Development of El- Student worksheet Integrated with Hidden Object Games Based on Predict-Observe-Explain Model to Improve Critical Thinking Skills and Visual Representation of High School Learners

Ana Helisa Rosianti[1*], Insih Wilujeng[1]

[1] Department of Physics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta, Yogyakarta Indonesia.

Abstract: This research aims to determine the effectiveness of El- Student worksheet integrated hidden object games based on the POE model to improve the critical thinking skills and visual representation of high school students. This type of research is research and development (R&D). The development model is 4D (Define, Design, Development, and Disseminate). The trial subjects consisted of 94 students divided into three groups, the experimental, control 1 and control 2 class. Data collection consists of product validation sheets and critical thinking skills and visual representation tests. Student worksheet development software using Live worksheet. Data analysis used SBI for product feasibility and Multivariate Analysis of Variance test. The results showed that El- Student worksheet integrated hidden object game based on the POE model is feasible for physics learning. The average posttest score to improve the critical thinking skills and visual representation of the experimental class was 80.78 and 87.34, while the control class 1 was 79.26 and 79.84, and control class 2 was 79.54 and 76.83. The Multivariate Analysis of Variance test results shows a significant value of 0.000 which is smaller than 0.05 and almost 100% effective contribution. Thus, the product is declared effective for improving students' critical thinking skills visual representation.

Keywords: Critical Thinking Skills; El- Student worksheet; Hidden Object Games; POE Model; visual representation

Introduction

Learning is an interaction between educators, students, and learning resources in a learning environment and students are required to be more active in learning to make students the center of learning activities. Many students in the learning process still memorize concepts, take notes, listen, are passive, and rarely use prior knowledge as the basis for learning, this condition causes low student learning outcomes. Understanding concepts is very important with the aim that students can remember the concept of the material they learned before, so that the learning process will become more meaningful (Ramadani & Nana, 2020).

The development of IT-based learning technology is developing rapidly, so it can be one of the solutions to overcoming the lack of interaction that occurs in the learning environment. The development of interactive multimedia in education applications such as e-learning has contributed greatly to changes in the learning process where the available features can increase the interactivity of students (Made Dwika Saniriati & Pratama Murtikusuma, 2021), Using the design of the student worksheets can also motivate and activate

students' participation in the learning process (Kahar et al., 2021) dan and many other interactive multimedia that can help students' understanding of the material through learning videos (Fauziyah & Sucahyo, 2021).

The use of technology in schools, especially in physics learning, is still not optimal because of the poor understanding of educators in using technology in the learning process (Sahelatua, 2018). This problem occurs in the process of combining learning strategies and models with technology and collaborating between subject matter and technology (Sastradika & Jumadi, 2018). To enable students to be actively involved in the learning process, especially in physics subjects, it is necessary to have the correct media and teaching materials that meet the needs of students. (Winingsih et al., 2020). One of the efforts that need to be made in learning is by channeling learning media with technology that is attractive and easily accessible to students.

Student worksheets are one of the teaching materials that can be developed more innovatively and packaged in print and online. Learner worksheets can be an IT-based learning media known as Electronic Student worksheet. El- Student worksheet can be an interactive tool because it features video, audio, images, links, and more varied shapes of questions as well as a series of stages of learning activities such as investigation and problem solving that are useful for understanding the concept of the material. (Syafitri & Tressyalina, 2020).

Physics learning is frequently focused on memorizing formulas without understanding the physical concepts, which will create students' misunderstanding of the physical problems of a topic (Tuah et al., 2019). Learning should not only be about memorizing formulas but also training students' skills to solve problems to support 21st century competencies. Students instill a strong critical thinking to solve problems (Kustijono & Amalia, 2019). Using Student worksheets in the classroom can support students' critical thinking work by teaching them how to frame problems, present arguments, assess, select, and apply solutions to specific challenges.

