



Effectiveness of E-Modules based on Inquiry Model Integrated with SETS Approach on 21st Century Skills

Westi Widia Wati¹, Syafriani^{2*}

¹Universitas Negeri Padang, Indonesia

*Correspondence to: syafri@fmipa.unp.ac.id

Abstract: The goal of this project is to create a successful physics e-module for 21st-century skills, utilizing an inquiry model combined with the SETS approach. The method used was the reference approach to Research and Development. This research was Plomp's (1997) development model. Seventy high school students served as the study's subjects. Results of an e-module effectiveness test for collaboration and critical thinking skills make up the data collected for this study. The control class's average score for critical thinking abilities was only 51.15 with a sufficient category, whereas the experimental class's score was 79.38 with a high category for each indicator. The results of the critical thinking skills were also strengthened by conducting the N-gain test. The control class had an n-gain value of -0.37 with a low category, while the experimental class had an n-gain value of 0.58 with a medium category. The experimental class's average student collaboration skills were 84.02 in the very collaborative category, compared to 76.12 in the collaborative category for the control group. These results indicate that the physics e-module is useful in enhancing students' 21st-century abilities.

Keywords: critical thinking, collaboration, e-module, inquiry, SETS

Recommended citation: Wati, W. W., & Syafriani. (2023). Effectiveness of E-Modules based on Inquiry Model Integrated with SETS Approach on 21st Century Skills. *Journal of Innovation in Educational and Cultural Research*, 4(4), 673-681.

INTRODUCTION

The foundations of the twenty-first century are science and technology (Brears, 2018; Fitri, 2019; Kurniawan et al., 2021; Santos, 2017). The rapidly increasing integration of technology has brought major changes to the education system (Cahyanti, 2021; Dakhi et al., 2020; Martinez, 2021). Education is a field that has an important role in creating competent human resources in the 21st century (Amalia et al., 2022; Ismail et al., 2022; Maskur, 2020). Education is the main key in the process of forming individuals to become more qualified so that they are ready to face global challenges that are increasingly advanced (Fadieny et al., 2021; Meyer et al., 2019). 21st-century education requires highly skilled and competitive human resources to master a variety of talents (Kim et al., 2019; Mas'ud et al., 2021; Robertson et al., 2021). The skills that have been launched by the Partnership for 21st Century Learning include higher-order thinking skills, skills in the world of work, and skills in using technology and information following the 21st-century innovative learning framework (Mahmudah et al., 2022; Perez et al., 2022).

21st-century talents are defined by the National Education Association (NEA) as "4C" skills: collaboration, communication, creativity, and critical thinking (Erdogan, 2019; Kim et al., 2019; Kusyanti, 2021; Ndiung et al., 2019). Studying physics requires not only facts, concepts, rules, and procedures, but also information gathering, technology application, scientific inquiry, and critical thinking. For this reason, studying physics also requires 21st-century abilities (Mahardika et al., 2022; Maknum, 2020). The process of combining different elements and activities to study different natural phenomena utilizing the phases of the scientific method is called "physics learning," and it will eventually assist students in developing their own knowledge (Darmaji, et al., 2019; Rizaldi et al., 2021). The development of inductive and deductive reasoning skills through the application of physics concepts and principles to the explanation of a variety of natural phenomena and the qualitative and quantitative solution of problems is one of the goals of studying physics (Mahardika et al., 2021; Weber, 2020). Students' cognitive abilities should be able to grow appropriately after learning physics (Miller et al., 2023; Nurasma et al., 2020).

The preliminary study's findings indicate that pupils' 21st-century skills are still comparatively low. The needs analysis conducted in this study reveals several factors that contribute to students' low 21st-century skills. First of all, most instructional materials are still printed and do not make full use of technology in the teaching and learning process. There is very little chance that printed materials can improve students' 21st-century skills. Second, even though e-modules are one type of instructional resource that has been shown to help students develop 21st-century abilities, teachers seldom ever use them in the classroom. To succeed in the twenty-first century, educators must prioritize active, inventive, and creative learning. They also need to be able to

incorporate technology into the classroom (Dakhi et al., 2020; Dias et al., 2022; Syahrawati et al., 2022).

