Development of E-LKPD Based on Kvisoft Flipbook Maker to Improve Concept Understanding of Class X Students on Global Warming Materials Manuscript

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Abstract: This research is a development research with the aim of developing learning media based on kvisoft flipbook maker on Global Warming material in order to improve understanding of concepts in class X high school students. This type of research is the development of Research and Development (R&D). The design of this study uses the ADDIE (Analysis, Design, Development, Implement, and Evaluation) model. The research subjects consisted of 26 students in each control and experimental class. The sample in this study was determined by random sampling. The instrument used is an assessment scale to determine the quality of the developed learning media and a concept understanding test to determine students' conceptual understanding. The software used to develop this learning media is kvisoft flipbook maker. Validation was carried out by 3 expert validators and students. Analysis of the data used is SBi to analyze the feasibility of the media and the Mann Whitney Test. The results showed that the kvisoft flipbook maker-based E-LKPD was feasible to be used in improving understanding of the concept of Global Warming in class X high school students. This was based on the average number of learning media feasibility scores by expert validators was 4.6 which means $\bar{X} \geq 4.21$ and the average score of the students' assessment is 3.6, which means $\bar{X} \geq 3.0$. The post-test average score of students' conceptual understanding in the control class was 70.58, while in the experimental class it was 83.85. Then from the results of the non-parametric test, the output of the test statistics is known as Asym.Sig (2-talled) with a value of 0.049 which means $\alpha < 0.05$.

Keywords: E-LKPD; Global Warming; Kvisoft flipbook maker

Introduction

Along with the times in the era of globalization, the Indonesian government has made development efforts to improve the quality of education in Indonesia. One of the latest efforts by the government is to create a Science Curriculum II to improve the quality of education and reform the education system (Vidal et al., 2022). Science Curriculum II is a curriculum with diverse learning where the content will be more optimal so that students have enough time to explore concepts and strengthen competencies. Independent Learning itself can be interpreted as freedom of thought. The main essence of freedom of thought comes from educators or teachers, so

teachers have the flexibility to choose various teaching tools so that learning can be adapted to the learning needs and interests of students (Naufal et al., 2020).

One of natural science learning is physics, most of the material is abstract concepts and difficult for students to understand. Global warming is one of the materials that is difficult for students to understand when the teacher delivers the material using the lecture method (Blais, 2020). Natural phenomena such as rising sea levels, ozone depletion, climate change, and the greenhouse effect still cause a lot of student misunderstanding (Binder et al., 2020). The concept of global warming symptoms requires students to be able to analyze the symptoms and their impact on life,

however, students are still difficult to achieve this, because the concept of global warming symptoms is abstract (Setianita et al., 2019). The results of interviews with physics teachers at SMAN 71 Jakarta said that students tend to be unable to explain and relate the concept of global warming to everyday life, this shows the low knowledge and understanding of students about the concept of global warming and results in the aim of studying global warming symptoms in schools being less than optimal (Alatas & Fauziah, 2020). Students have never been invited to do laboratory activities related to global warming due to the unavailability of the necessary tools and materials (Zeng & Zeng, 2021). Students are more interested in studying global warming when the material is presented with illustrated pictures and clear information based on the facts around them, while another students are still more interested in learning using conventional methods, namely memorization and lectures (Mustari et al., 2019). The learning process tends not to provide opportunities for students to understand everyday phenomena (Sagala et al., 2019). The teacher does not only act as someone who imparts knowledge in the learning process, but also plays a role in providing skills that can help students learn (Content, 2023).

