Video-Assisted Problem Based Learning Model to Improve Students' Critical Thinking Skills in Environmental Pollution

Dina Maulina[*], Median Agus Priadi, Viyanti, Agung Putra Wijaya, Elvira Sesie Ibirilia, & Yardan Permata Nurhadian

Departement of Mathematics and Science Education, Lampung University, Indonesia

Abstract: This study investigated the effect of using a video-assisted problem-based learning model on class VII students' critical thinking abilities on environmental pollution material. This research was conducted using quasi-experimental research design with a non-equivalent control group. The research data were in the form of qualitative data (critical thinking skills) and quantitative (student responses to learning using the video-assisted PBL model). Data analysis used the T-test ($p<0.05$). The results showed that there was an influence of using the video-assisted PBL model on students' critical thinking skills on environmental pollution material ($p<0.05$). The indicator for building basic skills obtained the highest average N-gain, namely 0.82 in the very good category. Meanwhile, the results of the student response questionnaire regarding the use of the video-assisted PBL model showed positive student responses with an average score of 89.67% in the very good category.

Keywords: critical thinking skills, PBL, environmental pollution and video.

▪ INTRODUCTION

The 21st century is a century where the world is experiencing major The 21st century is a century where the world is experiencing major transformations in various aspects of human life, one of which is the field of science and technology (Ozturk, 2023). Therefore, to respond to this, human resources are needed who have critical thinking, problem solving, communication and collaboration skills (Thornhill-Miller et al., 2023). Critical thinking skills are a cognitive skill that allows a person to analyze, evaluate and respond to situations or information in a rational and open way. Critical thinking skills are one part of higher order thinking skills. Ennis (2011) states that the definition of critical thinking is "critical thinking is reasonable, reflective thinking that is focused on deciding what to believe or do". From this definition, it is explained that critical thinking emphasizes reasonable and reflective thinking.

In reality, students' critical thinking abilities in Indonesia are still relatively low. This is shown by the results of Indonesia's Program for International Student Assessment (PISA), which received a low score. Based on the 2018 PISA results, Indonesia is ranked 72nd out of 79 countries with a score of 396 (Summaries, 2019). Meanwhile, Indonesia's 2022 PISA results are ranked 68th with a score of 383 (PISA, 2023). Therefore, the Minister of Education, Culture, Research and Technology (Mendikbudristek), said that the critical thinking skills of students in Indonesia must be further improved. According to (Bugg, 1997), measuring the level of critical thinking ability can be done using a description of indicators consisting of providing a simple explanation, building basic skills, concluding, providing further explanation, and organizing strategies and tactics.

The low critical thinking ability of students is because the learning carried out tends not to be student-centered, so that students will only learn by memorizing and remembering. This can cause students' low critical thinking skills as shown by students'

lack of participation in learning and students' discipline in receiving lessons (Kania et al., 2023). One way that can be used to improve students' critical thinking skills is by implementing innovative learning models that are superior and efficient. It is believed that the application of innovative learning models in learning can improve students' critical thinking skills. This is because the application of innovative learning models requires students to be actively involved in learning, and can generate concentration, motivation and independence in students' learning (Kwangmuang et al., 2021).

Problem based learning (PBL) is an innovative learning model that can improve students' critical thinking abilities. In the PBL model, students are directed to solve problems that are relevant to the situation, so that they are expected to be able to acquire and develop new knowledge in order to find the right solution for the situation (Chigbu et al., 2023). Therefore, students are not only asked to master concepts relevant to the problem in focus, but are also given the opportunity to develop their ability to apply scientific methods in solving problems, as well as improve their critical thinking skills (Liu & Shepherd, 2022).

In the PBL model, students will learn through problems that occur in real life (Iverson, 2024). One of the subjects that also studies problems that occur in real life is the science subject. Natural sciences are a collection of sciences that have special characteristics, namely studying concrete natural phenomena, in the form of reality and related to the causes and effects in their learning (Almulla, 2020); Seibert, 2021). One of the main science materials that can be taught using the PBL model is material regarding environmental pollution. Learning about environmental pollution using the PBL model is considered capable of improving students' critical thinking skills (Simatupang & Ionita, 2020).