Based on the above problems, there is a gap between the demands of the 21st century and the facts found in the field. The demands of 21st-century education require students to be able to master 21st-century skills (Agustiana, et al., 2021; Amilyana et al., 2021; Yulianto et al., 2019). Among the abilities required to meet the current global challenges are 21st-century competencies (Chusni et al., 2022; Sefriani et al., 2021; Yaarubi et al., 2021). A solution is needed that can improve 21st-century skills by optimizing the use of technology in learning to match the demands of 21st-century learning (Bordoloi et al., 2021; Dakhi et al., 2020; Kaya & Mertol, 2022; Maknum, 2020). One of the solutions provided for overcoming the above problems is to develop electronic teaching materials in the form of physics e-modules based on the integrated inquiry model of the SETS approach.

An electronic module is a systematic collection of digital educational resources in electronic format intended for self-study (Abidin et al., 2022; Meliza et al., 2021). Electronic teaching materials can enhance learning quality, make learning more engaging and dynamic, and be used at any time and location (Atik et al., 2022; Sidiq et al., 2020; Siman et al., 2022). The goal of the inquiry-based learning paradigm is to gather data through experiments or observations to use critical and logical thinking abilities to solve problems (Dewi, et al., 2019; Nasir, et al., 2022; Prayogi et al., 2022; Siburian et al., 2019; Sutiani et al., 2021). On the other hand, the SETS approach is an approach that integrates learning into four components, namely science, environment, technology, and society. SETS is an approach that makes it easier for students to understand the subject matter so that they can achieve competent understanding, helping them to have the ability to view things integratively towards the four elements of SETS (Fitri, 2019; Imaduddin & Hidayah, 2019)

The purpose of this project is to determine whether creating an online physics module using an inquiry model and the SETS approach is the most effective way to help students become more proficient in 21st-century abilities. Prior studies have been conducted on the creation of SETS-based e-modules or inquiry models to enhance students' 21st-century thinking abilities, but they have only looked at biology or chemistry classes; no findings have been found on physics. For instance, a 2021 study by Arinati et al. focused on developing an online scientific module using SETS and formative evaluations to enhance grade XI students' capacity for critical thought regarding biotechnology content (Arianti et al., 2021).

METHODS

This method used was the reference approach to Research and Development (R&D) (Sugiyono, 2010). Plomp's (1997) development approach, which involves three stages preliminary research, prototyping, and assessment was employed in this study. Seventy high school kids who can use technology effectively were the study's subjects. The research class participants were chosen using a purposive sampling technique. This study's data came from questionnaires on collaborative skills and the outcomes of e-module effectiveness exams for critical thinking abilities. Indicators of critical thinking skills in this study were based on indicators according to Facione (2011), which consist of interpretation, analysis, evaluation, and inference. The procedure for this study was as follows:

In this study, preliminary research was conducted as the initial phase. Need analysis, curriculum analysis, learner analysis, and idea analysis were the tasks completed at this point. Information at this stage was obtained utilizing interviews conducted with physics teachers and initial data collection related to students' 21st-century thinking skills. The second step in this research was the prototyping phase. The activities carried out at this stage included designing physics e-modules based on the inquiry model and integrating with the SETS approach as needed. The type of inquiry used in this research was guided inquiry. The phases of inquiry learning applied in the e-modules developed for this study were: (1) looking into phenomena; (2) concentrating on questions; (3) organizing an inquiry; (4) carrying out an investigation; (5) evaluating information and supporting documentation; (6) creating new knowledge; and (7) disseminating new knowledge.

The designed e-module contains a cover, a main menu that contains (a table of contents, a glossary, an introduction, learning activities, and bibliography), an introduction that contains (general instructions for using e-modules, special instructions for using e-modules, an inquiry model, and SETS approach, KD and IPK, subject matter, and learning objectives), and learning activities that contain (material descriptions, activity sheets based on inquiry model integrated SETS approach, critical thinking exercises, sample problems, and evaluation). The e-module design emphasized students' ability to find the concepts needed for themselves, and in the e-module, they were given an introduction to contextual material integrated with the four elements of the SETS approach. The third step in this research was the assessment phase. The assessment phase is the stage for conducting evaluations that aim to improve the developed product. The assessment phase was used to determine whether the product developed is feasible to use or not. The developed product went through several stages of assessment, namely the validation test stage, the practicality test, and the effectiveness test.