The use of media is very necessary in learning physics because there are many natural phenomena and phenomena that cannot be presented and understood properly by students without the media. Science and technology are an inseparable part of human daily life (Havryliuk et al., 2020). Technology is created and developed in accordance with its field in order to help life activities (Meyer et al., 2023). Information technology can be designed and developed into a media that functions as a tool in the learning process optimizing the quality of learning requires a change from conventional media to media based on Information and Communication Technology (ICT) (Graul et al., 2022). Technology that is used appropriately for education can improve the quality of student learning (Thoms et al., 2019). Learning activities cannot be separated from the teaching staff and teaching materials (Holt et al., 2019). One example of this change is the change in the use of conventional teaching materials being replaced with electronic-based teaching materials (Susilowati et al., 2018). In the era of increasingly developing technology, it is necessary to change the LKPD into electronic form (e-LKPD) which is able to facilitate the independent learning process and make it easier to communicate with teachers effectively (Rahayu et al., 2021). Because printed teaching materials have several drawbacks, namely not being able to represent movement, the presentation of material is linear, and it is difficult to provide guidance to the reader (Tsarapkina et al., 2021). So that flipbook-based teaching is needed

because it has features that resemble conventional textbooks but is able to present interesting examples of images, videos, animations, audio effects and there are quizzes that can be accessed offline (Safitri et al., 2021). Therefore teachers are required to create electronic learning media with good characteristics and can be used independently by students and can explain material through audio-visual (Rahmatika et al., 2021).

Kvisoft Flipbook Maker is a learning media can increase students' interest in learning because it does not only focus on reading, but can also include audio, animation and video. The characteristics of flipbook-based electronic learning media are that they contain practicum activities, a brief summary of the material, as well as the existence of learning videos that make learning better and more interesting (Perdana et al., 2021). This is an interesting interactive learning media so that learning is not monotonous or rigid and learning becomes more interesting and can be used independently (Fadillah et al., 2021). Students have a positive perception of the opportunities for developing and using flipbooks as digital learning media. Flipbook-based digital learning media can facilitate the learning process, one of which is science learning (Roemintoyo & Budiarto, 2021).

Based on this, an interesting electronic-based learning media is needed so that students can increase students' understanding of concepts in physics learning, especially in global warming material. This paper discusses the development of e-LKPD based on kvisoft flipbook maker to improve understanding of concepts on global warming material in class X science students at SMA Negeri 4 Palu.

Method

This research is a type of research and development or Research and Development (R&D). This study aims to make a product and test the feasibility of the product. In this study, a learning media based on Kvisoft Flipbook Maker was developed on global warming material. This learning media development model uses ADDIE which includes Analysis, Design, Development, Implementation, and Evaluation.

This research was conducted at SMA Negeri 4 Palu. The subjects of this study were two students of class X for the control class totaling 26 students and for the experimental class totaling 26 students. The instruments used are questionnaires and concept understanding tests. The data collection technique is by giving media assessment questionnaires to 3 expert validators to assess the feasibility of the developed media and questionnaires given to students to see the feasibility of using the developed media to students, then students were given concept understanding tests (pretest and

posttest) to see an increase in students' understanding of concepts. The data analysis technique used is SBi to analyze the results of the validation of media expert assessments and the analysis of the Mann Whitne Test to analyze the results of the student's concept understanding test (Pretest/Posttest).

Figure 1. Research design

Table 1. Score Category Qualitative Scale Five

Score Range	Description
$\bar{X} \geq 4.1$	Very Good
$3.40 < \bar{X} \leq 4.21$	Good
$2.30 < \bar{X} \leq 3.40$	Enough
$1.79 < \bar{X} \leq 2.30$	Not Enough
$\bar{X} \leq 1.79$	Very Less

Table 2. Score Category Qualitative Scale Four

Score Range	Description
$\bar{X} \geq 3.0$	Very Good
$3.0 \geq \bar{X} \geq 2.5$	Good
$2.5 \geq \bar{X} \geq 2.0$	Not Enough
$\bar{X} \leq 2.0$	Very Less

Result and Discussion

The results of this study are the feasibility test of learning media and the results of the concept understanding test of class X students. The media feasibility test is carried out by three expert validators and the feasibility test by students. While the concept understanding test was carried out in both classes, namely the control class and the experimental class. The control class uses conventional learning media in the form of modules from the school, while the experimental class uses the developed E-LKPD. In this study it was found that the increase in students' conceptual understanding in the experimental class tended to increase more than students' conceptual understanding in the control class.