Learning by using Student worksheet trains students to formulate problems, provide arguments, evaluate and decide and implement a particular problems, and can foster critical thinking skills. The ability for critical thinking is the cognitive ability to identify, analyze and evaluate arguments, overcome subjective conjectures, formulate logical reasons, and make the right decisions (Islamiyah et al., 2019). In addition, Krawec, (2014) explains the form of representation can explain information in the problem-solving process. The representational form of diagrams is suitable for presenting and explaining conceptual models and charts make it easy to show mathematical

relationships between different variables, while visual representations can be static (pictures, charts, tables, or diagrams) and dynamic (animation and quantum phenomena) (Ubaidillah, 2019).

A successful educator in managing the classroom is to change the state of students from passive to active (Shurygin & Krasnova, 2016). Current learning still makes educators the centre of learning with traditional models (Saputra & Novitasari, 2014). The teacher centre approach cannot improve students' learning ability in physics (Gok, 2018), and lack of critical thinking skills (Surayya et al., 2014). Kiliç, H. E. & Sen, (2014) indicated that appropriate learning models can be selected to educate subjects in educational programs and educational environments created to develop the potential thinking ability of learners. The solution offered by applying an innovative learning model, the Predict-Observe-Explain (POE) with the aim that the learning process is more meaningful and can overcome problems in everyday life (Islamiyah et al., 2019). This learning model involves students actively making predictions before conducting experiments, then observing throughout the experiment, and explaining the experimental results after the investigation (Maulida et al., 2018).

The development of IT-based learning technology in education is strongly influenced and coloured by the development of science and technology (Iriana Fristiana., 2016). The solution to this problem is that teaching materials in the form of El- Student worksheet can be developed contextually and interactively using a website created by Google, namely Live worksheets Sholehah, F., Sunarto, S., & Gazali, (2021) described that live worksheets can contain learning material content that is audio-visual, and allows students to access El- Student worksheet anywhere, either on a desktop, laptop, or mobile phone connected to the internet.

Based on this description, a develop the El- Student worksheet integrated hidden object games based on the Predict Observe Explain model to improve critical thinking skills and visual representation of high school students

Method

This research is a type of research and development (R&D). This research aims to produce a specific product and test a product's effectiveness. The result is El- Student worksheet integrated with hidden object games based on the POE model for optical instruments. This research was developed by following the 4D development model with the steps of define, design, develop and disseminate.

The research was conducted at SMA Negeri 5 Yogyakarta. The test subjects used three XI MIPA classes, which are 32 students in the experimental class, 32 students in control class 1, and 30 students in control class 2. The data collection instruments used questionnaires and tests of critical thinking skills and visual representation. Data collection techniques in the form of feasibility validation questionnaires given to two validators and giving critical thinking skills and visual representation tests to students (pretest and posttest) to see the improvement of critical thinking skills and visual representation of students. The data analysis technique used SBi to determine the results of the assessment of experts and MANOVA test to analyze the results of critical thinking skills and visual representation tests (pretest and posttest).

Table 1. Score and Categories of Ideal Assessment

Score Range	Category
$\bar{X} > (Xi + 1{,}8 \text{ Sbi})$	Very good
$(Xi + 0{,}6 \text{ Sbi}) < \bar{X} \leq (Xi + 1{,}8 \text{ Sbi})$	Good
$(Xi - 0{,}6 \text{ Sbi}) < \bar{X} \leq (Xi + 0{,}6 \text{ Sbi})$	Enough
$(Xi - 1{,}8 \text{ Sbi}) < \bar{X} \leq (Xi - 0{,}6 \text{ Sbi})$	Not Enough
$\bar{X} \leq (Xi - 1{,}8 \text{ Sbi})$	Very Less

Result and Discussion

The result of the research development product is a Electronic Student worksheet conducted through the Live worksheet web and can only be accessed through smartphones and laptops. The development model used in this research is 4D. The design of El- Student worksheet integrated hidden object games based on the POE model can be designed using MS. Power Point. The draft of El- Student worksheet in the form of MS. Power Point, then converted into PDF form and included in the web liver worksheet as the final form of El- Student worksheet products.