The validation test was conducted by three validators, namely UNP physics lecturers. Four criteria were used to validate the e-modules: software usage, display, learning design, and content content (Depdiknas,

2010). After the e-module developed was declared valid, a practicality test was conducted. The practicality test was carried out in three steps: a one-to-one evaluation test consisting of 3 students, a small group evaluation consisting of 8 students, and a limited field test consisting of physics teachers and students. The effectiveness test carried out in this study involved giving tests in the form of essay questions based on critical thinking indicators and distributing collaboration questionnaires. One example of the form of critical thinking essay questions used in this study can be seen in [Figure 1](#).

The number of earthquake events in the West Sumatra region throughout 2018 doubled compared to 2017. The Meteorology, Climatology, and Geophysics Agency (BMKG) Padang Panjang station summarized as many as 454 earthquake activities that occurred throughout 2018. Judging from the location and depth, the 2018 earthquake in West Sumatra was dominated by earthquakes from the subduction activity (collision) of the Indo-Australian tectonic plate. Based on the explanation above, how is the relationship between earthquakes and the mechanical waves that we study? Can an earthquake be considered a wave? Explain? And how do earthquakes reach the earth's surface?

Figure 1. Critical Thinking Essay Questions

Validity and reliability tests were done on the essays on critical thinking that were utilized in this study. The decision criterion is $r_{\text{count}} \geq r_{\text{table}}$, then the test item (item) is said to be valid. [Table 1](#) displays the criteria for test validation.

Table 1. Criteria for Test Validity.

Score Interval	Category
$0.81 \leq r_{xy} \leq 0.1$	Extremely high
$0.61 \leq r_{xy} \leq 0.8$	High
$0.41 \leq r_{xy} \leq 0.6$	Enough
$0.21 \leq r_{xy} \leq 0.4$	Low
$0.00 \leq r_{xy} \leq 0.20$	Extremely low

Reliability is related to trust issues. A test can be said to have a high level of reliability if it can give precise results. [Table 2](#) displays the criteria for test reliability.

Table 2. Test Reliability Criteria

Score Interval	Category
$0.81 \leq r_{xy} \leq 0.1$	Incredibly elevated
$0.61 \leq r_{xy} \leq 0.8$	Elevated
$0.41 \leq r_{xy} \leq 0.6$	Sufficient
$0.21 \leq r_{xy} \leq 0.4$	Low
$0.00 \leq r_{xy} \leq 0.20$	Extremely low

The effectiveness of physics e-modules based on the inquiry model integrated with the SETS approach to critical thinking skills was tested in several procedures: First, calculate the average percentage score on each critical thinking indicator consisting of four aspects, namely: interpretation, analysis, evaluation, and inference. The results of the calculation are categorized according to the criteria for achieving students' critical thinking skills, according to [Riduwan \(2013\)](#). [Table 3](#) shows the categorization criteria.

Table 3. Critical thinking ability criteria categories.

The percentage	Classification
81 – 100	Incredibly elevated
61 – 100	Elevated
41 – 60	Sufficient
21 – 40	Low
0 – 20	Extremely low

([Riduwan, 2013](#))

Second, analyze and measure the N-Gain value using the equation proposed by Hake (1999). The N-Gain values obtained were then converted using the criteria found in [Table 4](#).

Table 4. The Value of the N-Gain Index and its Classification

N- Gain Index	Classification
$(g) \geq 0,70$	Elevated
$0.30 \leq (g) < 0.70$	Sufficient
$(g) < 0.30$	Low

(Hake, 1999)

The e-module effectiveness test on collaboration skills was carried out by calculating the score obtained by each student, dividing it by the maximum score, and then multiplying it by one hundred percent. The criteria used to determine the competence of collaboration skills can be seen in Table 5.

