasi Matematika*, *6*(1), 194–211. https://doi.org/10.31764/jtam.v6i1.5755

Abriata, L. A. (2022). How Technologies assisted science learning at home during the COVID-19 Pandemic. *DNA and Cell Biology*, *41*(1), 19–24. https://doi.org/10.1089/dna.2021.0497

Adedoyin, O. B., & Soykan, E. (2020). Covid-19 pandemic and online learning: the challenges and opportunities. *Interactive Learning Environments*, *1–13*. https://doi.org/10.1080/10494820.2020.1813180

Al Darayseh, A. (2020). The impact of COVID-19 pandemic on modes of teaching science in UAE schools. *Journal of Education and Practice*, *11*(20), 110–115 https://doi.org/10.7176/JEP/11-20-13

Ali, M. M., Yager, R. E., Hacieminoglu, E., & Caliskan, I. (2013). changes in student attitudes regarding science when taught by teachers without experiences with a model professional development program. *School Science and Mathematics*, *113*(3), 109–119. https://doi.org/10.1111/ssm.12008

Bertrand, P., Guegan, J., Robieux, L., McCall, C. A., & Zenasni, F. (2018). Learning empathy through virtual reality: Multiple strategies for training empathy-related abilities using body ownership illusions in embodied virtual reality. *Frontiers in Robotics and AI*, *5*, 26. https://doi.org/10.3389/frobt.2018.00026

Elvarita, A., Iriani, T., & Handoyo, S. S. (2020). The Development of Teaching Materials for Electronic Module of Soil Mechanics in Bachelor Degree of Building Engineering Education Program, State University of Jakarta. *Jurnal Pensil: Pendidikan Teknik Sipil*, *9*(1), 1–7. https://doi.org/10.21009/jpensil.v9i1.11987

Ennis, R. H. (1985). A logical basis for measuring critical thinking skills. *Educational Leadership*, *43*(2), 44–48. Retrieved from https://jgregorymcverry.com/readings/ennis1985assessingcriticalthinking.pdf

Fitriana, A. R., & Kaniawati, I. (2017). Role of integrated sciences teaching materials on pressure topic to improve student's critical thinking skills in junior. *Asian Journal of Education and E-Learning*, *5*(2), 82–85. https://doi.org/10.24203/ajeel.v5i2.4697

Fitriani, A., Zubaidah, S., Susilo, H., & Muhdhar, M. H. I. A. (2020). PBLPOE: A Learning Model to Enhance Students' Critical Thinking Skills and Scientific Attitudes. *International Journal of Instruction*, *13*(2), 89–106. https://doi.org/10.29333/iji.2020.1327a

Gikas, J., & Grant, M. M. (2013). Mobile computing devices in higher education: Student perspectives on learning with cellphones, smartphones & social media. *Internet and Higher Education*, *19*, 18–26. https://doi.org/10.1016/j.iheduc.2013.06.002

Hamid, M. A., Yuliawati, L., & Aribowo, D. (2020). Feasibility of electromechanical basic work e-module as a new learning media for vocational students. *Journal of Education and Learning (EduLearn*, *14*(2), 199–211. https://doi.org/10.11591/edulearn.v14i2.15923

Husnah, M. (2017). Hubungan tingkat berpikir kritis terhadap hasil belajar fisika siswa dengan menerapkan model pembelajaran problem-based learning. *PASCAL (Journal of Physics and Science Learning*, *1*(2), 10–17. Retrieved from https://jurnal.uisu.ac.id/index.php/PASCAL/article/view/338

Iriani, T., & Handoyo, S. S. (2020). Vocational school teacher competence need analysis based on 21st-century learning for millennial generation. *KnE Social Sciences*, 877–885. https://doi.org/10.18502/kss.v4i14.7943

John, O. K., & Ademola, O. R. (2014). Scientific attitude, attitude to science and science achievement of senior secondary school students in Katsina State, Nigeria. *Journal of Educational and Social Research*, *4*(1), 445–452. https://doi.org/10.5901/jesr.2014.v4n1p445

Ke, F., & Moon, J. (2018). Virtual collaborative gaming as social skills training for high-functioning autistic children. *British Journal of Educational Technology*, *49*(4), 728–741. https://doi.org/10.1111/bjet.12626

Kim, S., Raza, M., & Seidman, E. (2019). Improving 21st-century teaching skills: The key to effective 21st-century learners. *Research in Comparative and International Education*, *14*(1), 99–117. https://doi.org/10.1177/1745499919829214

Korucu, A. T., & Alkan, A. (2011). Differences between m-learning (mobile learning) and e-learning, basic terminology and usage of m-learning in education. *Procedia-Social and Behavioral Sciences*, *15*. https://doi.org/10.1016/j.sbspro.2011.04.029

Kousar, S., Afzal, M., Ahmed, F., & Bojnec, Š. (2022). Environmental awareness and air quality: The mediating role of environmental protective behaviors. *Sustainability*, *14*(6), 3138. https://doi.org/10.3390/su14063138

Liesa-Orús, M., Latorre-Cosculluela, C., Vázquez-Toledo, S., & Sierra-Sánchez, V. (2020). The technological challenge facing higher education professors: Perceptions of ICT tools for developing 21st century skills. *Sustainability*, *12*(13), 5339. https://doi.org/10.3390/su12135339