Develop product

The development process El- Student worksheet with MS. Power point produces six parts of El- Student worksheet consisting of the first part (cover, preface, table of contents, instructions for use, competencies, and material map), the second part is El- Student worksheet meeting 1 (eyes and glasses), the third part is evaluation 1 (eyes and eyeglasses), the fourth part is El- Student worksheet meeting 2 (lup), the fifth part is evaluation 2 (lup) and the sixth part is a bibliography and profile (student and supervisor). Then, the six parts of the Student worksheet were converted to pdf format to be combined in the live worksheet web.
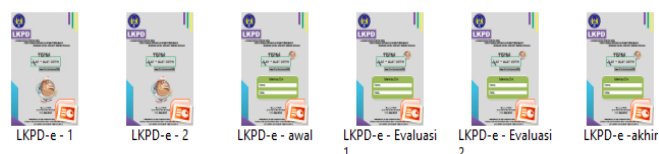

Figure 1. Cover El- Student worksheet

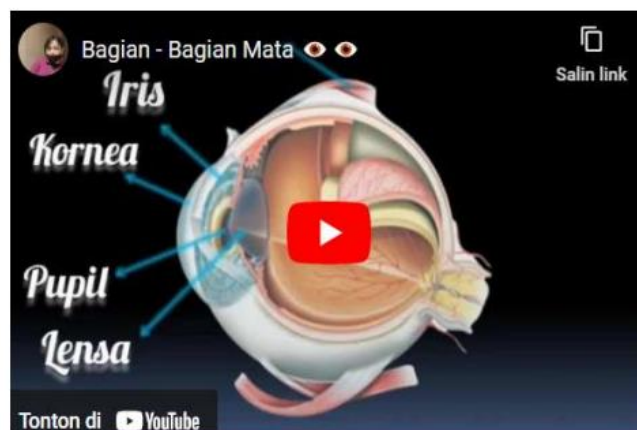**Figure 2.** Design the El- Student worksheet on Ms PowerPoint

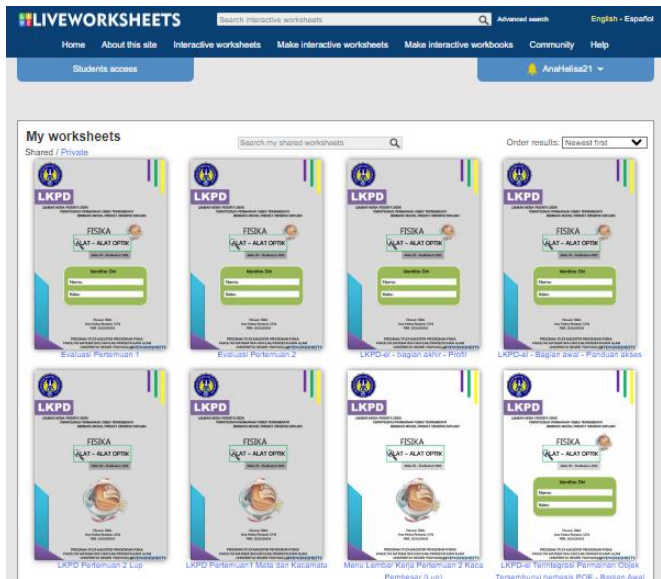**Figure 3.** Video short of material

Figure 4. Product on web live worksheet

Eligibility Product

El- Student worksheet integrated hidden object games based on the POE model was validated by media experts and material experts. Media experts and material experts reviewed in aspects of content, presentation, design and language. The results of validation of media experts are summarized in Table 2 and validation of material experts are summarized in Table 3.

Table 2. Results Validation El- Student worksheet by Media Experts

Aspect	$(\bar{X})$	$\overline{X\iota}$	SBi	Category
Content	7	4.5	1.5	Good
Presentation	23.5	12.5	4.16	Very Good
Design	28	14.5	4.83	Very Good
Language	11	6.5	2.16	Very Good

Based on the analyze of media aspects with sub-aspects including aspect content, presentation, design and language. The results of the content aspect analyze the score interval at $5.4 < \bar{X} < 7.2$ with the "Good" category. While the aspect presentation, design and language obtained the score 23.5 > 19.9; 28 > 23.2; and 11 > 10.3 with "Very Good" category. Based on the overall results of the media aspect analysis, El- Student worksheet can be implemented in learning.