Table 5. Criteria for Collaboration Skills

Value	Classification
> 80	Incredibly Collaborative
60 - 80	Collaborative
40 - 60	Collaboration Sufficient
< 40	Less collaboration

RESULT AND DISCUSSION

Findings from this study demonstrate how well the inquiry-model-based physics e-module combined with the SETS method helps students develop 21st-century abilities. The N-gain test, averaging the values for each critical thinking component, and estimating the average value for teamwork abilities were used to quantify the effectiveness. The results of the effectiveness of the physics e-module based on the inquiry model integrated with the SETS approach are described as follows:

First, each critical thinking skill indicator which consists of indicators for interpretation, analysis, assessment, and inference showed how effective the physics e-module based on the inquiry model combined with the SETS approach to critical thinking skills was. Table 6 displays the average percentage score for each critical thinking indicator for both the experimental and control groups.

Table 6. Average percentage score of students' critical thinking ability indicators.

Critical thinking indicators	Experiment		Control	
	average score (%)	Description	average score (%)	Description
Interpretation	88,57	Extremely high	69,69	High
Analysis	82,72	Extremely high	52,48	Enough
Evaluation	76,53	High	44,24	Enough
Inference	69,68	High	38,21	Low
critical thinking average	79,38	High	51,15	Enough

Overall, the average critical thinking skill scores of the experimental and control groups showed a significant difference (Table 6). Every critical thinking skill indicator has a higher average value in the experimental class than in the control group. The outcomes demonstrate that the created physics e-modules can enhance students' capacity for critical thought. Critical thinking abilities are essential abilities that students need to acquire since they enable them to solve problems and choose the best possible answer.

Students with strong critical thinking abilities will find it simpler to comprehend and solve difficulties, as well as to develop and test hypotheses and come to conclusions based on the situation. Related research conducted by Rahayu (2022) shows that using e-modules in the learning activity process provides an increase in students' critical thinking skills. Additional relevant research is also carried out by Amalia et al. (2022), demonstrating the efficacy of android-based e-modules in enhancing students' critical thinking abilities. Additionally, Mahmudah et al. (2022) clarify that the e-module based on the PBL model can greatly enhance students' critical thinking abilities. This is evident from the rise in each critical thinking indicator's average value that was noted following the use of the created e-module. The N-gain test indicates how well the physics e-module, which integrates the SETS approach with the inquiry model, addresses critical thinking skills. Table 7 displays the findings of the N-gain test that was performed for this investigation.

Table 7. N-gain score

Class	N-Gain score	Classification	Interpretation
Experiment	0,58	Medium	Effective enough
Control	-0,37	Low	Ineffective

Table 7 demonstrates the notable differences between the N-gain value attained by the experimental class and the control class. By comparison, the experimental class achieved an N-gain value of 0.58 with a medium category, while the control class received an N-gain value of -0.37 with a low category. Table 7 findings demonstrate how well the physics e-module helps students develop their critical thinking abilities. According to Lindawati et al. (2022), who have also undertaken related studies, creating e-modules based on the inquiry model can help students' critical thinking abilities. Miftakhurrohman et al. (2023) conduct related research as well, explaining how e-modules built on guided inquiry models can enhance students' literacy and critical thinking abilities. This is demonstrated by the results of the students' pretest and posttest average values, which rise noticeably. The efficiency of the SETS-integrated inquiry model-based physics e-module to collaboration skills is seen from the average value obtained from the questionnaire that has been given. Table 8 displays the average percentage of students' collaboration skills for the study's experimental and control classes.

Table 8. Average percentage score of students' collaboration skills

Class	Percentage Score (%)	Category
Experiment	84,02	Highly collaborative
Control	76,12	collaborative

Overall, there is a substantial difference between the experimental and control classes' average collaboration skill values (Table 8). The control class is in the collaborative category, but the experimental class is in the very collaborative category. One of the abilities that students need to have is the ability to collaborate with others. With this ability, students can face problems around the world and more quickly adjust to changes in their environment. Activities that are reciprocally carried out in a coordinated attempt to attain a common goal will be considered collaboration skills. These activities will involve sharing objectives, resources, and representations about the participants' joint efforts. Collaboration skills will also teach how to respect each other, build trust, and have a sense of responsibility (Miller et al., 2023; Supena et al., 2021).