In response to the low critical thinking abilities of class VII students, in implementing the PBL model it is necessary to utilize technology in the form of interesting learning media, one of which is video. Video is a form of electronic media that can integrate audio and visual technology together which can create a dynamic and interesting display. Videos can present information, explain processes, explain complex concepts, teach skills and can influence students' attitudes (Ghani et al., 2021). Therefore, the use of the video-assisted PBL model is considered to be able to improve students' critical thinking abilities such as problem solving and decision making processes (Pimdee et al., 2024).

Based on the reasons above, researchers are interested in conducting research on the effect of using video-assisted PBL models on students' critical thinking abilities. The aim of this research is to determine the effect of using the video-assisted PBL model on the critical thinking skills of class VII students on environmental pollution material and to determine students' responses to the video-assisted PBL model used on environmental pollution material.

▪ **METHOD**
Participants

This research was conducted in the even semester of the 2023/2024 academic year at MTsN ((Junior High School) 2 Bandar Lampung which is located on Jl. Pisang Island No.20, Harapan Jaya, Kec. Sukarame, Bandar Lampung City, Lampung-Indonesia. The population in this study were class VII students at MTsN 2 Bandar Lampung. Samples

were taken using purposive sampling technique. The sample used as the experimental class was class VII U2 with 31 students and the class used as the control class was class VII U3 as much as 32 students.

Research Design and Procedures

The research design used a quasi-experimental with a non-equivalent control group, presented in table 1.

Table 1. Pre-test – post-test non–equivalent control group design

Group	Pretest	Treatment	Posttest
Experimental	Y1	X1	Y2
Control	Y1	X2	Y2

Note: A = Experimental group; B = Control group; X1 = Learning with PBL model; X2 = Learning with STAD cooperative model; Y1 = Pretest and observation sheet; Y2 = Posttest and observation sheet

The research procedure was carried out through: (1) observing problems in schools, (2) determining research samples, (3) preparing research instruments and validating instruments in the form of cognitive tests on environmental pollution material with multiple choices and student response questionnaires regarding the use of video-assisted PBL models with a Likert scale, through instrument trials and analyzing validity tests, reliability tests, discrimination power, and difficulty levels, (4) setting experimental and control classes, (5) implementing the research stages carried out, namely implementing the syntax of the PBL learning model, (6) the final stage of collecting data and analyzing data from cognitive environmental pollution questions, analyzing the results of processing, and providing conclusions.

Instrument

The types of data used in this research are quantitative and qualitative. Quantitative data was obtained from the pre-test and post-test scores given to both classes during the learning process. Meanwhile, qualitative data was obtained from the results of analysis of student learning response questionnaires using the video-assisted PBL model. The techniques used in collecting data for this research were tests and questionnaires. The test is used to determine students' critical thinking abilities by giving a pre-test before learning begins and giving a post-test after learning has been completed. Meanwhile, questionnaires are used to find out students' responses regarding learning that has taken place using the video-assisted PBL model.

The instruments used in this research are pre-test and post-test questions to measure the results of participants' critical thinking abilities who were raised on environmental pollution material. The questions used consisted of 12 questions which included the five indicators of critical thinking abilities: (1) Provide a Simple Explanation, (2) Building Basic Skill, (3) Conclude, (4) Provide Further Explanation, (5) Setting Strategy and Tactics. Student response questionnaire regarding the use of video-assisted PBL models. Questionnaires are given to students at the end of the learning process. The questionnaire consists of 15 statements consisting of three indicators: (1) Student responses to learning with the PBL model, (2) Students' responses to the use of video media, (3) Student responses to critical thinking skills. Before the instrument is used in research, the

instrument prerequisites are tested using the Kolmogorov-Smirnov statistical test, the pretest and posttest data for the experimental class and control class (p<0.05), which means that the data for both groups were normally distributed.

Data Analysis

The pre-test and post-test results obtained were then calculated by calculating the Normalized-gain (N-gain) to measure the increase in critical thinking abilities of class VII students on environmental pollution material. Next, a normality test was carried out using the Saphiro-Wilk test and a homogeneity test using the Levene Test. Data that is normally distributed and homogeneous is tested for hypotheses using the Independent Sample T-Test. Then an effect size test was carried out using Cohen's formula to find out how much influence the use of the video-assisted PBL model had on students' critical thinking abilities.

▪ **RESULT AND DISSCUSSION**

Based on the results of the research that has been carried out, the following results were obtained in table 2.