Develop Product

Shows the cover of the E-LKPD with the Yogyakarta state university logo. Then there is the title of the material contained in the E-LKPD which is about global warming. Furthermore, there is a class description located at the top left which indicates that the E-LKPD can only be used for class X students.
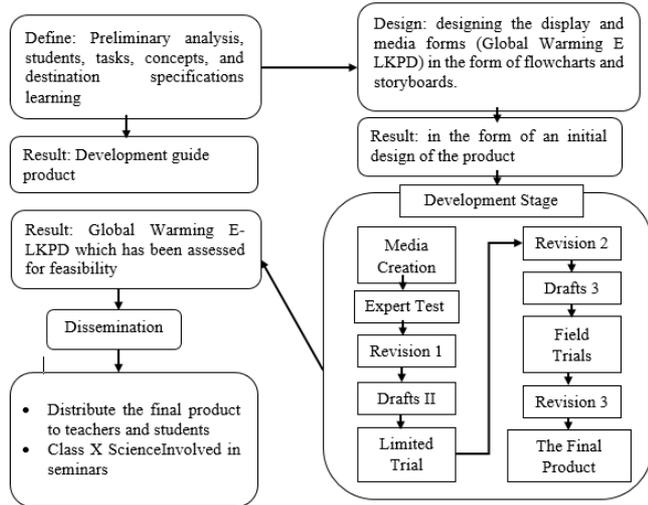

Figure 2. Cover E-LKPD

Figure 3. The instructions for using the E-LKPD

Figure 4. Short learning video

On this sheet each part of the E-LKPD is briefly explained. Starting from the introduction, contents, to the closing of each sheet that will be viewed. So students can understand what they can get on each sheet.

Containing a short learning video about global warming material that can be played offline so that students can understand material containing audio-visual about the global warming process.

Figure 5. Quizzes

Quizzes related to the material that has been studied. This quiz aims to see students' understanding of global warming material. The form of the quiz on the E-LKPD is multiple choice.

Media Eligibility

The average score of the validation results of experts from each aspect is 4.6 which means $\bar{X} \geq 4.21$ and is included in the very good category. In the didactic aspect, the average score obtained is 4.6. On the construction aspect, the average score obtained is 4.7. On the technical aspect, the average score obtained is 4.3. In the media aspect, the average score obtained is 4.6. In the material aspect, the average score obtained is 4.9. These results show that the Kvisoft Flipbook Maker-based E-LKPD that was developed is feasible to use.

Table 3. E-LKPD Validation Results by Expert Validators

Aspect	$\bar{X}$ Assessment Score			$\bar{X}$	$\bar{X}i$	SBi	Category
	1	2	3				
Didactic	4.8	4.2	4.8	4.6	3	0.67	Very Good
Construction	4.6	4.6	5	4.7	3	0.67	Very Good
Technical	3.7	4.7	4.7	4.3	3	0.67	Very Good
Media	4.5	4.5	4.8	4.6	3	0.67	Very Good
Theory	4.8	5	5	4.9	3	0.67	Very Good
Average				4.6			Very Good

The average score of validation results by students in each aspect is 3.6, which means $\bar{X} \geq 3$ and is included in the very good category. In the aspect of presenting the material, an average score of 3.6 is obtained. In the linguistic aspect, an average score of 3.5 is obtained. In

the utilization aspect, an average score of 3.6 was obtained. In the graphical aspect, an average score of 3.7 is obtained. These results indicate that the Kvisoft Flipbook Maker-based E-LKPD that was developed is feasible to be used by students.

Table 4. E-LKPD Assessment Results by Students

Aspect	$\bar{X}$ Assessment Score 1-26	$\bar{X}i$	SBi	Category
Material Presentation	3.6	2.5	0.5	Very Good
Language	3.5	2.5	0.5	Very Good
Utilization	3.6	2.5	0.5	Very Good
Graphic	3.7	2.5	0.5	Very Good
Average	3.6			Very Good

Concept Understanding

The average score in the pretest of the experimental class is 67.69 and the posttest value after using the electronic learning media of students' worksheets is 83.85. Meanwhile, the average score in the pretest control class was 70.58 and the posttest score after using the conventional learning module was 79.23. Based on these data, it is known that the two classes, namely the control class and the experimental class, have increased understanding of the concept. However, to be more convincing, the data were analyzed using the Mann Whitney test.

