Asian Journal of Science Education
Vol. 5. No. 2, October (2023) 83 - 92

e-ISSN 2715-5641
DOI: doi.org/10.24815/ajse.v5i2.32112

Asian Journal of Science Education

Journal homepage: https://jurnal.usk.ac.id/AJSE

Development of e-Handout Based on Problem-Based Learning to Improve Students Cognitive on Rotation Dynamics

Safriana[1], Vivi Gumanti[2], Fajrul Wahdi Ginting[3]
[1,2,3]Department of Physics Education, Malikussaleh University, North Aceh – Indonesia

ARTICLE HISTORY

Submited : May 25, 2023
Revised : November 11, 2023
Accepted : Desember 01, 2023
Publication : Desember 02, 2023
Avaible *Online* : Desember 02, 2023

KEYS WORDS .
E-handout, problem-based learning, cognitive learning outcomes

CORRESPONDENCE AUTHOR

*E-mail: safriana@unimal.ac.id

ABSTRACT.

Learning outcomes in the 21st century require students to have the ability to think critically, carry out analysis, and find solutions. This research aims to determine the increase in students' cognitive learning outcomes after using e-handout-based PBL and to determine students' responses to e-handouts. This research method is the Research and Development (R&D) uses the ADDIE model. This research is a nonequivalent control group design. The subjects in this research were expert validators, physics teachers, and 11th-grade students from State Senior High School 1 Syamtalira Aron. The research instruments use multiple choice test instruments, validation sheets, interview sheets, observation sheets and student questionnaires. Qualitative descriptive analysis technique is the data analysis technique used. The assessment results based on validation by e-handout-based PBL material experts obtained an average percentage for all aspects of 92.3% in the very good/decent category, e-handout-based PBL media experts obtained an average score of 90%. with the very appropriate category, and student responses obtained an average score of 89% in the "very good" category. The results of the experimental class analysis of the N-gain score were 71.02% in the "high" category. the control class obtained a score of 56.56% in the "medium" category. Based on data hypothesis testing using the Independent Sample t-test, the sig (2-tailed) value was 0.000. From the hypothesis it can be concluded that problem-based learning-based e-handouts are suitable for use and can improve students' cognitive learning outcomes.

INTRODUCTION

Currently, the mechanism of education in Indonesia and even in other countries is experiencing obstacles. The COVID-19 pandemic has caused major changes in almost all aspects of life, including the education system. In general, learning that is usually done conventionally turns into distance learning or is done online, the implementation of which cannot be separated from the use of information technology (Ceballos et al., 2020). Technology acts as a medium for educators' and students' interaction in implementing online learning. In addition, technology also plays a role in facilitating educators to prepare learning materials so that learning continues even though it is not done face-to-face. In the implementation of online learning, some obstacles become a challenge for

education actors related to academic culture, including values, attitudes, knowledge, skills, and the readiness of facilities and infrastructure related to technology (Hutagol, 2013).

Along with the development of the technological era, there are currently many platforms that can help the implementation of online learning, such as e-learning, Google Classroom, Edmodo, Moodle, study houses, and even more platforms in the form of video conferencing such as Google Meet, Zoom, and Visco Webex (Yunitasari & Hanifah, 2020). Using and utilizing technology as a medium for teaching materials in this new normal is highly recommended as a facility to help educators achieve learning goals. It is also stated (Rogantina, 2017) that Educational technology can improve the quality of school education and increase the effectiveness and efficiency of the teaching and learning process.

Although the face-to-face learning system has now begun to be re-applied in several areas including Aceh Province. The school must also continue to comply with and apply the health protocol rules by maintaining distance and limits on direct interaction between teachers and students. However, the implementation of shifting learning is also carried out by arranging student learning hours in turn and limiting the number of students in class. This causes the learning process, including the delivery of materials and teaching materials to be less effective. In addition, it was also found that students only used a limited number of printed books during the learning process in the classroom so students are less able to understand the learning material, especially in physics lessons that are considered difficult by students.