The results of the Eligibility assessment of El- Student worksheet are supported by Choiroh et al., (2018), claiming that El- Student worksheet supported by live worksheet, 79% of students' feedback statements have a good or positive category. Learners are more involved and excited when learning, which results in a good student response to the live worksheet. In line with this, Kahar et al., (2021) found that student learning outcomes were in the good category, confirming that the student worksheet design can effectively foster higher order thinking skills. On the other hand, the design can also stimulate students and their interest in the material. One of the most successful strategies for student learning effectiveness is to instill a sense of like, pleasure, interest, and comfort (Alarifin, 2014).

Table 3. Results Validation El- Student worksheet by Material Experts

Aspect	$(\bar{X})$	$\overline{X\iota}$	SBi	Category
Content	30.5	16.5	5.5	Very Good
Presentation	24	12.5	4.16	Very Good
Design	16	8.5	2.8	Very Good
Language	11	6.5	2.16	Very Good

Based on the analyze of material aspects with sub-aspects content with score 30.5 > 26.4 n "Very Good" category, aspect presentation with score 24 > 19.9 in "Very Good" category, then aspect design with score 16 > 13.5 in "Very Good" category and aspect language with score 11 > 10.3 in "Good" category. Based on the results of the analyze every sub-aspect material, it can be concluded that the aspect material is "Very Good" category and feasible to use in research.

Product Practicability

The practicality assessment of El- Student worksheet integrated hidden object games based on the POE model was carried out by physics teachers with the assessment results described in Table 4.

Tabel 4. Results Practicality assessment

Aspect	$(\bar{X})$	$\overline{X\iota}$	SBi	Category
Content	32	16.5	5.5	Very Good
Presentation	12	6.5	2.16	Very Good
Design	28	14.5	4.83	Very Good
Language	12	6.5	2.16	Very Good

Based on the practicality assessment results the score of 32 > 26.4 with the category is "Very Good", the presentation aspect with the score of 12 > 10.83 with the category is "Very Good", then the design aspect of 28> 23.2 with the category is "Very Good" and the language aspect with the score of 12 > 10.83 with the category is " Very Good". Based on the analyze of each aspect, it can be concluded that El- student worksheet is practical to use and has a Very Good category.

The eligibility and practicality assessments of the El- student worksheet developed as a whole have a very good/eligible category and are practically used in physics learning, this is in line with research from Pabri et al., (2022) which states that El- student worksheet assisted by liveworksheet are in a very eligible and good category to practice critical thinking skills. Azizah & Kuswanti, (2022) also stated that El- student worksheet

is categorized as valid and practical and students give positive responses in using El- student worksheet. In addition, Wulandari & Nofina, (2022) state that electronic worksheets using POE based liveworksheets can be used with a very eligible category. Wati et al., (2021) explained that multimedia-based El- Student worksheet by considering the flexible use of involving student worksheets directly in secondary schools is significant, effective, and can affect learning outcomes in the cognitive field.

Critical thinking skills and visual representation

The results of average pretest and posttest of critical thinking ability and visual representation on the three classes are shown in Table 4. The data shows that the experimental class has the highest average posttest compared to control 1 and control 2 classes. This shows an improvement in critical thinking skills and visual representation in the experimental class compared to the control class.

Table 5. Results Average Pretest and Posttest

Class	Critical Thinking Skills		Visual Representation	
	Pretest	*Posttest*	*Pretest*	*Posttest*
Experiment	63.74	80.78	61.56	87.34
Control 1	59.11	79.26	64.38	79.84
Control 2	54.37	79.54	60.67	76.83

Based on the Manova test, the significant value used is Wilks' Lambda. The significant Wilks' Lambda result of the analyze is 0.000. This value is less of 0.05. Based on the Manova test, it was concluded that there was a significant difference in critical thinking skills and visual representation using El- Student worksheet integrated hidden object game based on POE model.