The explanation above is also in line with Susilawati et al. (2022), that e-modules are proven to improve student collaboration skills. E-modules provide opportunities for students to be able to do group activities so that with group activities, students will be trained on how to collaborate well. As well as research conducted by Kurniawati et al. (2019), e-modules integrated with POE and SETS have proven effective in improving collaboration skills. This is evidenced by the increase in the average value of collaboration skills after using the developed e-module. Zakiyah (2022) also explains that using STEM-based e-modules integrated with ethnoscience can improve students' collaboration skills through the project tasks contained in the e-module. The results of the students' pretest and posttest provide proof for this.

CONCLUSION

This study's findings allow for the drawing of the following conclusions: (1) There is a positive correlation between the use of the physics e-module, which is based on the inquiry model and integrates the SETS approach, and students' increased ability to think critically. This is supported by the N-gain test and is demonstrated by the experimental class's average value of each critical thinking indicator, which is higher than that of the control class. (2) There is a rise in students' cooperation skills after utilizing the physics e-module, which is based on the inquiry model coupled with the SETS approach and effectively addresses collaboration skills among students. The average score of students' collaboration abilities in the experimental class is higher than in the control class, which serves as proof of this.

REFERENCES

- Abidin, Z., & Wulandari, T. C. (2022). The model of analytical geometry interactive module using systematic, active, effective (SAE) model to support students' autonomous learning and mathematics education competence. *American Journal of Humanities and Social Sciences Research (AJHSSR)*, 6(5), 76-80.
- Agustiana, I. G. A. T., Tika, I. N., & Wibawa, M. C. (2021). Improving creative thinking through creative responsibility-based learning (CRBL) model. *International Journal of Elementary Education*, 5(4), 547-553.

- Amalia, Z., Yuliyanti, D., Rohman, F., & Nurhanurawati, N. (2022). The development of an android-based e-module to increase student's critical thinking skills: a comprehensive need analysis. *International Journal of Educational Studies in Social Sciences*, 2(3), 180-185.
- Amilyana, A. S., Noer, T. K. M. S., & Raharjo, R. (2021). A teaching material based on science, environment, technology, and society to improve student's critical thinking skills: synchronous and asynchronous learning during covid-19 pandemic. *International Journal of Recent Educational Research (IJORER)*, 2(4), 372-391.
- Arianti, D. T., Parno, P., Marsuki, M. F., Fitriyah, I. J., & Nida, S. (2022, January). Development of Science E-module Based on SETS (Science, Environment, Technology, and Society) with Formative Assessments to Improve Critical Thinking Ability of Grade IX Students on Biotechnology Materials. *Eighth Southeast Asia Design Research (SEA-DR) & the Second Science, Technology, Education, Arts, Culture, and Humanity (STEACH) International Conference (SEADR-STEACH 2021)*, 38-46. Atlantis Press.
- Atik, B., Sri, U., & Aditia, E. (2022). Development of blood circular system e-module human based on science assisted flip pdf professional for improving concept understanding class V elementary students. *Uniglobal of Journal Social Sciences and Humanities*, 1(1), 59-67.
- Basri, H., Purwanto, P., Asari, A. R., & Sisworo, S. (2019). Investigating critical thinking skill of junior high school in solving mathematical problem. *International Journal of Instruction*, 12(3), 745-758.
- Brears, L., MacIntyre, B., Sullivan, G. (2020). Preparing teachers for the 21st century using PBL as an integrating strategy in science and technology education. *Design and Technology Education: An International Journal*, 16(1), 36-46.
- Bordoloi, R., Das, P., & Das, K. (2021). Perception towards online/blended learning at the time of COVID-19 pandemic: an academic analytic in the Indian context. *Asian Association of Open Universities Journal*, 16(1), 41-60.
- Cahyanti, C., Sudibyo, E., & Rahayu, Y. S. (2021). Effectiveness of insect encyclopedia e-book with mind mapping strategy to train students' creative thinking skills. *International Journal of Recent Educational Research (IJORER)*, 2(4), 432-443.
- Chusni, M. M., Saputra, S., Suranto, S., & Rahardjo, S. B. (2022). Enhancing critical thinking skills of junior high school students through discovery-based multiple representations learning model. *International Journal of Instruction*, 15(1), 927-944.
- Dakhi, O., Jama, J., Ambiyar, A., & Ishak, I. (2020). Blended learning: a 21st-century learning model at college. *International Journal of Multi-Science*, 1(7), 50-65.
- Darmaji, D., Astalini, A., Kurniawan, D. A. (2019). E-module-based problem-solving in basic physics practicum for science process skills. *International Journal of Online and Biomedical Engineering (IJOE)*, 15(15), 4-17.
- Dewi, R. K., & Wardani, S. (2019). Guided inquiry assisted by Edmodo application to improve student critical thinking skills in redox material. *International Conference on Mathematics, Science, and Education (ICMSE)*, 1-9.
- Depdiknas. (2010). *Panduan Penyusunan bahan ajar berbasis TIK*. Direktorat Jenderal Manajemen Pendidikan Dasar dan Menengah
- Dias, L., & Victor, A. (2022). Teaching and learning with mobile devices in the 21st-century digital world: benefits and challenges. *European Journal of Multidisciplinary Studies*, 7(1), 26-34.
- Erdogan, V. (2019). Integrating 4C skills of 21st century into 4 language skills in EFL classes. *International Journal of Education and Research*, 7(11), 113-124.
- Fadieny, N., & Fauzi, A. (2021). Usefulness of e-module based on experiential learning in physics learning. *International Journal of Progressive Sciences and Technologies (IJPST)*, 25(1), 410-414.
- Fitri, S. K. (2019). Need analysis on sets (science, environment, technology and society)-based practice guidance development for semester ii of x grade of senior high school. *International Journal of Progressive Sciences and Technologies (IJPST)*, 14(1), 66 - 69.
- Imaduddin, M., & Hidayah, F. F. (2019). Redesigning laboratories for pre-service chemistry teachers: from cookbook experiments to inquiry-based science, environment, technology, and society approach. *Journal of Turkish Science Education*, 16(4), 489 - 507.

