JPPIPA 11(1) (2025)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

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

Validity, Practicality E-Module Global Warming, Guided Inquiry to Improve Students' Creative Thinking Skills

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Received: August 15, 2024
Revised: November 24, 2024
Accepted: January 25, 2025
Published: January 31, 2025

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DOI: 10.29303/jppipa.v11i1.9819

Abstract: The purpose of this study was to produce a physics e-module on global warming mitigation material based on guided inquiry with valid and practical categories. The type of research used is Research and Development development research. The research model used is the Van Den Akker development model. This model consists of four stages, namely preliminary research, prototyping stage, summative evaluation and reflection and documentation. The data used in this study are needs analysis data, validation and practicality. The instruments used are preliminary questionnaires, validation sheets, and practicality sheets. Data analysis techniques for needs analysis and practicality tests use descriptive analysis, analysis of validity using the Aiken's V formula. The results of this study are that the physics e-module on global warming mitigation material based on guided inquiry is in the valid category and the practicality level of the e-module is in the very practical category by teachers and students.

Keywords: Creative thinking skills; Guided inquiry; Practicality; Validity

Introduction

Education is one of the fundamental aspects in developing quality human resources (Fazira et al., 2023). A good development is certainly rooted in quality human resources. If the quality of human resources is not qualified, then sustainable development will be difficult to achieve. One of the initial steps to achieve SDGs (Sustainable Development Goals) is through education (Cahyani et al., 2024; Purwanti et al., 2024; Wibowo et al., 2022). Along with the development of science and technology, the need for innovation in the learning process is increasing, education must be adjusted to these technological developments (Fitria et al., 2024; Rasmi et al., 2023; Suyono, 2024). One of the biggest challenges facing the world of education today is how to prepare students who not only have sufficient knowledge, but are also able to think creatively in dealing with various problems (Xing et al., 2023). In this context, the Merdeka Curriculum is present as a solution according to the needs of the times. This step is the key to creating a generation that is ready to face global complexity and demands, as well as maintaining the sustainability of national development in the future (Monalisa et al., 2023).

Physics as one of the science subjects taught at the high school level has an important role in equipping students with logical, analytical and creative thinking skills creative (Pratiwi et al., 2024). One of the important and relevant topics in physics learning is global warming. Global warming is a complex and urgent environmental issue, which requires in-depth understanding and innovative solutions (Ruhana et al., 2024). Therefore, effective learning on this topic is very necessary to increase students' awareness and understanding of the impacts of global warming and their role in preserving the environment.

The guided inquiry approach has been proven to be an effective method in improving students' creative thinking skills (Dani et al., 2021; Kurniawan et al., 2021;

How to Cite:
Fauzi, A., & Habibah, R. (2025). Validity, Practicality E-Module Global Warming, Guided Inquiry to Improve Students' Creative Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, *11*(1), 701–708. https://doi.org/10.29303/jppipa.v11i1.9819

Susilawati et al., 2023, 2022). Guided inquiry provides opportunities for students to be actively involved in the learning process through observation, experimentation, and independent discovery of concepts with teacher guidance (Blanchard et al., 2010; Muliani et al., 2019). This approach encourages students to not only passively receive information, but also to explore and relate physics concepts to real phenomena that occur in their surroundings.

E-modules based Guided inquiry are one of the innovations developed to meet the learning needs in this digital era. E-modules are digital teaching materials designed to support interactive, flexible, and personalized learning processes (Resti et al., 2024). The advantages of e-modules include being accessible anytime and anywhere, so that students can learn according to their rhythm and needs. In addition, e-modules also allow for the presentation of more interesting learning materials through the use of multimedia, such as videos, animations, and interactive simulations (Nurhasanah et al., 2023; Nurmilah et al., 2023; Rosita et al., 2024).

However, in order for this e-module to be implemented effectively in learning, high validity and practicality are required. The validity of the e-module includes aspects of material suitability, readability, and meaningfulness for students (Ananda et al., 2023; Makhroji et al., 2023). E-modules must be able to convey physics concepts in a way that is correct and easy for students to understand. Meanwhile, practicality includes the ease of use of the module by teachers and students, as well as the module's ability to support the achievement of learning objectives that have been set in the Merdeka Curriculum (Ananda et al., 2023).

Research on the practicality and validity of this guided inquiry-based physics e-module is important to ensure that the e-module is not just a technological innovation, but also has significant pedagogical value in supporting the development of students' creative thinking skills. The validity of the e-module can be measured through validation tests by experts in the field of physics education, while practicality can be seen from the responses of teachers and students to the use of the e-module in daily teaching and learning activities.