The following test to identify details of the effect of independent variables to each dependent variable was conducted with the Post Hoc test. Before conducted the Post Hoc test, first looked at the output value of Levene's Test of Equality of error Variances for critical thinking skills and visual representation summarised in Table 6.

Table 6. Levene's Test of Equality of error Variances

Variable Dependent	Sig.
Critical Thinking Skills	0.743
Visual Representation	0.257

The variables have equal variance if the sig value. > 0.05. The results of the Levene test will affect the Post Hoc test that will be used. If sig. > 0.05 then the Post Hoc test uses the Benferroni test, while if sig. < 0.05 then use Games-Howell. The Levene test results show that all dependent variables have the same variance because the significant value is greater than 0.05. Thus, the Post Hoc

test used is the Benferroni test. The Post Hoc test results for critical thinking skills and visual representation are shown in Table 7.

Table 7. Results Post Hoc Test

Variable Dependent	Variable independent		Sig.
Critical Thinking Skills	Experiment	Control 1	0.832
		Control 2	0.027
	Control 1	Control 2	0.347
Visual Representation	Experiment	Control 1	0.002
		Control 2	0.000
	Control 1	Control 2	0.418

The Post Hoc test shows some differences in each independent variable which can be explained that the critical thinking ability variable between experimental and control class 1 students shows no difference because the significant value is greater than 0.05. The absence of differences also occurred in control 1, and control 2 classes, while in experimental and control 2 classes showed a difference in sig. 0.027 is smaller than 0.05. In conclusion, the use of an El- Student worksheet integrated hidden object game based on the POE model influences in improving critical thinking skills. Consistent with the results of this research, Amaliyah & Nasrudin, (2019) confirmed that the POE teaching model can be used in training critical thinking skills showing the acquisition of a percentage of the gain score value of 68% in the high category. The application of the POE model in the experimental group obtained an average and N-gain of 86.02 and 79.38 (high category), while the control class that did not use POE obtained an average score of 79.38 and N-gain of 71.18 (high category) (Samya et al., 2021).

The results of Post Hoc test on visual representation show the experiment class has differences with control 1 and control 2 classes viewed from the significant value at 0.002 < 0.05 and 0.000 < 0.05. The significant value of 0.002 < 0.05 and 0.000 < 0.05, showed the experiment class had differences with the control class 1 and control class 2. The control 1 and control 2 classes show no difference because 0.418 is larger than 0.05. In conclusion, the use of El- Student worksheet integrated hidden object games based on the Poe model has the highest effect in improving students' visual representation. Lahope et al., (2020), found that students' visual representation ability has a percentage of 4.76%. This indicates that visual representation has a great influence in physics learning.

In addition, to find out how far the effectiveness of the treatment given between the Experiment, Control 1 and Control 2 classes, the percentage of effective contribution was calculated. Through manual calculations using the t value of 1,093 and df 62 in the experimental and control class 1, an effective

contribution of 99.997% was obtained. Then, the experiment and control 2 classes using the t value of 2.569 and df 60 showed an effective contribution of 99.999% and the control 1 and control 2 classes showed an effective contribution of 99.998% with the t value of 1.653 and df 60.

The findings of the effective contribution on visual representation variable showed the experiment and control class 1 with the value of t 3.657 and df 62 was 99.999%. Then, the experiment and control 2 classes with the t value of 5.303 and df 60 obtained an effective contribution of 99.999%. while, the control 1 and control 2 classes with the t value of 1.392 and df 60 obtained an effective contribution of 99.998%.

The application of El- Student worksheet assisted by live worksheet web is effective and easy to use, this is in line with the research of Choiroh et al., (2018) which states that students' interest and ease in understanding the material when learning physics using El- Student worksheet by live worksheet. Oktaviami, (2022), claimed that students responded positively to the POE-based Student worksheet which indicated an interest of 64.89% for its application. El- Student worksheet based on the POE model has also been able to improve critical thinking and visual representation skills following research conducted by Olivia & Muchlis, (2021), Zulaikha et al., (2021) dan Khowatin, (2017) which states that learning involving the POE model is effective in increasing learning activities, especially oral, visual, writing and monoric activities and actively both in the affective and psikomotor domains to improve critical thinking and visual representation skills.