- Ismail, R., Zaman, H. B., & Mohammad, U. H. (2022). A Visual-based project production package for design and technology subject based on computational thinking skills across-stem. *International Journal on Informatics Visualization*, 6(2), 445-454.
- Kaya, N. G., & Mertol, H. (2022). The importance of technology in the education of gifted in the context of 21st-century skills. *Journal of Computer and Education Research*, 10(19), 18-25.
- Kim, S., Raza, M., & Seidman, E. (2019). Improving 21st-century teaching skills: the key to effective 21st-century learners. *Research in Comparative & International Education*, 14(1), 99-117.
- Kurniawan, H., Budiyo, B., Sajidan, S., & Siswandari, S. (2021). The pinter learning model to enhance higher-order thinking and communication skill in algebra. *International Journal of Instruction*, 14(3), 359-374.
- Kurniawati, H. A., Erriska, R. R., & Prasetyo, Z. K. (2020, February). Development of POE and SETS Based Science E-Module to Facilitate Creative Thinking Skill and Collaboration Skill. *International Conference on Educational Research and Innovation (ICERI 2019)*, 122-126. Atlantis Press.
- Kusyanti, R. N. T. (2021). Development of interactive digital module based on virtual laboratories in the COVID-19 pandemic era in dynamic fluid material. *International Journal of Active Learning*, 6(1), 41-48.
- Lindawati, L., Wardani, S., & Sumarti, S. S. (2019). Development of inquiry materials based on chemical representation to improve students' critical thinking ability. *Journal of Innovative Science Education*, 8(3), 332-343.
- Mahardika, A. I., Saputra, N. A. B., Hayanti, M., Nurmalingda, N., Lazuarid, N. S., & Pratama, W. A. (2022). Practicality of fluid physics e-module oriented problem authentic wetland use contextual teaching and learning approach. *International Journal of Social Science and Human Research*, 5(11), 5014-5018.
- Mahardika, A. I., Wiranda, N., Arifuddin, M., Kamal, M., Erlina, M., & Hayati, M. (2021). The student response to interactive e-modules to support science literacy in distance learning physics. *International Journal of Innovative Science and Research Technology*, 6(11), 258-261.
- Mahmudah, S., Noer, T. K. M. S., & Rahayu, Y. S. (2022). Profile of students' critical thinking ability: implementation of e-module based on problem-based learning. *International Journal of Recent Education Research (IJORER)*, 3(4), 478-488.
- Maknum, J. (2020). Implementation of guide inquiry learning model to improve understanding of physics concepts and critical thinking skill of vocational high school students. *International Education Studies*, 13(6), 117-130.
- Martinez, C. (2022). Developing 21st-century teaching skills: a case study of teaching and learning through project-based curriculum. *Cogent Education*, 9(2), 1-16.
- Mas'ud, M., Putra, T. P., Zulfarina, Z., & Linda, R. (2021). The effectiveness of interactive integrated science e-module with connected type to improve students-mastery on energy topic. *International Journal of Educational Best Practices (IJEBCP)*, 5(2), 211-222.
- Maskur, R., Sumarno, S., Rahwamati, Y., Pradana, K., Syaxali, M., Septian, A., & Palupi, E. K. (2020). The effectiveness of problem-based learning and aptitude treatment interaction in improving mathematical creative thinking skills on curriculum 2013. *European Journal of Educational Research*, 9(1), 375-383.
- Meliza, M., Andromeda, A., Yerimadesi, Y., & Aini, S. (2021). Validity and practicality of chemical equilibrium e-module based on integrated guided inquiry learning for senior high school grade eleven. *International Journal of Progressive Sciences and Technologies (IJPSAT)*, 28(2), 561-571.
- Meyer, M. W., & Norman, D. (2019). Changing design education for the 21st century. *The Journal of Design, Economics, and Innovation*, 6(1), 14-49.
- Miftakhurrohman, N. L., Masykuri, M., & Ariyani, S. R. D. (2023). The effect of guided inquiry-based excretion system e-module to improve critical thinking and ICT literacy skills for students. *Jurnal Penelitian Pendidikan IPA*, 9(3), 682-689.
- Miller, B. T., Camarda, A., Mercier, M., Bukhardt, J. M., Morisseau, T., Bougrine, B., Vinchon, F., Hayek, S. E., Landais, M. A., 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(54), 2-32.