Table 5. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Dev
Pre-Test Experiment	26	50	90	67.69	11.066
Post-Test Experiment	26	70	100	83.85	8.867
Pre-Test Control	26	55	80	70.58	6.376
Post-Test Control	26	70	90	79.23	5.602

Based on statistical test using Mann Whitney obtained α of 0.049. Because $\alpha < 0.05$ then H_0 is rejected, it can be seen that there is an increase in students' conceptual understanding after learning is carried out in the control and experimental classes. To see the significant difference in concept understanding between the control and experimental classes, it is necessary to analyze the average rating value between the two classes.

Table 6. Output Tes Statistics Uji Mann Whitney

Mann Whitney	233.000
Wilcoxon	584.000
Z	-1.964
Asymp. Sig. (2-tailed)	0.49

This research and development aims to create interactive learning media in the form of E-LKPD which can be a source of learning for students and as material to assist in the learning process so that students can understand the concepts in the material in the learning media and help students in the practical learning process. It is also hoped that the development of media and can also be a guide for teachers in the learning process, is also expected to be used as an additional reference for further research on the development of learning media in the form of E-LKPD. The steps for developing this learning media using the ADDIE model development design consist of 5 stages, namely Analysis, Design, Development, Implementation and Evaluation.

The first stage begins with analyzing the conditions of students, curriculum, concepts, and concept maps. An analysis of the condition of the students was obtained from the results of direct interviews with the subject teacher, namely Mrs. Sunarsih Hente, M.Pd. while the curriculum analysis was obtained from the administrative staff of SMA Negeri 4 Palu. The concept analysis and concept maps were obtained from literature studies from various books and articles. The second stage is designing. The planning stage begins with storyboard design, material preparation, assessment instrument preparation and supporting material collection. The third stage is the development stage where at this stage the researcher makes learning media in accordance with the plans that have been made before. In the development process, researchers use Microsoft Power Point, Flipbook and Builder to APK. The application contains short material, learning videos, quizzes and a glossary. After the application is complete, then carry out media and material validation as well as distributing questionnaires to see the feasibility of the instrument to students. The aspects assessed in the developed E-LKPD are didactic, construction, technical, media and materials. The result of obtaining an average validation score by an expert validator on the eligibility of the E-LKPD, namely 4.6, is included in the "very good" category. While the feasibility assessment by students with the aspects of material presentation, language, utilization and graphics obtained an average score of 3.6 including the "very good" category. The fourth stage is the implementation stage. At this stage the application that has been corrected according to the advice of the expert validator is then applied to classroom learning. The developed media is aimed at increasing students' understanding of concepts. The results of the comparison of increasing students' understanding of concepts are seen based on the differences in the average post-test scores in each class. In the control class the average score was 70.58, while in the experimental class the average score was 83.85. The fifth stage is the

evaluation stage. At this stage the management of the results of the assessment and drawing conclusions is carried out. Based on the results of questionnaires obtained from expert validators and students, it was found that the Kvisoft Flipbook Maker based E-LKPD on global warming material is feasible to use in increasing students' conceptual understanding.

The interactive learning media in the form of E-LKPD which was developed has 13 sheets arranged using several software including Microsoft Office Word 2013, Microsoft Office PowerPoint 2013, KVisoft Flip Book Maker, and Builder To Apk. This learning media is arranged on the front cover, how to use the E-LKPD, learning outcomes, learning objectives, concept maps, introduction, material descriptions, simple practicum, practice questions, glossary, and bibliography. This learning media in the form of E-LKPD is designed in an electronic form that can be accessed via a smartphone. The material compiled in this learning media is entitled Global Warming for X-grade SMA.