The results of the research and development of El- Student worksheet integrated with hidden object games based on the POE model can be summarised that El- Student worksheet can be used as an alternative teaching material for high school physics to improve critical thinking skills and visual representation of high school students. The resulting El- Student worksheet has the main advantages, namely that it can used anytime and anywhere, and the results of student work can be done directly on El- Student worksheet without the need to work in print. The weakness of this El- Student worksheet is that it requires an internet connection in its operation.

Conclusion

Based on the results of research, it was concluded that the El- Student worksheet integrated hidden object games based on the POE model was feasible and practical and categorised "Very Good." The significant value of Wilks' Lambda based analyze is 0.000. The value is less of 0.05. It concluded that there was a significant difference in critical thinking skills and visual

representation using El- Student worksheet integrated hidden object games based on the POE model. The effective contribution of the product showed almost 100%.

Author Contributions
Ana Helisa Rosianti, concepting the research idea, methodology, designing the product, analysing the data, implementing the research. Insih Wilujeng, mentorship and review of article drafts, supervision of the research.

Conflicts of Interest
The authors have no conflict of interest with any person/institution/organisation or the like associated with this research. Research design, product development, data collection, data processing, data analyzes, manuscript preparation and ready for publication are based on the author's willingness and no pressure/coercion from other parties.

References

Alarifin, D. H. (2014). Penerapan Permainan Dalam Pembelajaran Pada Matakuliah Fisika Permainan Untuk Menghlangkan Kesan Kaku Calon Guru Fisika. *Jurnal Pendidikan Fisika*, 2(2). https://doi.org/10.24127/jpf.v2i2.120

Azizah, M. I., & Kuswanti, N. (2022). Pengembangan E-LKPD Berbasis Think Pair Share pada Materi Sistem Gerak untuk Melatihkan Keterampilan Berpikir Kritis Peserta Didik Kelas XI. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, 11(2), 405–417. https://doi.org/10.26740/bioedu.v11n2.p405-417

Choiroh, S. S., Budi Prastowo, S. H., & Nuraini, L. (2023). Identifikasi Respon Peserta Didik Terhadap E-LKPD Interaktif Fisika Berbantuan Live Worksheet Pokok Bahasan Pengukuran. *JURNAL PEMBELAJARAN FISIKA*, 11(4), 144. https://doi.org/10.19184/jpf.v11i4.34891

Fauziyah, N. I., & Sucahyo, I. (2021). Pengembangan Lembar Kerja Peserta Didik (LKPD) pada Materi Radiasi Benda Hitam dengan Berbantuan PhET simulations. *PENDIPA Journal of Science Education*, 5(3), 384–388. https://doi.org/10.33369/pendipa.5.3.384-388

Gok, T. (2018). The Evaluation of Conceptual Learning and Epistemological Beliefs on Physics Learning by Think-Pair-Share. *Journal of Education in Science, Environment and Health*, 4(1), 69–80. https://doi.org/10.21891/jeseh.387489

Iriana Fristiana. (2016). *Pengembangan Kurikulum Teori Konsep dan Aplikasi*. yogyakarta: Parama Ilmu.