In this pandemic, students need teaching materials that contain concise, easy-to-understand and practical material that can be accessed via the internet. One of the teaching materials that are concise and easy to understand is handouts because handouts are printed teaching materials that contain summaries of material from various literatures (Angraini et al., 2022; Pahlawan, 2021). Handouts can also be compiled into interesting learning resources accompanied by pictures and illustrations that increase students' interest in learning, which can positively affect learning outcomes. This is also stated in the research of (Safitri et al., 2021) saying that learning using handouts shows an increase in students' creative thinking skills and very good student responses. Handouts can also increase learning independence and understanding of students' concepts (Haji et al., 2015). The handouts are then packaged through electronic media or the internet that can be accessed by students personally through software such as phones, androids, and PC. So that students can use e-handouts anytime and anywhere. Applying Problem-Based Learning E-Handout can improve mathematical representation abilities and self-efficacy (Aminah et al., 2020; Rianti et al., 2020). In addition to providing good teaching materials, appropriate learning approaches and methods can also assist teachers in implementing subject matter to achieve the desired learning objectives. An approach that sees learning as an active process of learners constructing meaning, either in the form of text, dialogue, physical experience, or other forms, is called a constructivist approach.

One of the constructivist approaches that effectively improves learning outcomes is a PBL-based approach (Gary, 2015; Luliyarti et al., 2020; Widiyanti, 2015). By using a problem-based approach, which is an approach that confronts students with practical problems as a stimulus for students in learning (Supriyati et al., 2019), it can increase students' learning activities and produce better achievements. It is also stated in that problem-based learning can make students think more critically and creatively (Kusuma et al., 2017; Nicholus et al., 2023).

Based on the discussion above, researchers are interested in making media e-handout based problems for teaching materials to serve as a source of creative and innovative teaching materials by utilizing technology as a medium of delivery during this pandemic. The learning resources developed are teaching materials in the form of electronic teaching materials whose contents are loaded in electronic form, namely in the form of audio, audio-visual, or interactive multimedia. In addition, electronic teaching materials have many advantages, especially in increasing learning motivation. Teaching materials contain animated images, videos, and audio, making it an interesting interactive learning media so that learning is not monotonous.

RESEARCH METHODS

Research Approach

The type of research carried out using research and development (R&D) methods with the development research model applied is the ADDIE model. The ADDIE model has five stages, namely Analysis-Design-Develop-Implement-Evaluate, where this development model is class-oriented. the R&D research method is a research method used to produce certain products and test the effectiveness of these products (Sugiyono, 2014). The product of this research is e-handout media-based problems-based learning on the material of rotational dynamics and rigid body balance.

Research Participants

The subjects in this research are expert validators, physics teacher practitioners and 11th grade students from State Senior High School 1 Syamtalira Aron. The sample selection technique in this study used a purposive sampling technique, namely determining the sample with certain considerations. The subjects this study were 25 students from 11th Mathematic and Science grade 1 students as the experimental class and 25 students from 11th Mathematic and Science grade 2 students as control class at State Senior High School 1 Syamtalira Aron. The researcher chose the class because the two classes were superior classes that had almost the same differences in learning outcomes.

Research Instruments

This study using test techniques in the form of multiple-choice test instruments as pretest and posttest and non-test designs in the form of validation sheets, interview sheets, observation sheets, and student questionnaires.

Data Collection

The data collection techniques in this study use test techniques in the form of multiple choice test instruments as pretest and posttest and non-test strategies in the form of validation sheets, interview sheets, observation sheets, and student questionnaires.

Data Analysis

The data analysis technique used is a qualitative descriptive analysis technique, which is used to process data from the validation review of media experts, material experts, and practical test experts in the form of suggestions and comments regarding the improvement of PBL-based e-handout media products on rotational dynamics and rigid body balance material as well as quantitative descriptive analysis techniques to process data on expert lecturer validation scores and pretest and posttest test instruments.

RESULTS AND DISCUSSION

Results

1. Analyze Stage (Analysis)

Based on the results of the needs questionnaire, it can be said that students at State Senior High School 1 Syamtalira Aron have difficulty understanding physics learning, including the material of rotational dynamics and rigid body balance. So, the researchers developed an e-handout media problems based learning in addition to improving students' cognitive learning outcomes. E-handouts are also expected to facilitate and increase students' learning motivation at home and in the classroom.

2. Design Stage (Planning)

The purpose of the design stage is to prepare the initial design of learning media or product design. This stage consists of three steps, namely:

a. Media Selection

The selection of media is adjusted to the purpose of delivering learning materials. In this study, physics learning about rotational dynamics and rigid body balance is in the form of teaching materials using PBL-based physics handout electronic media.

b. Format Selection

The selection of this format is done by reviewing the existing structures. E-handouts based problem-based learning are made in the form of electronic media with HTML file format using the professional 3D Pageflip application and FLIPHTML5

c. Initial Design

The initial draft of the e-handout was designed using the Canva application, which includes all page designs such as cover, content, and cover.