Learning media in the form of E-LKPD is arranged in electronic form which aims to create interactive, effective, and efficient learning media. Where in this fairly rapid technological development, most students use smartphones more in learning. Whether it's at home or at school Smartphones are things that are quite mandatory for students today. Because of this, printed books are rarely used in student learning because they are considered boring, and ineffective to carry anywhere. This is in accordance with the results of research conducted by Fahmi et al. (2019), students are more interested in using learning media in electronic form which was developed through the kvisoft flipbook maker application (Fahmi et al., 2019). So the learning media in the form of E-LKPD is considered easier and more effective to be used by students and teachers in the teaching and learning process (Indrawan & Yudiana, 2022). Setianingrum et al. (2022) in their research also stated that the advantages of Electronic LKPD teaching materials are the Electronic LKPD design, there are animated videos of short stories, legend stories, pictures and videos about style and motion as well as a combination of background colors that do not make children bored, the language used simple and easy to understand, its application in the use of Electronic LKPD can be used individually or in groups (Setianingrum et al., 2022).

The analysis of data from the results of research on the development of E-LKPD is based on the results of product validation questionnaires, product trials and test questions to determine the level of understanding of students' concepts. At the product validation stage, the E-LKPD which has been compiled and improved upon the advice of the supervisor, is then validated by an expert validator to assess the quality and feasibility of

the E-LKPD, and revised if there are criticisms and suggestions from the validator. Then the results of the assessment from the experts are used as a reference for improving and perfecting the product through revision. Meanwhile, product trials were given to students at SMA Negeri 4 Palu. The trial on students aims to determine the responses of students to the learning media, and to determine the level of understanding of students' concepts after being given the learning media in the form of the E-LKPD that has been developed. This is in accordance with the research conducted by Safitri et al. (2023), students gave a positive response to the learning media, namely E-LKPD (Yola & Kurniawati, 2023). This is also in line with Nirmala et al. (2021), E-LKPD has good quality to be used in learning and is effective in increasing students' knowledge (Nirmala et al., 2021).

Based on the assessment of material experts, there are several aspects that are assessed from this E-LKPD learning media, namely didactic aspects, technical aspects, and media and material aspects. The average score of the media feasibility results is 4.6 and is categorized as "very good". From the results obtained, the expert validators have determined that the E-LKPD is suitable for use in research.

After completing the assessment by the expert validator, then product trials are carried out on students. The purpose of the product trial conducted by testing on 26 students of class X is to determine the students' responses to the developed E-LKPD. The test was carried out by students by filling out a student response questionnaire which had 22 statement items. The average score obtained in the test on students is 3.6 which is included in the "Very Good" category. This means that the developed E-LKPD media is in good qualification and is suitable for use as a learning resource for students.

Furthermore, the concept understanding test was given to students before and after treatment. In the pretest, in the control class the average value obtained was 70.58 and the average value in the experimental class was 67.69. This shows that students' understanding of the concept of electricity is very minimal but can still be understood. While the average value of the post test, the control class obtained a value of 79.23 and the average value of the experimental class was 83.85. This is supported by a non-parametric hypothesis test where the output of Test Statistics is known to be Asym.Sig (2-talled) with a value of 0.049. Because the value is 0.049 < 0.05, it can be concluded that the hypothesis is accepted. This means that there is a difference between understanding the concept of global warming for the pretest and posttest in both classes. Furthermore, there is a difference in the average level of concept understanding in the two classes. In the control class the

average rating value is 22.46 while in the experimental class the average rating value is 30.54.

Conclusion

Based on the results of the research, it can be concluded that the kfisoft flipbook maker-based E-LKPD is feasible to use in terms of the validation results. This can be seen from the validation results which show that the devices and instruments are in the very feasible category for use. There is a significant difference in the results of the pretest and post-test students' conceptual understanding between the control class and the experimental class after being given treatment. The treatment that uses E-LKPD based on kfisoft flipbook maker on global warming material is superior to the treatment that only uses conventional learning modules.