- Nasir, M., Cari, C., Sunarno, W., & Rahmawati, F. (2022). The effect of STEM-based guided inquiry on light concept understanding and scientific explanation. *EURASIA Journal of Mathematics, Science and Technology Education*, 18(11), 2-13.
- Nahar, S., Suhendri, S., Zailani, Z., & Hardivizon, H. (2022). Improving students' collaboration thinking skill under the implementation of the quantum teaching model. *International Journal of Instruction*, 15(3), 451-464.
- Nazifah, N., & Asrizal, A. (2022). Development of stem-integrated physics e-modules to improve 21st-century skills of students. *Jurnal Penelitian Pendidikan IPA*, 8(4), 1784-1789.
- Ndiung, S., Dantes, N., Ardana, I. M., & Marhaeni, A. A. I. N. (2019). Treffinger's creative learning model with RME principles on creative thinking skill by considering numerical ability. *International Journal of Instruction*, 12(3), 731-744.
- Nurasma, N., Shamsuddin, S., & Kaur, J. (2020). Students' learning style and its effect on blended learning does it matter. *International Journal of Evaluation and Research in Education (IJERE)*, 9(1), 195-202.
- Parno, P., Supriana, E., Yuliati, L., Widarti, A. N., Ali, M., & Azizah, U. (2019). The influence of STEM-based 7E learning cycle on students' critical and creative thinking skills in physics. *International Journal of Recent Technology and Engineering (IJRTE)*, 8(2), 761-769.
- Perez, L. I. G., & Montoya, M. S. R. (2022). Components of education 4.0 in 21st-century skills frameworks: systematic review. *Sustainability MDPI*, 14(1), 2-31.
- Prasetyo, I., Suryono, Y., & Gupta, S. (2021). The 21st-century life skills-based education implementation at the non-formal education institution. *Journal of Nonformal Education*, 7(1), 1-7.
- Pratama, O. R., Connie, C., & Risdinato, E. (2020). Development of a learning module using the self-organized learning environment (sole) model with augmented reality assistance on the materials of rotation dynamics and equality of rigid bodies. *International Journal of E-learning and Multimedia*, 1(1), 1-11.
- Prayogi, S., Ahzan, S., Indriaturrahmi, R., & Rokhmat, J. (2022). Opportunities to stimulate the critical thinking performance of preservice science teachers through the ethno-inquiry model in an e-learning platform. *International Journal of Learning, Teaching and Education Research*, 21(9), 134-153.
- Riduwan. (2012). *Belajar Mudah Penelitian Untuk Guru, Karyawan dan Peneliti Pemula*. Alfabeta
- Rizaldi, D. R., Makhrus, M., Fatimah, Z., & Nurhayati, E. (2021). Adaptation to new normal conditions: students' physics learning outcomes using the blended learning model. *International Journal of Asian Education*, 2(3), 369-376.
- Robertson, S. L. (2021). Global competencies and 21st century higher education and why they matter. *International Journal of Chinese Education*, 1-9.
- Santos, J. M. (2017). 21st century learning skills: a challenge in every classroom. *International Journal of Emerging Multidisciplinary Research*, 1(1), 31-35.
- Sefriani, R., Sepriana, R., Wijaya, I., Radyuli, P., & Menrisal, M. (2021). Blended learning with Edmodo: the effectiveness of statistical learning during the COVID-19 pandemic. *International Journal of Evaluation and Research in Education (IJERE)*, 10(1), 293-299.
- Siburian, J., Corebima, A. D., Ibrohim, I., & Saptasari, M. (2019). The correlation between critical and creative thinking skills on cognitive learning results. *Eurasian Journal of Educational Research*, 81(2), 99-114.
- Sidiq, R., Najuah, N., & Suhendro, P. (2018). Development of interactive e-modules based on video tutorial practices learning models in historical learning strategies as a source of innovative learning. *International Journal of Educational Research & Social Sciences*, 1(1), 119-125.
- Siman, S., Panjaitan, K., Riadi, S., & Harto, B. (2022). Development of hydraulic course e-modules to increase students' learning interest in mechanical engineering education. *International Journal of Innovative Technologies on Social Science*, 4(36), 1-5.
- Sugiyono. (2012). *Metode Penelitian Kuantitatif, Kualitatif, dan R & D*. Alfabeta.
- Supena, I., Darmuki, A., & hariyadi, A. (2021). The Influence of 4C (constructive, critical, creativity, collaborative) learning model on students' learning outcomes. *International Journal of Instruction*, 14(3), 873-892.