- Cover

Figure 1. E-Handout Cover Design
Source: Canva.com (2021)

- Content Material

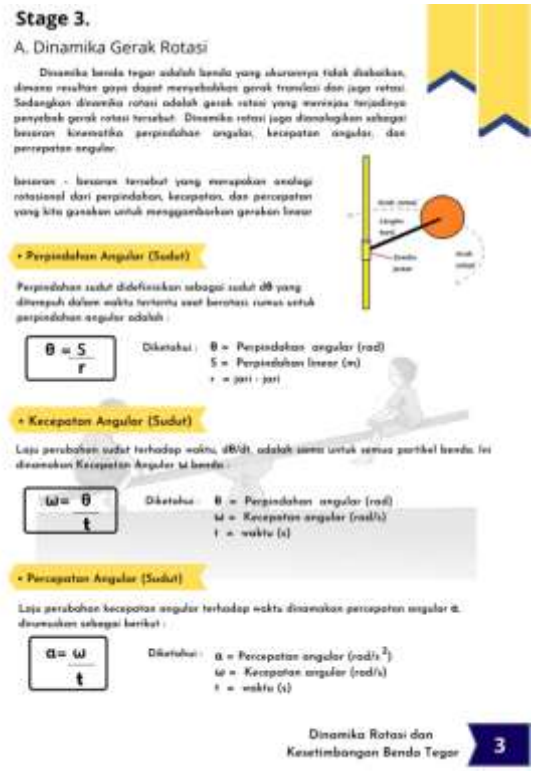

Figure 2. Content Material Design E-handout
Source: Canva.com (2021)

- Closing (Bibliography)

Figure 3. E-Handout Closing Design
Source: Canva.com (2021)

3. Development Stage (Development)

The following is the data from the material and media experts' assessment of e-handouts based on problem-based learning.

a. Validation of Material Experts

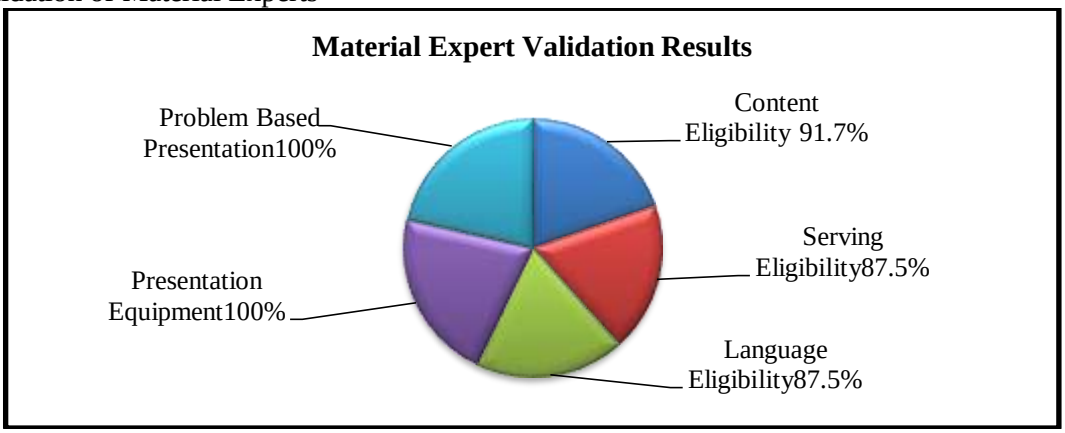

Figure 4. Graph of Material Expert Validation Test Results

The average percentage result for all aspects was obtained at 92.3% with the criteria of "very good" and very feasible to use.