Table 2. Statistical test results for pre-test, post-test, and n-gain critical thinking ability

Treatment	Class	Mean ± Standard Deviation	Normality Test	Homogeneity Test	Independent Sample t-Test
Pre-Test	And	36.02 ± 6.22	Sig. 0.67 > 0.05	Sig. 0.24 > 0.05	Sig. (2-tailed) 0.00 < 0.05
	C	36.01 ± 7.82	Sig. 0.99 > 0.05		
Post-Test	And	83.17 ± 7.29	Sig. 0.53 > 0.05	Sig. 0.40 > 0.05	
	C	75.83 ± 5.99	Sig. 0.80 > 0.05		
N-gain	And	0.73 ± 0.12 (High)	Sig. 0.12 > 0.05	Sig. 0.65 > 0.05	
	C	0.61 ± 0.10 (Medium)	Sig. 0.87 > 0.05		

Note: E = Experimental class; C = Control class

Table 2 showed that there was an influence of using the video-assisted PBL model on students' critical thinking abilities (p<0.05). Students' achievements on each critical thinking indicator can be determined through the N-gain value of each critical thinking indicator, furthermore an analysis is carried out on each indicator presented in the following in figure 1.

Data in Figure 1 show that the average N-gain for each indicator of students' critical thinking abilities is higher than the N-gain in the control class. Next, a hypothesis test was carried out, an effect size test was carried out to determine the magnitude of the influence of using the video-assisted PBL model on students' critical thinking abilities. Based on these results, it could be seen that the highest increase in N-gain is found in the indicator of building basic skills. The high indicator of building basic skills cannot be separated from the role of using the video-assisted PBL model. The PBL model will confront students with real problems presented via video. In this way, students will be more active in the learning process and students' thinking processes will be trained so that
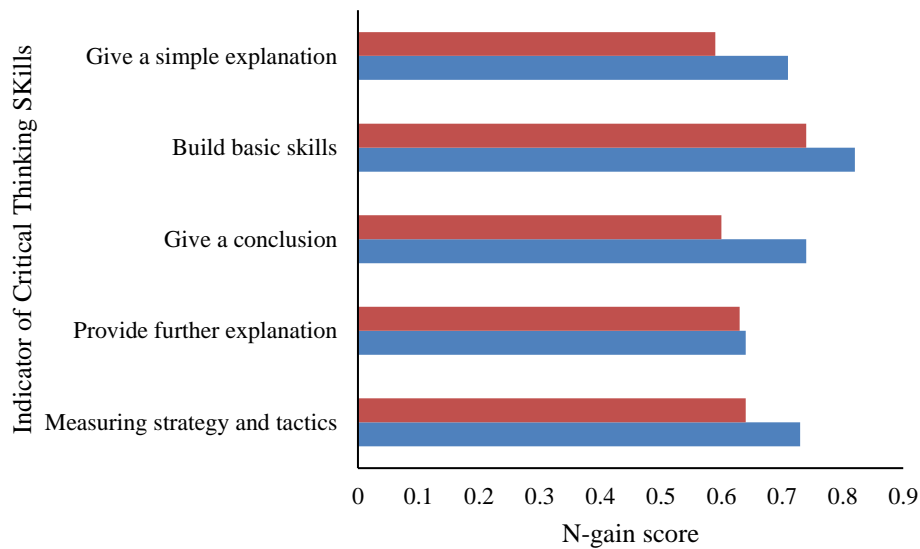
Figure 1. Average N-gain of critical thinking skills indicators

students' critical thinking abilities will increase (Adila et al., 2023; Kania et al., 2023; Maulina et al., 2023).

The indicator that gets the lowest N-gain value is the indicator that provides further explanation. This is because when answering questions, most students are not able to provide a detailed and precise explanation about something. The low ability of students to provide further explanations is because in the learning process using the video-assisted PBL model, video media is used to provide initial understanding and clear context (Gedera, 2018; Study, 2022). Video media is used in the process of forming initial understanding, namely in the process of orienting students to the problem, further it may not be in-depth enough to provide further complex and detailed explanations. Therefore, students are less able to link the information obtained with existing theories. This is in line with Zamilah et al. (2023) that indicators that provide further explanation are the indicators that get the lowest n-gain value. The low n-gain value is related to students' lack of thinking ability in connecting one concept with another.