Islamiyah, B. M. W., Al Idrus, S. W., & Anwar, Y. A. S. (2019). Pengaruh Model Pembelajaran Predict, Observe and Explain (POE) Terhadap Kemampuan Berpikir Kritis Siswa. *Chemistry Education Practice*, 2(2), 14. https://doi.org/10.29303/cep.v2i2.1294

Kahar, M. S., Syahputra, R., Arsyad, R. Bin, Nursetiawan, N., & Mujiarto, M. (2021). Design of Student Worksheets Oriented to Higher Order Thinking Skills (HOTS) in Physics Learning. *Eurasian Journal of Educational Research*, 2021(96), 14–29. https://doi.org/10.14689/ejer.2021.96.2

Khowatin, S. K. (2017). *Model Pembelajaran POE (Prediction, Observation, Explaination) Disertai LKS berbasis Representasi Matematik dan Grafik pada Pembelajaran Materi Getaran Harmonis di SMAN Jember* [Universitas Jember]. Retrieved from http://repository.unej.ac.id/handle/123456789/82392

Kiliç, H. E., & Sen, A. I. (2014). The effect of physics education based on out-ofschool learning activities and critical thinking on students' attitudes. *Journal Education and Science*, 39(176), 13–30. https://doi.org/https://dx.doi.org/10.15390/EB.2014.3635

Krawec, J. L. (2014). Promblem representation and Mathematical Problem solving of student of Varying Math ability. *Journal of Learning Disabilities*, 47(2), 103. https://doi.org/ttps://doi.org/10.1177/002221941243697

Kustijono, R., & Amalia, R. (2019). Pengembangan e-Book Fisika menggunakan sigil untuk melatihkan keterampilan berpikir kritis siswa SMA. *Inovasi Pendidikan Fisika*, 8(1). https://doi.org/10.26740/ipf.v8n1.p%25p

Lahope, K. S., Tulandi, D. A., & Mongan, S. W. (2020). Studi kompetensi multirepresentasi Mahasiswa pada Topik Interferensi dan Difraksi. *Jurnal Pendidikan Fisika*, 1(3), 90–94. https://doi.org/10.53682/charmsains.v1i3.43

Made Dwika Saniriati, D., & Pratama Murtikusuma, R. (2021). Development of Adobe Animate Learning Media Assisted by Schoology on Arithmetic Sequences and Series. *Jrpipm*, 4(2), 132–145. journal.unesa.ac.id/index.php/jrpipm

Maulida, R. A. N., Kusumawati, I., & Wijaya, A. K. (2018). Pengembangan Buku Petunjuk Praktikum IPA Berbasis Model Pembelajaran POE (Predict Observe Explain) Pada Materi Usaha dan Energi. *JIPF (Jurnal Ilmu Pendidikan Fisika)*, 3(1), 14. https://doi.org/10.26737/jipf.v3i1.332

Oktaviami, H. N. (2022). *Pengembangan E-LKPD Berbasis POE (Predict-Observe-Explain untuk Meningkatkan Keterampilan Proses Sains*. UIN Walisongo.

Olivia, C., & Muchlis. (2021). Pengembangan Lkpd Berbasis Predict-Observe-Explain Daya Hantar Listrik Larutan. *Jurnal Pendidikan Kimia Undiksha*, 5(1), 27–36. Retrieved from https://ejournal.undiksha.ac.id/index.php/JJPK

Pabri, M., Medriati, R., & Risdianto, E. (2022). Uji Kelayakan E-LKPD Berbasis Kontekstual Berbantuan Liveworksheet untuk Melatih Kemampuan Berpikir Kritis di SMA. *Jurnal Ilmiah Pendidikan Fisika*, 6(3), 637. https://doi.org/10.20527/jipf.v6i3.6812

Ramadani, E. M., & Nana. (2020). Penerapan Problem Based Learning Berbantuan Virtual Lab Phet pada Pembelajaran Fisika Guna Meningkatkan Pemahaman Konsep Siswa SMA : Literature Review. *Jurnal Pendidikan Fisika Tadulako Online*, 8(1), 87–92. Retrieved from http://jurnal.untad.ac.id/jurnal/index.php/EPFT/article/view/15961

Sahelatua, L. V. dan M. (2018). Kendala guru memanfaatkan media It dalam pembelajaran di Sdn 1 Pagar Air Aceh Besar. *Ilmiah Pendidikan Guru Sekolah Dasar*, 3(2), 131–140. Retrieved from https://jim.usk.ac.id/pgsd/article/view/8579