b. Validation of Media Experts

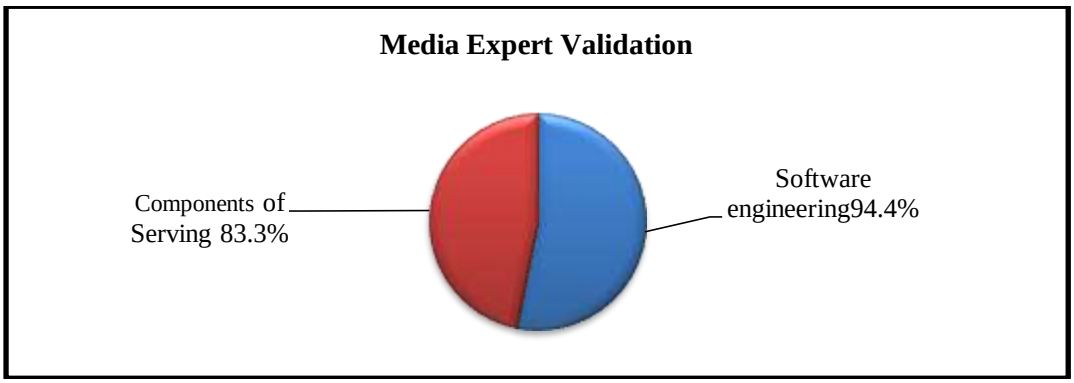

Figure 5. Graph of Revision Media Expert Validation Test Results

The average percentage result for all aspects is obtained with a percentage of 90% with the criteria of "very good." Based on the data results, the media is "very good" and feasible to use.

4. Implementation Stage

a. Teacher Assessment Questionnaire Results

Based on the teacher's questionnaire results, the PBL-based e-handout media is very feasible. Using e-handout-based problem-based learning makes students more motivated to learn physics. The percentage results of various aspects of the teacher practicality assessment questionnaire are as follows:

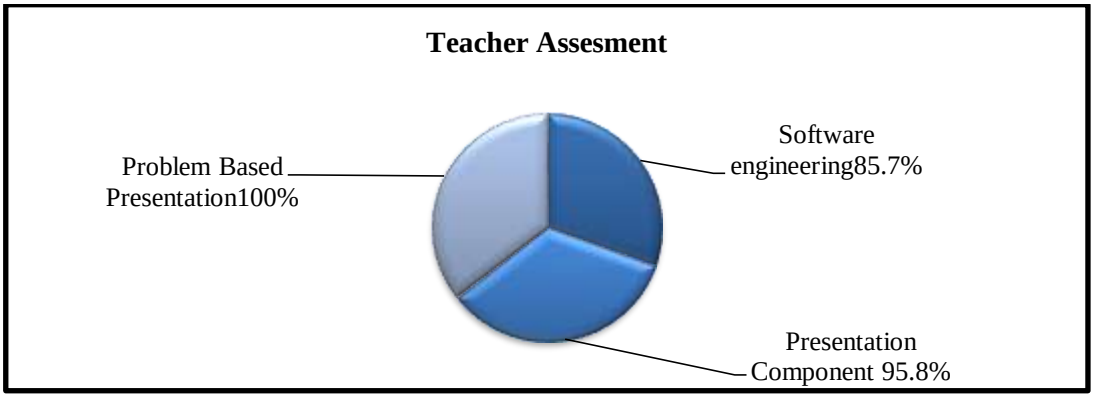

Figure 6. Teacher Assessment Questionnaire Graph

b. Student Response Questionnaire Results

The following is the result of the recapitulation of the student response questionnaires.

Table 1. Student Response Questionnaire Results

Aspects	Components	Percentage (%)	Criteria
Interest	Attractive E-Handout Display	96%	Very Good
	This E-Handout makes me more excited and want to learn physics	84%	Very Good
	This E-Handout helped me master the material on rotational dynamics and rigid body balance.	80%	Very Good
Material	The existence of examples in life provides a better understanding of the matter of rotational dynamics and rigid body balance	91%	Very Good
	Examples of problems provide a better understanding of the material of rotational dynamics and rigid body balance.	88%	Very Good
	The material presented in this E-handout is easy for me to understand.	92%	Very Good
	The material presented in this E-handout is easy for me to understand.	92%	Very Good
Language	This media can be used easily	87%	Very Good
	The sentences used by the e-handout are clear and easy to understand.	84%	Very Good
	The font size used is appropriate and easy to read.	84%	Very Good
Technical Quality	This media can be used easily	92%	Very Good
	This media is very practical and easy to carry everywhere.	96%	Very Good
Overall Percentage Average		**89%**	**Very Good**

5. Evaluation Stage

The evaluation stage is carried out based on providing student response questionnaires on the use of PBL-based e-handouts. The results of these responses are used as input for media improvement. The purpose of e-handouts media-based problems-based learning is to increase sample questions in the form of videos and to increase learning videos related to the phenomenon of rotational dynamics in everyday life as well as conclusions in each sub-section of the material.