According to (Almulla, 2020; Kusuma et al., 2024; Maulina et al., 2023; Pimdee et al., 2024), the PBL model is considered suitable if it is collaborated with video media. The use of video media can help students in the process of identifying problems, solving problems and finding solutions to problems in the learning process, so that the use of video-assisted PBL models is considered to be able to improve students' critical thinking abilities. In the learning process, students' critical thinking skills are developed through the five PBL syntaxes. In the first syntax, students will be oriented to problems presented via video which can improve critical thinking skills in the indicator of building basic skills, because in this indicator students are required to be able to observe a phenomenon or problem. By presenting the phenomenon of environmental pollution via video, students are trained to build their own knowledge through observing the problems presented in the video (Lena & La'i, 2021). When playing a video, students don't just watch it, but students are also required to analyze the video to get information that will be used to answer the questions presented on the LKPD (Anggito et al., 2021). This is supported by (Ananda

et al., 2023; Nicholus et al., 2024), in the first stage when students carry out the process of searching for solutions to the problems given, students will use their thinking system, namely using initial knowledge related to critical thinking indicators, namely building basic skills.

Furthermore, the students will be organized to learn by being grouped strategically to encourage the exchange of ideas between fellow students in the problem-solving process. Students will write down the problems they find in the video and provide an explanation of the problem. At this stage, you can improve critical thinking skills on indicators that provide simple explanations, because at this stage students are required to discuss problems regarding environmental pollution that they have discovered in the video, then students are asked to work together and provide an explanation regarding these problems (Maulina et al., 2023). This is in line with the statement by Wijayanti & Siswanto (2020), that indicators that provide simple explanations are included in the good category, because in the learning process students are able to formulate problems and write down the main issues according to the cases they find in the video.

Moreover, students will be guided to carry out investigations. Students will collect information both through videos and other sources. Then students are directed to discuss the process of solving environmental pollution problems that occur. Through this stage, students will exchange opinions regarding solutions to solve environmental pollution problems contained in the video. At this stage, students can improve their critical thinking skills on indicators of building basic skills and providing further explanations. According to (Almulla, 2020; Kusuma et al., 2024)at this stage students will connect the problems that occur with theory so that they will train students' critical thinking skills, namely providing further explanations. By learning using this video-assisted PBL model, students will gain new knowledge about environmental pollution and can improve students' critical thinking skills (Liao & Wu, 2023; Zhicong et al., 2023).

According to (Anggito et al., 2021; Nicholus et al., 2024), students are said to have critical thinking skills if students are able to find solutions to problems that occur in the learning process. In the learning process using the PBL model, this activity is included in the stage of developing and presenting the results of the work. At this stage, students are asked to develop solutions to the problems found and present their work in the form of posters regarding efforts to mitigate environmental pollution. Next, students explain the results of the discussions that have been carried out through group presentations. In this activity, each group is given the opportunity to provide input on the answers from other groups in turn. So that learning activities run smoothly and students are enthusiastic in participating in learning (Pimdee et al., 2024; Seibert, 2021). This stage can improve critical thinking skills on indicators of managing strategies and tactics, because at this stage students are asked to find solutions that can be used to solve environmental pollution problems contained in the video.

After developing and presenting the results of their work, students will be asked to analyze and evaluate the problem-solving process. At this stage students will evaluate the solutions they have developed and review the overall problem-solving process (Yang & Oh, 2023). This stage can improve critical thinking skills on concluding indicators, because students are trained to draw conclusions based on the results of discussions that have been carried out. This is in line with research conducted by (Yaqinuddin et al., 2020),

in the final stage of the PBL model an evaluation was carried out related to critical thinking skills, namely concluding the results of the discussions that had been carried out.

Table 3. Effect size test results for critical thinking ability

Class	Average *N-gain*	Standard Deviation	Effect Size	Note
Experiment	0.73	0.12	1.086	Large
Control	0.61	0.10		

The results of the effect size calculation in table 3 showed that the effect size value is 1,086 which is included in the large category. Therefore, this shows that the use of the video-assisted PBL model has a big influence on students' critical thinking abilities. The results of the analysis of student response questionnaires are presented in table 4 below.

Table 4. Results of student responses to the video-assisted PBL model

Indicator	Percentage	Category
Student responses to learning with the PBL model	89.16%	Very high
Student responses to the use of video media	90.19%	Very high
Student responses to critical thinking skills	89.67%	Very high
Average	89.67%	Very high

Based on the results of the analysis of student response questionnaire data, it was shows that on average students answered strongly agree to positive statements and answered strongly disagree to negative statements (Table 4). Therefore, the use of the video-assisted PBL model received a positive response and was well received by students.