The results of this study are expected to provide important contributions in the development of effective and innovative teaching materials, which are in accordance with the demands of the Merdeka Curriculum and the needs of students in facing global challenges. Valid and practical e-modules will be valuable tools for teachers in teaching, as well as helping students in developing creative thinking skills that are very necessary in this era of globalization.

Method

This type of research is Research & Development. In development research, the results of development can be in the form of a prototype model or learning device (Antonini et al., 2022; Razak et al., 2023; Yani et al., 2020). The development model used is the Van Den Akker model which consists of 4 stages, starting from the preliminary research stage, the prototype stage, the summative evaluation stage, and systematic reflection and documentation. In this study, it was limited to the validity and practicality stages of the product. The validity instrument was carried out by five validators, namely three lecturers, one teacher and one student who had developed similar products. The practicality instrument was carried out by teachers and students. The validity and practicality instruments were filled in using a Likert scale as follows:

Table 1. Scale Likert

Likert Scale	Evaluation
1	Very Disagree
2	Disagree
3	Quite Agree
4	Agree
5	Very Agree

After respondents have filled out the Likert scale questionnaire, the validity of the product is calculated using the formula:

$$V = \sum \frac{S}{\{n(c-1)\}} \quad (1)$$

After the validity results are processed using the formula, the determination of the validity of the product is determined by the interpretation criteria of the scores obtained. The criteria used in determining the validation of the physics e-module of global warming mitigation material based on guided inquiry can be seen in the following table:

Table 2. Validity Product Criteria

Value	Criteria
≥ 0.6	Valid
≤ 0.6	Not Valid

After validity is done, then practicality is done. The practicality instrument is carried out by teachers and students using a Likert scale. Then the results are processed with the following formula:

$$\text{Score} = \frac{total\ score\ obtained}{maximum\ score} x\ 100\% \quad (2)$$

After the results are obtained, the determination of the practicality of the product is carried out, whether it is practical or not is determined by the criteria for interpreting the scores obtained. The criteria used in determining the practicality of the physics e-module on global warming mitigation material based on guided inquiry can be seen in the following table:

Table 3. Practicality Product Criteria

Value	Criteria
0-20	Not practical
21-40	Less practical
41-60	Quite practical
61-80	Practical
81-100	Very practical

Result and Discussion

Preliminary Research

The results of the analysis of the passing standards are in the less category. In the attitude competency, the results obtained the highest score with a good category, this means that students have a good attitude in learning physics. Religious competency is the second best competency with a sufficient category, which means that students have a good spiritual attitude in everyday life. While in the skills and knowledge competencies, students are in the less category.

The results obtained from the performance analysis are in the less category. Based on interviews with teachers at school, the cause of this is influenced by several aspects such as lack of time, educators often have a large workload, including teaching classes, preparing lesson materials and doing other administrative tasks. Lack of time can make it difficult for educators to take the time to conduct performance analysis regularly.

The results of the analysis of learning difficulties are in the less category, which means that students still experience difficulties in the physics learning process. Difficulty in understanding abstract material can be overcome by using learning media. Learning using media other than textbooks is very helpful for students to learn independently, is able to improve learning outcomes and increase student activity, according to research conducted Asih et al. (2022) and Hamidi et al. (2024) where the use of e-modules can overcome students' learning difficulties.

Analysis of learning resources or teaching materials is in the less category. Educators during the learning process only use printed books available from the library and learning media are only the educators themselves. Teaching materials are one of the important factors in the learning process, according to research Sundari et al. (2024) which says that teaching materials are an important factor in the effectiveness of a learning process.

The analysis of the learning model is in the less category. Based on observations by looking at the module where the learning process uses a learning model but the model is not applied in class according to the steps of the model. The learning model is very important in the learning process. The learning model arena influences how students acquire knowledge, skills, and understanding of various concepts and topics.

Then the analysis of students, analysis of motivation and attitudes of students are in the sufficient category. The involvement and support of teachers in the learning process can greatly affect student motivation. This is influenced by several factors, one of which is the use of teaching materials, the use of innovative, interesting, and interactive teaching materials can help increase student interest. Variations in teaching models and the use of technology in learning can also increase student interest and involvement according to research Yevira et al. (2023) where the research results show that the application of e-modules in the learning process can increase student interest.