6. Presentation Data of Students' Cognitive Learning Outcomes Improvement

Based on the test of calculating the N-Gain score in the experimental class and control class, it shows that the average value of the N-Gain score for the practical class using e-handouts media problems-based learning and the control class that does not use e-handouts media-based problems-based learning on rotational dynamics material. The rigid body balance is as follows:

Table 2. Results of N-Gain Score Calculation of Experimental Class and Control Class

No.	Name Class	N-gain Score	Criteria
1.	Experimental Class	71%	High
2.	Control Class	56,5%	Medium

Improved cognitive learning outcomes of students in the experimental class showed more significant results than in the control class. Based on the results of the N-gain in the practical class I obtained an N-gain of 71.02% in the "high" category. While in the control class only received an N-gain value of 56.56% in the "medium" category.

Discussion

Based on the research data, using e-handouts helps students learn independently at home and in the classroom. Applying the PBL model in the e-handout exposes students to real problems(Imaningtyas et al., 2016). So that students can think critically and organize their knowledge to solve the problem. Then, using e-handouts also helps make it easier for students to understand the material presented because students easily understand it. It was also conveyed by (Angraini et al., 2022) that the use of handouts helps students in solving problems to increase learning activities and students' cognitive learning outcomes. Interactive teaching materials also can help students learn to improve student learning outcomes (Pahlawan, 2021)

E-handout media-based problem-based learning on rotational dynamics and rigid body balance material is very suitable to be used as a learning resource to make it easier for students to understand the material in learning during a pandemic. Cognitive learning outcomes of students in the experimental class who used e-handout media-based problems-based learning experienced a more significant improvement than control class students who did not use e-handout media-based problems-based learning on rotational dynamics and rigid body balance. This is shown based on N-gain results in the experimental class of 71.02% in the "high" category and the N-gain results in the control class of 56.5% in the "medium" category. The responses of teachers and students when using PBL-based e-handouts showed very good results. This is shown based on the results of the teacher's assessment percentage of 91.1% with the "very good" criteria and the average percentage of student response questionnaires of 89% with the "very good" criteria. In further research on the development of e-handouts, it is strongly recommended that aspects of local wisdom be included as content on e-handouts (Angraini et al., 2022; Pahlawan, 2021; Safitri et al., 2021). This will make it easier for students to abstract their learning experiences from everyday conditions in the surrounding environment, and the learning atmosphere will be more contextual for students (Astra et al., 2019). In addition, students are also more interested and motivated in learning physics, rotational dynamics, and rigid body balance so they can create independent learning at school and home. According to (Haji et al., 2015) the independence of students when learning with the help of handouts is higher than before learning with the use of it. Digital handouts also overcome dependence on instructional media in the classroom (textbook) and improve self-direct learning (Clausen et al., 2019).

The use of e-handout media-based problems in learning rotational dynamics and rigid body equilibrium received a very good response from teachers and students. This is because e-handout-based problems are teaching material in an electronic format that contains concise material that is easy to understand and attractive to stimulate students' curiosity in following the lesson. Likewise, (Rianti et al., 2020) said that handouts were very suitable to be used as a source of learning both independently and in the learning process in the classroom. Digital handouts can also improve students digital literacy and make physics learning more effective for understanding concepts (Tolino et al., 2020).

CONCLUSION

Based on the result of the data, it can be concluded that e-handout media based problems based learning that has been developed is feasible to be used as a learning medium to improve students' cognitive learning outcomes in the material of rotational dynamics and rigid body balance with the results of material expert assessments of 92.3% with "very good/valid" criteria and media experts 94.4% with "very good/valid" criteria. In further research regarding the development of e-handouts, it is highly recommended that aspects of local wisdom be included as content in e-handouts. This will make it easier for students to abstract their learning experiences from everyday conditions in the surrounding environment, and the learning atmosphere will be more contextual.

Acknowledgments

Thank you to several parties who have helped with this research.