When the learning process was completed, experimental class students were given a student response questionnaire regarding the use of the video-assisted PBL model containing 15 questions. The indicator questions in the questionnaire include learning using the PBL model, learning using video media and students' critical thinking abilities after carrying out learning using the video-assisted PBL model (Nicholus et al., 2024; Samad & Setyabudhi, 2023). The results of the student response questionnaire regarding learning using the video-assisted PBL model showed that there were positive responses from students in the learning process, especially regarding environmental pollution material. This is in line with research conducted by Cahyani et al. (2021), the PBL model is a model that can improve critical thinking skills and increase discipline in students. The PBL model is a learning model that requires students to find solutions to problems that occur in the real world which can be solved in groups. The PBL model directs students to learn independently so that it can improve students' critical thinking skills. According to Soima et al. (2021), the use of video media in the learning process is also considered to be able to improve students' critical thinking abilities. This is because by using video media students will be interested and more enthusiastic about learning so that it can make the learning process more conducive, and students will be more active in the learning process. Therefore, the use of the video-assisted PBL model is considered appropriate and can improve students' critical thinking abilities.

▪ **CONCLUSION**

Based on the results of the research that has been carried out, it can be concluded that there is an influence of using the video-assisted PBL model on the critical thinking abilities of class VII students on environmental pollution material ($p<0.05$), which means there is a significant difference between the experimental and control classes. Then the student response questionnaire regarding the use of the video-assisted PBL model obtained an average score of 89.67% in the very high category. So the use of the video-assisted PBL model gets a positive response from students.

The implementation of the video-assisted PBL model is an alternative to improve critical thinking skills in science learning, especially in environmental pollution material. Further researchers should be able to design videos that contain real/contextual problems and clear information about environmental pollution. Especially in the implementation of the model in presenting problems, this study has limitations in presenting local-scale environmental pollution problems. Thus, all critical thinking indicators can be achieved optimally.

▪ **REFERENCES**

Almulla, M. A. (2020). The effectiveness of the project-based learning (PBL) Approach as a Way to Engage Students in Learning. SAGE Open, 10(3). https://doi.org/10.1177/2158244020938702

Ananda, Y., Rahmatan, H., Samingan, Huda, I., & Mudatsir. (2023). Application of the video-assisted problem based learning model to increase student learning motivation in virus material. Jurnal Penelitian Pendidikan IPA, 9(8), 6230–6237. https://doi.org/10.29303/jppipa.v9i8.4766

Anggito, A., Pujiastuti, P., & Gularso, D. (2021). The effect of video project-based learning on students' critical thinking skills during the covid-19 pandemic. AL-ISHLAH: Jurnal Pendidikan, 13(3), 1858–1867. https://doi.org/10.35445/alishlah.v13i3.772

Bugg, N. (1997). Teaching critical thinking skills. Radiologic Technology, 68(5), 433–434. https://doi.org/10.4324/9780429342042

Cahyani, H. D., Hadiyanti, A. H. D., & Saptoro, A. (2021). *Peningkatan sikap kedisiplinan dan kemampuan berpikir kritis siswa dengan penerapan model pembelajaran problem based learning.* Edukatif : Jurnal Ilmu Pendidikan, 3(3), 919–927.

Chigbu, B. I., Ngwevu, V., & Jojo, A. (2023). The effectiveness of innovative pedagogy in the industry 4.0: Educational ecosystem perspective. Social Sciences and Humanities Open, 7(1). https://doi.org/10.1016/j.ssaho.2023.100419

Gedera, D. (2018). Use of interactive video for teaching and learning. In ASCILITE 2018 - Conference Proceedings - 35th International Conference of Innovation, Practice and Research in the use of Educational Technologies in Tertiary Education: Open Oceans: Learning Without Borders 362–367.

Ghani, A. S. A., Rahim, A. F. A., Yusoff, M. S. B., & Hadie, S. N. H. (2021). Effective learning behavior in problem-based learning: a scoping review. Medical Science Educator, 31(3), 1199–1211. https://doi.org/10.1007/s40670-021-01292-0

Iverson, D. (2024). The influence of problem-based learning models on student learning outcomes on dynamic fluid material. 4(02), 7823–7830.