Magno, G. C., Bardemorilla, N. G., & Pecson, R. R. (2016). Student teachers and cooperating teachers' practices in the 21st century classroom: Developing 21st century skills among learners. *International Journal of Social Science and Humanities Research*, *4*(3), 539–546. Retrieved from https://www.researchpublish.com/papers/student-teachers-and-cooperating-teachers-practices-in-the-21st-century-classroom-developing-21st-century-skills-among-learners

Mahmudah, S., Kirana, T., & Rahayu, Y. S. (2022). Profile of Students' Critical Thinking Ability: Implementation of E-Modul Based on Problem-Based Learning. *IJORER: International Journal of Recent Educational Research*, *3*(4), 478–488. https://doi.org/10.46245/ijorer.v3i4.231

Mukhtar, K., Javed, K., Arooj, M., & Sethi, A. (2020). Advantages, Limitations and Recommendations for online learning during COVID-19 pandemic era. *Pakistan Journal of Medical Sciences*, *36*(COVID19-S4). https://doi.org/10.12669%2Fpjms.36.COVID19-S4.2785

Noordewier, M. K., & Dijk, E. (2017). Curiosity and time: From not knowing to almost knowing. *Cognition and Emotion*, *31*, 411–421. https://doi.org/10.1080/02699931.2015.1122577

Pursitasari, I. D., Suhardi, E., & Fitriana, I. (2019). Development of Motion-Theme Teaching Materials for Science Learning in Junior High School. *Advances in Social Science, Education and Humanities Research*, *253*, 238–241. https://doi.org/10.2991/assehr.k.200513.069

Salta, K., Paschalidou, K., Tsetseri, M., & Koulougliotis, D. (2022). Shift from a traditional to a distance learning environment during the COVID-19 pandemic: university students' engagement and interactions. *Science & Education*, *31*(1), 93–122. https://doi.org/10.1007/s11191-021-00234-x

Salzberger, B., Glück, T., & Ehrenstein, B. (2020). Successful containment of COVID-19: the WHO-Report on the COVID-19 outbreak in China. *Infection*, *48*(2), 151–153. https://doi.org/10.1007/s15010-020-01409-4

Santoso, T. N. B., Siswandari, S., & Sawiji, H. (2018). The Effectiveness of eBook versus Printed Books in the Rural Schools in Indonesia at the Modern Learning Era. *International Journal of Educational Research Review*, *3*(4), 77–84. https://doi.org/10.24331/ijere.453512

Schutte, N. S. (2019). The Impact of Virtual Reality on Curiosity and Other Positive Characteristics. *International Journal of Human–Computer Interaction*, 1–8. https://doi.org/10.1080/10447318.2019.1676520

Sirwan, K., & Nurkhamid. (2021). Developing E-module based on mobile learning as a preparation media. *Journal of Physics: Conference Series*, *1833*, 12049. https://doi.org/10.1088/1742-6596/1833/1/012049

Sukendro, S., Habibi, A., Khaeruddin, K., Indrayana, B., Syahruddin, S., Makadada, F. A., & Hakim, H. (2020). Using an extended Technology Acceptance Model to understand students' use of e-learning during Covid-19: Indonesian sport science education context. *Heliyon*, *6*(11), 5410. https://doi.org/10.1016/j.heliyon.2020.e05410

Wahyuddin, E., E., S., & S. (2022). The Application of Collaborative Learning Model to Improve Student's 4Cs Skills. *Anatolian Journal of Education*, *7*(1), 93–102. Retrieved from https://www.e-aje.net/images/dosyalar/aje_2022_1_8.pdf

Wahyuni, S., Erman, E., Sudikan, S., & Jatmiko, B. (2020). *Edmodo-Based Interactive Teaching Materials as an Alternative Media for Science Learning to Improve Critical Thinking Skills of Junior High School Students*. International Association of Online Engineering. Retrieved from https://www.learntechlib.org/p/217835/.

Wang, Y., Di, Y., Ye, J., & Wei, W. (2021). Study on the public psychological states and its related factors during the outbreak of coronavirus disease 2019 (COVID-19) in some regions of China. *Psychol Health Med*, *26*(1), 13–22. https://doi.org/10.1080/13548506.2020.1746817

Warlinda, Y. A., Yerimadesi, Y., Hardeli, H., & Andromeda, A. (2022). Implementation of Guided Discovery Learning Model with SETS Approach Assisted by E-Modul Chemistry on Scientific Literacy of Students. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 507–514. https://doi.org/10.29303/jppipa.v8i2.1264

Winter, E., Costello, A., O'Brien, M., & Hickey, G. (2021). Teachers' use of technology and the impact of Covid-19. *Irish Educational Studies*, *40*(2), 235–246. https://doi.org/10.1080/03323315.2021.1916559

Yulianti, E., Maharani, D. W., & Hamimi, E. (2021). Integrated Science Education Mobile Application: Edukit for 21st Century Students. *SEJ (Science*

Education Journal, *5*(1), 41–58. https://doi.org/10.21070/sej.v5i1.1091

Zhou, G., Chen, S., & Chen, Z. (2020). Back to the spring of 2020: facts and hope of COVID-19 outbreak. *Frontiers of Medicine*, *14*, 113–116. https://doi.org/10.1007/s11684-020-0758-9