Analysis of creative thinking skills is at low criteria. Seeing the situation in the learning process at school, teachers only use textbooks in the learning process and are implemented with a simple orientation, this makes students less given the opportunity to hone or improve their thinking skills. Fahmi et al. (2023) stated that less interactive learning can affect students' creative thinking abilities.

Prototype (Prototyping Stage)

In the product creation or development stage, there are 2 stages, the first is product design in the form of e-modules and the second stage is to conduct formative evaluation. The results of each stage are explained as follows:

Design stage

The design stage aims to describe the results of the e-module design based on the results of preliminary research. The e-module designed is an e-module on global warming mitigation material using a guided inquiry learning model. The structure of the designed e-module consists of three parts, namely the beginning, content and end (closing). The explanation of each part is explained as follows:

Cover

The cover or title page is the main attraction for readers in using the e-module as a learning resource in learning activities. The e-module cover can be seen in Figure 1.

Figure 1. Front and back cover design of the physics e-module

In Figure 1, the cover consists of the e-module identity, namely the name of the subject, topic/learning material, class, author's name, logo and images that can represent the contents of the e-module that has been developed.

E-module usage instructions

The instructions for using the e-module can be seen in Figure 2 as follows:

Figure 2. E-module usage instructions

In Figure 2, the user manual contains information about how to use the e-module and the functions of the buttons in the e-module.

Glossary

In this e-module, the glossary is created based on global warming material and can be seen in Figure 3 as follows:

Figure 3. Glossary

Figure 3 the glossary section contains an explanation of the meaning of a term, difficult words arranged in alphabetical order.

Learning activities

The design of the learning activity display can be seen in Figure 4 as follows:

Figure 4. Learning activities

In Figure 4, it is known that the learning activities in the e-module contain learning objectives, material descriptions, skill worksheets and exercises. In guided inquiry-based learning activities.

Exercise

In this e-module, the exercises are made in the form of essays, where the exercises can be seen in Figure 5 as follows:

Figure 5. Exercise

In Figure 5, it is known that there are 2 exercises per chapter. This exercise is a written assessment to see the extent of the mastery of the learning outcomes that have been achieved by students as a basis for carrying out the following activities.

Evaluation

In this e-module there is an evaluation, where the evaluation can be seen in Figure 6 as follows:

Figure 6. Evaluation

In Figure 6, the evaluation design of the e-module can be seen. This evaluation aims to assess the extent of the mastery of knowledge that has been achieved by students. This evaluation is formed in multiple choices where there are 4 answer options, this evaluation section is made in the form of an interactive evaluation, this evaluation is opened by clicking the star button above, then students can immediately answer questions, where when answering questions students immediately get feedback from the answers that have been chosen whether right or wrong.

Author profile

In this e-module there is also a profile of the author, where the author's profile can be seen in Figure 7 as follows:

Figure 7. Author profile

The image above is the author's profile, where the writing profile section contains the lecturer's profile and the student's profile in the form of self-introduction as a designer.

Formative Evaluation

At the development stage, validation was carried out by experts, where the designed e-module was validated by five validators. The assessment of the physics e-module based on Guided Inquiry as an independent teaching material to improve the creative thinking skills of high school/MA class X students was assessed using a validation instrument.During the validation process, the validator provides suggestions and input on the designed product. The validation instruments used consist of aspects of material substance, learning design, display, and software utilization. The validation results of the physics e-module can be seen in table 4.

Table 4. E-Module Validity Results

Aspect	Aiken'V Values	Criteria
Substance of Material	0.90	Valid
Learning Design	0.92	Valid
Appearance	0.90	Valid
Software utilization	0.90	Valid
verage	0.91	Valid

In Table 4 it is knownIt is known that the developed e-module has an Aiken's V value with an average of 0.91 which is in the valid criteria. Based on these data, the e-module of high school physics for grade X on global warming mitigation material based on guided inquiry can be used in learning activities. Some comments and suggestions given by the validator can be seen in Table 5.