Kania, N., Fitriani, C., & Bonyah, E. (2023). Analysis of students' critical thinking skills based on prior knowledge mathematics. International Journal of Contemporary Studies in Education (IJ-CSE), 2(1), 49–58. https://doi.org/10.56855/ijcse.v2i1.248

Kusuma, N. T., Maulina, D., & Wiono, W. J. (2024). The students creative thinking on environmental pollution material using video-assisted problem based learning model. 6(1), 56–62.

Kwangmuang, P., Jarutkamolpong, S., Sangboonraung, W., & Daungtod, S. (2021). The development of learning innovation to enhance higher order thinking skills for students in Thailand junior high schools. Heliyon, 7(6), e07309. https://doi.org/10.1016/j.heliyon.2021.e07309

Liao, C. H., & Wu, J. Y. (2023). Learning analytics on video-viewing engagement in a flipped statistics course: Relating external video-viewing patterns to internal motivational dynamics and performance. Computers and Education, 197(February), 104754. https://doi.org/10.1016/j.compedu.2023.104754

Liu, Y., & Pásztor, A. (2022). Effects of problem-based learning instructional intervention on critical thinking in higher education: A meta-analysis. Thinking Skills and Creativity, 45(May). https://doi.org/10.1016/j.tsc.2022.101069

Maulina, D., Hikmawati, A., & Marpaung, R. R. T. (2023). The effect of implementing ESD in the PBL model on critical thinking ability in environmental pollution material. Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah, 8(2), 253. https://doi.org/10.24042/tadris.v8i2.18444

Nicholus, G., Nzabahimana, J., & Muwonge, C. M. (2024). Evaluating video-based PBL approach on performance and critical thinking ability among Ugandan form-2 secondary school students. Cogent Education, 11(1). https://doi.org/10.1080/2331186X.2024.2346040

Öztürk, Ö. T. (2023). Examination of 21st century skills and technological competences of students of fine arts faculty. International Journal of Education in Mathematics, Science and Technology, 11(1), 115–132. https://doi.org/10.46328/ijemst.2931

Pimdee, P., Sukkamart, A., Nantha, C., Kantathanawat, T., & Leekitchwatana, P. (2024). Enhancing Thai student-teacher problem-solving skills and academic achievement through a blended problem-based learning approach in online flipped classrooms. Heliyon, 10(7). https://doi.org/10.1016/j.heliyon.2024.e29172

Samad, & Setyabudhi, A. L. (2023). Application of video-based learning media with applications to improve learning activities of vocational high school students. Technical and Vacational EducationInternational Journal, 3(1), 2721–9798. https://www.mand-ycmm.org/index.php/taveij/article/view/211/453

Seibert, S. A. (2021). Problem-based learning: A strategy to foster generation Z's critical thinking and perseverance. Teaching and Learning in Nursing, 16(1), 85–88. https://doi.org/10.1016/j.teln.2020.09.002

Study, E. A. C. (2022). Assessment of interactive video to enhance learning. 35.

Thornhill-Miller, B., Camarda, A., Mercier, M., Burkhardt, J. M., Morisseau, T., Bourgeois-Bougrine, S., Vinchon, F., El Hayek, S., Augereau-Landais, M., Mourey, F., Feybesse, C., Sundquist, D., & Lubart, T. (2023). Creativity, critical thinking, communication, and collaboration: assessment, certification, and promotion of 21st century skills for the future of work and education. Journal of Intelligence, 11(3). https://doi.org/10.3390/jintelligence11030054

Yang, S. Y., & Oh, Y. H. (2023). Video-assisted versus traditional problem-based learning: a quasi-experimental study among pediatric nursing students. Journal of Nursing Research, 31(3), E277. https://doi.org/10.1097/jnr.0000000000000557

Yaqinuddin, A., Kashir, J., AlKattan, W., & AlKattan, K. (2020). Applying integrated video assisted learning approaches for medical clerkship – potential adaptations in the post-COVID-19 era. Journal of Medical Education and Curricular Development, 7, 238212052096304. https://doi.org/10.1177/2382120520963043

Zhicong, Z., Heming, L., & Jiaxian, Z. (2023). Teaching with social context in instructional video facilitates second language vocabulary learning. Heliyon, 9(3), e14540. https://doi.org/10.1016/j.heliyon.2023.e14540