Saputra, H. J., & Novitasari, A. D. (2014). Keefektifan Pembelajaran Outdoor Learning Berbasis Nilai Karakter Terhadap Hasil Belajar Tematik Terintegrasi Siswa Kelas VI SD Negeri 1 Meteseh Rembang. *Malih Peddas (Majalah Ilmiah Pendidikan Dasar)*, 4(2), 26–34. https://doi.org/https://doi.org/10.26877/malih peddas.v4i2.536

Sastradika, D., & Jumadi. (2018). Development of subject-specific pedagogy based on guidedinquiry about newton's law to improve senior high school students' scientific literacyability Development of subject-specific pedagogy based on guided inquiry about newton's law to improve sen. *InJournal of Physics: Conference Series*, 1742–6596. https://doi.org/https://doi.org/10.1088/1742-6596/1097/1/012017

Sholehah, F., Sunarto, S., & Gazali, M. (2021). *Pengembangan E-Lkpd Berbasis Kontekstual Menggunakan Liveworksheets Pada Materi Aritmetika Sosial Kelas Vii Smp Ahmad Dahlan Kota Jambi*. UIN Sulthan Thaha Saifuddin Jambi.

Shurygin, V. Y., & Krasnova, L. A. (2016). Electronic learning courses as a means to activate students' independent work in studying physics. *International Journal of Environmental and Science Education*, 11(8), 1743–1751. https://doi.org/10.12973/ijese.2016.551a

Surayya, L., Subagia, I. W., & Tika, I. N. (2014). Pengaruh

Model Pembelajaran Think Pair Share Terhadap Hasil Belajar Matematika Siswa. *JJurnal Pendidikan Dan Pembelajaran IPA Indonesia*, *4*(1), 1–11. https://doi.org/10.36294/jmp.v2i1.123

Syafitri, R. A., & Tressyalina. (2020). *The Importance of the Student Worksheets of Electronic (E-LKPD) Contextual Teaching and Learning (CTL) in Learning to Write Description Text during Pandemic COVID-19*. *485*, 284–287. https://doi.org/10.2991/assehr.k.201109.048

Tuah, T., Herman, N. D., & Maknun, J. (2019). E-Books in Teaching and Learning Process. *Proceedings of the 5th UPI International Conference on Technical and Vocational Education and Training (ICTVET 2018)*, *299* (Ictvet 2018), 281–287. https://doi.org/10.2991/ictvet-18.2019.64

Ubaidillah, M. (2019). Analisis Kesalahan Mahasiswa dalam Menyelesaikan Soal Representasi Visual pada Materi Optika Geometri. *PSEJ (Pancasakti Science Education Journal)*, *4*(1), 55. https://doi.org/10.24905/psej.v4i1.1226

Wati, D. A., Hakim, L., & Lia, L. (2021). Development of Newton Law Interactive E-LKPD Based On Mobile Learning Using Live Worksheet In High School. *Jurnal Pendidikan Fisika*, *10*(2), 72–80. https://doi.org/10.24114/jpf.v10i2.13990

Winingsih, P. H., Hidayah, A. N., & Amalia, A. F. (2020). Development Of Physics E-LKPD (Electronic Worksheets) Using 3D Pageflip Based on Problem Based Learning on Balancing And Rotation Dynamics. *Jurnal Ilmiah Pendidikan Fisika-COMPTON*, *7*(2), 36–43. https://doi.org/https://doi.org/10.30738/cjipf.v7i2.9091

Wulandari, R. W., & Nofina, M. (2022). The Development of POE-based (Predict, Observe, and Explain) E-Student Worksheet for Eleventh-Grade Plant Histology Subject. *Biosfer: Jurnal Tadris Biologi*, *13*(1), 21–35. https://doi.org/10.24042/biosfer.v13i1.11270

Zulaikha, D. F., Pujianto, P., & Wiyatmo, Y. (2021). Learning Activities in Physics Using Students Worksheet Based on Predict-Observe-Explain (POE). *JIPF (Jurnal Ilmu Pendidikan Fisika)*, *6*(3), 208. https://doi.org/10.26737/jipf.v6i3.2103