Table 5. Validator Comments and Suggestions on the Physics E-Module

Validators	Comments and suggestions	Follow-up
US	Add information or instructions to the Phet simulation activity, so that students can discover the concept of global warming.	Information or instructions for Phet simulation activities have been added
SN	The writing style is not EYD yet	The layout has been corrected
	For the first chapter the paragraph displayed is too long	For the first chapter the paragraph has been corrected
	For the first chapter, the problem formulation questions, hypotheses and student worksheets must be in one topic.	For the first chapter, the problem formulation questions, hypotheses and student worksheets have been created according to the topic unity.
	For this purpose, please pay attention to Indonesian language rules.	The language rules in the objective have been corrected
	Some buttons do not have access permissions	Buttons not having access permissions has been fixed
FN	Arrange learning objectives covering the ABCD zone	Learning objectives have been arranged according to the alphabet
	On the cover, also include the word E-module	The word E-module is also included on the cover.
LD	Glossary	The glossary section should be slightly improved.
RA	-	-

Assessment (Summative Evaluation)
Teacher Practicality Test

The results of the practicality of teacher responses were obtained by giving a questionnaire on the practicality of teacher responses to two physics teachers at MAN 3 Mandailing Natal. The results of the practicality of teacher responses can be seen in Table 6.

Table 6. Results of E-Module Practicality Based on Teacher Responses

Component	Mark (%)	Criteria
Ease of use	0.89	Very practical
Learning time efficiency	0.83	Very practical
Benefit	0.88	Very practical
Average	0.87	Very practical

Based on Table 6, it is known that the average practicality value of the physics e-module based on teacher responses is 0.87 or 87% with very practical criteria. Based on these data, the physics e-module for grade X high school based on guided inquiry is very practical to use in learning activities.

Student Practicality Test

The results of the practicality of the student responses used were class X MIA 2 with a total of 32 students. The results of the practicality test of the student responses can be seen in table 7.

Based on Table 7, it is known that the average practicality value of the physics e-module based on student responses is 0.80 or 80% with very practical criteria. Based on these data, the physics e-module for grade X high school based on guided inquiry is very practical to use in learning activities.

Table 7. Practical Results of Student Responses

Component	Mark (%)	Criteria
Ease of use	0.81	Very practical
Learning time efficiency	0.80	Very practical
Benefit	0.80	Very practical
Average	0.80	Very practical

Conclusion

Validity and Practicality Test Results of the physics e-module on guided inquiry-based wave heating mitigation material, namely that validity is assessed using four components, namely substance of material, learning design, appearance and use of software. Based on the assessment of these four components, it is stated that the e-module is based on guided inquiry. has been produced as valid and feasible. The results of data analysis from the practicality test were obtained from an assessment of user ease, time efficiency and the benefits of e-modules in learning activities. The average practicality test results by teachers are in the very practical category. Then the results of the practicality test by students are also in the very practical category. Based on these results, it was found that the physics e-module on global warming mitigation material based on guided inquiry to improve students' creative thinking skills is in the very practical category both in terms of ease of use, efficiency of learning time and benefits.

Acknowledgments
Thanks are given to the validators who have taken the time to provide input, suggestions, and assessments of the feasibility of this research product; to the Principal who has given permission and support to conduct research in the school environment; to the teachers who have helped in the data collection process, provided information, and facilitated during the research and all parties involved, both directly and indirectly, in assisting the research process. Your contribution and support are very valuable for the success of this research.

Author Contributions
All authors contributed to writing this article.

Funding
This research did not receive external funding.

Conflicts of Interest
The author declares there is no conflict of interest in writing this article.

References

Ananda, P. N., & Usmeldi, U. (2023). Validity and Practicality of E-Module Model Inquiry Based Online Learning to Improve Student Competence. *Jurnal Penelitian Pendidikan IPA*, *9*(4), 2010–2017. https://doi.org/10.29303/jppipa.v9i4.3563

Antonini, A., Melani, S., Mazza, A., Baldini, L., Adirosi, E., & Ortolani, A. (2022). Development and Calibration of a Low-Cost, Piezoelectric Rainfall Sensor through Machine Learning. *Sensors*, *22*(17), 6638. https://doi.org/10.3390/s22176638

Asih, T. L. B., Prayitno, B. A., & Ariani, S. R. D. (2022). Improving the Problem-Solving Skill of Students using Problem-Based Learning-Based E-Modules. *Jurnal Penelitian Pendidikan IPA*, *8*(3), 1447–1452. https://doi.org/10.29303/jppipa.v8i3.1696

Blanchard, M. R., Southerland, S. A., Osborne, J. W., Sampson, V. D., Annetta, L. A., & Granger, E. M. (2010). Is inquiry possible in light of accountability?: A quantitative comparison of the relative effectiveness of guided inquiry and verification laboratory instruction. *Science Education*, *94*(4), 577–616. https://doi.org/10.1002/sce.20390