References

Alatas, F., & Fauziah, L. (2020). Model problem based learning untuk meningkatkan kemampuan literasi sains pada konsep pemanasan global. *JIPVA (Jurnal Pendidikan IPA Veteran)*, *4*(2), 102. https://doi.org/10.31331/jipva.v4i2.862

Binder, P.-M., Foreman-Bunting, K. D., Whitney, Z. A., Leach, A. M., Dukes, E. S., & Galloway, J. N. (2020). Greenhouse Gas Footprints for Physicists. *The Physics Teacher*, *58*(4), 238–240.

https://doi.org/10.1119/1.5145466

Blais, B. S. (2020). Model Comparison in the Introductory Physics Laboratory. *The Physics Teacher*, *58*(3), 209–213. https://doi.org/10.1119/1.5145420

Content, R. (2023). *How Can We Design Instruction to Support Student Reasoning About Physicists' Ethical Responsibilities in Society? December 1992.* https://doi.org/10.1119/5.0087490

Fadillah, A., Nopitasari, D., & Bilda, W. (2021). Development E-Book Learning Media Based on Kvisoft Flipbook Maker. *Kreano, Jurnal Matematika Kreatif-Inovatif,* *12*(2), 312-322. https://doi.org/10.15294/kreano.v12i2.31684

Fahmi, S., Priwantoro, S. W., Cahdriyana, R. A., Hendroanto, A., Rohmah, S. N., & Nisa, L. C. (2019). Interactive Learning Media Using Kvisoft Flipbook Maker for Mathematics Learning. *Journal of Physics: Conference Series*, *1188*(1). https://doi.org/10.1088/1742-6596/1188/1/012075

Graul, B., Rollins, M. L., Powers, N., & Corte, D. Della. (2022). Student-Created Video Content for Assessment and Experiential Learning. *The Physics Teacher*, *60*(6), 491–495. https://doi.org/10.1119/5.0029343

Havryliuk, N., Osaulchyk, O., Dovhan, L., & Bondar, N. (2020). Implementation of E-Learning As an Integral Part of the Educational Process. *Society. Integration. Education. Proceedings of the International Scientific Conference*, *4*, 449. https://doi.org/10.17770/sie2020vol4.5019

Holt, M., Gillen, D., Nandlall, S. D., Setter, K., Thorman, P., Kane, S. A., Miller, C. H., Cook, C., & Supalo, C. (2019). Making Physics Courses Accessible for Blind Students: Strategies for Course Administration, Class Meetings, and Course Materials. *The Physics Teacher*, *57*(2), 94–98. https://doi.org/10.1119/1.5088469

Indrawan, I. K. O., & Yudiana, K. (2022). Types of Force and Their Utilization: Guided Inquiry-Based Interactive E-LKPD for Fourth Grade Elementary School Students. *Mimbar PGSD Undiksha*, *10*(2), 376–385. https://doi.org/10.23887/jjpgsd.v10i2.47364

Meyer, J. C., Passante, G., Pollock, S. J., & Wilcox, B. R. (2023). *How media hype affects our physics teaching: A case study on quantum computing. 339*(October 1992). https://doi.org/10.1119/5.0117671

Mustari, M., Hoya, A. L., Akmansyah, M., Diani, R., & Asyhari, A. (2019). Development of E-Learning Based Blogs on Global Warming Subject. *Journal of Physics: Conference Series*, *1155*(1). https://doi.org/10.1088/1742-6596/1155/1/012036

Naufal, H., Irkhamni, I., & Yuliyani, M. (2020). Penelitian

Penerapan Program Sistem Kredit Semester Menunjang Terealisasinya Merdeka Belajar di SMA Negeri 1 Pekalongan. *Jurnal Konferensi Ilmiah Pendidikan*, *1*(1), 141–148. Retrieved from https://proceeding.unikal.ac.id/index.php/kip/article/view/493

Nirmala, L. R., Yulianti, D., Maulina, D., & Sabdaningtyas, L. (2021). PQ4R-based E-LKPD to improve the fourth grade students' higher order thinking skills. *International Journal of Educational Studies in Social Sciences (IJESSS)*, *1*(3), 114–117. https://doi.org/10.53402/ijesss.v1i3.26