- Susilawati, S. A., Ibrahim, M. H., Isa, N., Wahab, N. A., Musiyani, M., Herinato, A., & Rochayati, N. (2022). The Methodology of Developing the Urban Heat Island e-Module on the Achievements and Collaboration Skills of High School Students in Surakarta. *Indonesian Journal on Learning and Advanced Education*, 4(2), 140-156.
- Sutiani, A., Siutmorang, M., & Silalahi, A. (2021). Implementation of an inquiry learning model with science literacy to improve student critical thinking skills. *International Journal of Instruction*, 14(2), 117-138.
- Syahrawati, E. Y., Suanatini, E., & Indana, S. (2022). Profile of blended learning implementation in learning activities. *International Journal of Recent Educational Research (IJORER)*, 3(1), 45-60.
- Weber, J., & Wilhelm, T. (2020). The benefit of computational modelling in physics teaching: a historical overview. *European Journal of Physics*, 40(2), 1-18.
- Yaarubi, M. A. Marni, N. B., Awae, F., & Abuhassna, H. (2023). The effect of an educational module according to 21st-century skills on the academic achievement of students of schools in Oman. *International Journal of Academic Research in Business & Social Sciences*, 13(3), 1368-1379.
- Yulianto, T., Pramudya I., & Slamet, I. (2019). Effects of the 21st-century learning model and problem-based models on higher order thinking skill. *International Journal of Educational Research Review*, 1(1), 749-755.
- Zakiah, N. A., & Sudarmin, S. (2022). Development of e-module STEM integrated ethnoscience to increase 21st-century skills. *International Journal of Active Learning*, 7(1), 49-58