Cahyani, M. D., Gusman, T. A., & Akbar, A. Y. (2024). Profile of Green Chemistry on Chemistry Education Students: Study on Developing Green Chemistry Practical Module to Support Sustainable Development Goals (SDGs). *Jurnal Penelitian Pendidikan IPA*, *10*(10), 7954–7959. https://doi.org/10.29303/jppipa.v10i10.7796

Dani, R., Murniati, M., & Evendi, E. (2021). Application of the Guided Inquiry Model to Improve Student's Motivation and Creativity. *Jurnal Penelitian Pendidikan IPA*, *7*(4), 642–650. https://doi.org/10.29303/jppipa.v7i4.783

Fahmi, R. M., & Jumadi, J. (2023). Analysis of Research Trends in Creative Thinking Skills in Science Learning: A Systemic Literature Review. *Jurnal Penelitian Pendidikan IPA*, *9*(7), 204–211. https://doi.org/10.29303/jppipa.v9i7.2742

Fazira, P., Ahmad, F., & Syarifah. (2023). Pengembangan Sumber Daya Manusia Dalam Meningkatkan Mutu Pendidikan Agama Islam di SMA Negeri 1 Brandan Barat. *Jmi: Jurnal Millia Islamia*, *02*(1), 221–231. Retrieved from https://jurnal.perima.or.id/index.php/JMI/article/view/264/221

Fitria, D., Lufri, Asrizal, & N, A. (2024). Digital Teaching Material of Integrated Science with Blended-PBL Model for Independent Curriculum. *Jurnal Penelitian Pendidikan IPA*, *10*(11), 8328–8338. https://doi.org/10.29303/jppipa.v10i11.9058

Hamidi, A., Akmala, R., Suyanta, & Wilujeng, I. (2024). Development of PBL Based E-Modules to Boost Students' Science Process Skills. *Jurnal Penelitian Pendidikan IPA*, *10*(2), 820–827. https://doi.org/10.29303/jppipa.v10i2.5939

Kurniawan, R., & Syafriani, S. (2021). Praktikalitas dan Efektivitas Penggunaan E-Modul Fisika SMA Berbasis Guided Inquiry Terintegrasi Etnosains untuk Meningkatkan Berpikir Kritis Peserta Didik. *Jurnal Eksakta Pendidikan (JEP)*, *5*(2), 135–141. https://doi.org/10.24036/jep/vol5-iss2/572

Makhroji, M., Rahmiati, R., Chairuddin, C., & Isda, I. D. (2023). Development of E-Module Based on Flip Book Media to Improve Students' Speaking Skills. *Jurnal Kependidikan: Jurnal Hasil Penelitian Dan Kajian Kepustakaan Di Bidang Pendidikan, Pengajaran Dan Pembelajaran*, *9*(4), 1270. https://doi.org/10.33394/jk.v9i4.8999

Monalisa, M., & Irfan, A. (2023). Tantangan Guru Dalam Menerapkan Kurikulum Merdeka. *Jurnal Basicedu*, *7*(5), 3228–3233. https://doi.org/10.31004/basicedu.v7i5.6055

Muliani, N. K. D., & Wibawa, I. M. C. (2019). Pengaruh Model Pembelajaran Inkuiri Terbimbing Berbantuan Video Terhadap Hasil Belajar IPA. *Jurnal Ilmiah Sekolah Dasar*, *3*(1), 107. https://doi.org/10.23887/jisd.v3i1.17664

Nurhasanah, D., Iswanto, B. H., & Nasbey, H. (2023). E-Modul Project Based Learning Untuk Pembelajaran Fisika SMA Pada Materi Pemanasan Global. *Lontar Physics Today*, *2*(1), 1–8. https://doi.org/10.26877/lpt.v2i1.14349

Nurmilah, N., Nana, & Sulistyaningsih, D. (2023). Pengembangan E-Modul Interaktif Berbasis Model Pembelajaran Poe2we Menggunakan Flipbook

Maker Pada Materi Gelombang Bunyi Dan Cahaya. *Jurnal Kumparan Fisika*, *6*(2), 107–118. https://doi.org/10.33369/jkf.6.2.107-118

Pratiwi, H. Y., Sujito, S., Sunardi, S., & Sayyadi, M. (2024). The Learning Revolution: Investigating the Use of Technology to Explore Mathematical Physics Learning. *Kasuari: Physics Education Journal (KPEJ)*, *7*(1), 216–226. https://doi.org/10.37891/kpej.v7i1.523