Perdana, M. A., Wibowo, D. E., & Budiarto, M. K. (2021). Digitalization of Learning Media through Digital Book Development Using the Flipbook Application. *Jurnal Pendidikan Dan Pengajaran*, *54*(2), 263. https://doi.org/10.23887/jpp.v54i2.34639

Rahayu, S., Ladamay, I., Wiyono, B. B., Susanti, R. H., & Purwito, N. R. (2021). Electronics Student Worksheet Based on Higher Order Thinking Skills for Grade IV Elementary School. *International Journal of Elementary Education*, *5*(2), 453. https://doi.org/10.23887/ijee.v5i3.36518

Rahmatika, R., Yusuf, M., & Agung, L. (2021). The Effectiveness of Youtube as an Online Learning Media. *Journal of Education Technology*, *5*(1), 152. https://doi.org/10.23887/jet.v5i1.33628

Roemintoyo, R., & Budiarto, M. K. (2021). Flipbook as Innovation of Digital Learning Media: Preparing Education for Facing and Facilitating 21st Century Learning. *Journal of Education Technology*, *5*(1), 8. https://doi.org/10.23887/jet.v5i1.32362

Safitri, R., Haryanto, H., & Harizon, H. (2021). Development of PBL-STEM-based E-LKPD to improve students' science literacy skills on reaction rate materials. *Jurnal Pendidikan Kimia*, *13*(2), 113–129. https://doi.org/10.24114/jpkim.v13i2.26980

Sagala, R., Umam, R., Thahir, A., Saregar, A., & Wardani, I. (2019). The effectiveness of stem-based on gender differences: The impact of physics concept understanding. *European Journal of Educational Research*, *8*(3), 753–761. https://doi.org/10.12973/eu-jer.8.3.753

Setianingrum, D. A., Ula, E. M., Pratiwi, S., & Jumadi. (2022). Development of LKPD With A Contextual Approach to Material Opportunities In SMP. *Holistic Science*, *2*(3), 117–126. https://doi.org/10.56495/hs.v2i3.51

Setianita, O. T., Liliawati, W., & Muslim. (2019). Identifikasi miskonsepsi siswa SMA pada materi pemanasan global menggunakan four – tier diagnostic test dengan analisis confidence discrimination quotient (CDQ). *Prosiding Seminar Nasional Fisika 5.0, 1*(5), 186–192. Retrieved from http://proceedings.upi.edu/index.php/sinafi/art

icle/view/585

Susilowati, S., Sajidan, S., & Ramli, M. (2018). Keefektifan perangkat pembelajaran berbasis inquiry lesson untuk meningkatkan keterampilan berpikir kritis siswa. *Jurnal Penelitian Dan Evaluasi Pendidikan*, *22*(1), 49–60. https://doi.org/10.21831/pep.v22i1.17836

Thoms, L.-J., Colicchia, G., Watzka, B., & Girwidz, R. (2019). Electrocardiography with a Smartphone. *The Physics Teacher*, *57*(9), 586–589. https://doi.org/10.1119/1.5135782

Tsarapkina, J. M., Anisimova, A. V., Gadzhimetova, B. D., Kireycheva, A. M., & Mironov, A. G. (2021). The impact of digital education transformation on technical college teachers. *Journal of Physics: Conference Series*, *2001*(1). https://doi.org/10.1088/1742-6596/2001/1/012030

Vidal, X. C., Manzano, R. C., & Lema, I. V. (2022). An Experimental Analogy for Teaching the Law of Radioactive Decays in Secondary School Classrooms. *The Physics Teacher*, *60*(8), 690–693. https://doi.org/10.1119/5.0055748

Yola, S. F., & Kurniawati, D. (2023). Development of Guided Discovery Learning Voltaic Cell E-LKPD for Class XII SMA/MA Students. *Journal of Educational Sciences,* *7*(1), 110-121. http://dx.doi.org/10.31258/jes.7.1.p.110-121

Zeng, L., & Zeng, G. (2021). Enhancing Student Learning of Global Warming Through Reflective Writing. *The Physics Teacher*, *59*(9), 706–708. https://doi.org/10.1119/10.0007397