Purwanti, P., Hayat, M. S., & Dewi, E. R. S. (2024). Students' Creative Thinking Skills with STEAM-SDGs Approach to Energy Concept: Rasch Model Analysis. *Jurnal Penelitian Pendidikan IPA*, *10*(12), 11152–11161. https://doi.org/10.29303/jppipa.v10i12.9532

Rasmi, D. P., Hendri, M., & Azriyanti, R. (2023). Analysis of the Need for Development of Teaching Materials in the Form of STEM-Based Electronic Modules. *Jurnal Penelitian Pendidikan IPA*, *9*(6), 4135–4141. https://doi.org/10.29303/jppipa.v9i6.2683

Razak, A., Taufik, W., Putri, D. H., & Irdawati, I. (2023). Development of Learning Videos for Students of Class X IPA MAN 1 Pasaman Barat. *Jurnal Penelitian Pendidikan IPA*, *9*(5), 2452–2461. https://doi.org/10.29303/jppipa.v9i5.3124

Resti, N., Ridwan, R., Palupy, R. T., & Riandi, R. (2024). Inovasi Media Pembelajaran Menggunakan AR (Augmented Reality) pada Materi Sistem Pencernaan. *BIODIK*, *10*(2), 238–248. https://doi.org/10.22437/biodik.v10i2.34022

Rosita, K., & Muflihah, U. (2024). Menumbuhkan Kemampuan Berpikir Kreatif Siswa Dalam Pembelajaran Ipa Menggunakan E-Modul Terintegrasi Game Based Learning. In *Proceeding Seminar Nasional IPA* (pp. 427–436). Retrieved from https://proceeding.unnes.ac.id/snipa/article/view/3717

Ruhana, F., Suwartiningsih, S., Mulyandari, E., Handoyo, S., & Afrilia, U. A. (2024). Innovative Strategies for Achieving Sustainable Development Goals Amidst Escalating Global Environmental and Social Challenges. *International Journal of Science and Society*, *6*(1), 662–677. https://doi.org/10.54783/ijsoc.v6i1.1054

Sundari, P. D., Hidayati, Saputra, D., Sari, S. Y., & Anusba, E. B. (2024). Analysis of Teaching Materials Needs for Digital Module Development in Physics Learning: Teachers Perception. *Jurnal Penelitian Pendidikan IPA*, *10*(2), 674–680. https://doi.org/10.29303/jppipa.v10i2.6093

Susilawati, Doyan, A., Rokhmat, J., & Muliyadi, L. (2023). Analysis Validation of Modern Physics Learning Media Based on Smartphone Integrated Project Based Learning to Improve Students' Creativity and Scientific Literacy. *Jurnal Penelitian Pendidikan IPA*, *9*(10), 7888–7892. https://doi.org/10.29303/jppipa.v9i10.5404

Susilawati, S., Doyan, A., & Harjono, A. (2022). Development of Learning Media for Wave Ripple Tanks with the Implementation of Guided Inquiry Models on Students' Mastery of Concepts and Scientific Creativity. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 985–991. https://doi.org/10.29303/jppipa.v8i2.1542

Suyono, S. (2024). Strategi Peningkatan Kualitas Pembelajaran Berbasis Teknologi di Perguruan Tinggi Vokasi: Tinjauan terhadap Implementasi Platform Pembelajaran Online. *Journal on Education*, *6*(4), 21519–21528. https://doi.org/10.31004/joe.v6i4.6138

Wibowo, R. A., & Liu, W.-T. (2022). Indonesian Vocational Educators' Cognition and Behavior towards Sustainable Development Goals (SDGs): A Qualitative Study. *The 5th International Conference on Vocational Education Applied Science and Technology 2022*, 11. https://doi.org/10.3390/proceedings2022083011

Xing, Z., & Qi, Y. (2023). Development of creativity in physical education teachers using interactive technologies: involvement and collaboration. *Education and Information Technologies*, *28*(5), 5763–5777. https://doi.org/10.1007/s10639-022-11422-9

Yani, Y. P., Hardeli, H., Oktavia, B., & Kurniawati, D. (2020). Development of an Integrated E-Module of Scientific Literacy and Video Demonstration Using a Problem-Based Learning Model for High School Students on Acids and Bases. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 452–462. https://doi.org/10.29303/jppipa.v8i2.1306

Yevira, R., Yustina, & Yennita. (2023). Development of SETS (Science Environment Technology and Society) Based E-Modules on Environmental Pollution Materials to Increase Learning Interest and Critical Thinking Ability. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 6306–6313. https://doi.org/10.29303/jppipa.v9i8.4229