References

Aminah, S. N., Jumadi, & Astuti, D. P. (2020). The development of PBL e-handout assisted by PhET simulation of optical material-lenses for high school students. *Journal of Physics: Conference Series*, *1440*(1), 012038. https://doi.org/10.1088/1742-6596/1440/1/012038

Angraini, R., Widiana, R., & Sari, L. Y. (2022). Expert Assessment of Android based E-Handout on Animal Tissues Structure and Function Materials. *Journal Of Biology Education Research (JBER)*, *3*(2), 66–71. https://doi.org/10.55215/JBER.V3I2.5957

Astra, I. M., Susanti, D., & Novriansyah, A. (2019). Development of e-Handout materials physics based android for improvement learning outcomes senior high school student. *Journal of Physics: Conference Series*, *1318*(1), 012068. https://doi.org/10.1088/1742-6596/1318/1/012068

Ceballos, M., Buckridge, H., & Taylor, R. T. (2020). Educational Leadership Students and Mixed Reality Experiences: Building Student Confidence to Communicate with Parents and Teachers. *International Journal of Educational Leadership Preparation*, *15*(1), 58–71.

Clausen, J. M., Finsness, E. S., Borthwick, A. C., Graziano, K. J., Carpenter, J. P., & Herring, M. (2019). TPACK leadership diagnostic tool: Adoption and implementation by teacher education leaders. *Journal of Digital Learning in Teacher Education*, 35(1), 54-72.

Gary, K. (2015). Project-based learning. *Computer*, 48(9), 98-100.

Haji, A. G., Safriana, & Safitri, R. (2015). The Use Of Problem Based Learning To Increase Students' Learning Independent And To Investigate Students' Concept Understanding On Rotational Dynamic At Students Of SMA Negeri 4 Banda Aceh. *Jurnal Pendidikan IPA Indonesia*, *4*(1), 67–72.

Hutagol, K. (2013). Pembelajaran kontekstual untuk meningkatkan kemampuan representasi matematis siswa sekolah menengah pertama. *Jurnal Ilmiah Program Studi Matematika*

journal.stkipsiliwangi.ac.id/index.php/infinity/article/view/27/26

Imaningtyas, C. D., Karyanto, P., Nurmiyati, N., & Asriani, L. (2016). Penerapan E-Module Berbasis Problem Based Learning untuk Meningkatkan Literasi Sains dan Mengurangi Miskonsepsi pada Materi Ekologi Siswa Kelas X MIA 6 SMAN 1 Karanganom Tahun Pelajaran 2014/2015. *Bioedukasi: Jurnal Pendidikan Biologi*, *9*(1), 4. https://doi.org/10.20961/bioedukasi-uns.v9i1.2004

Kusuma, A., Candramila, W., & Ariyati, E. (2017). Respon Siswa Terhadap Pembelajaran Berbasis Masalah Pada Materi Pencemaran Lingkungan Di Kelas X Sma. *Jurnal Pendidikan Dan Pembelajaran Untan*, *6*(10), 211336. https://media.neliti.com/media/publications/211336-respon-siswa-terhadap-pembelajaran-berba.pdf

Luliyarti, D. S., Astuti -, D. P., Eveline, E., Wilujeng, I., Rahmawati, E. N., & P Astuti, dan D. (2020). Development of e-handout assisted by PhET simulation with problem based learning (PBL) model about momentum conservation law and collision to train students' conceptual understanding. *Journal of Physics: Conference Series*, *1440*(1), 012048. https://doi.org/10.1088/1742-6596/1440/1/012048

Nicholus, G., Muwonge, C. M., & Joseph, N. (2023). The Role of Problem-Based Learning Approach in Teaching and Learning Physics: A Systematic Literature Review. *F1000Research 2023*, 12:951.. https://doi.org/10.12688/f1000research.136339.1

Pahlawan, R. (2021). Developing an Interactive Digital Handout for Momentum and Impulse Material Physics in High Schools. *Journal of Education Technology*, 5(1), 137-144.

Rianti, S., Akhsan, H., & Ismet, I. (2020). Development Modern Physics Digital Handout Based on Technology Literacy. *Berkala Ilmiah Pendidikan Fisika,* 8(1), 23-32.. https://doi.org/10.20527/bipf.v8i1.7593

Safitri Advisor, A., Gusmaweti, D., & Si, M. (2021). Development of e-handout-based teaching materials with an approach inquiry in biology learning on ecological material for class X science students at SMA Pertiwi 2 Padang. *Jurnal Fakultas Keguruan Dan Ilmu Pendidikan*, *9*(2), 9–11.

Sugiyono. (2014). *Metode Penelitian Pendidikan Pendekatan Kuantitatif,. Kualitatif, dan R&D*. Bandung: Alfabeta.

Supriyati, Y., Permana, H., & Efitayani, C. (2019). Pengembangan E-Handout Pada Materi Gerak Harmonik Sederhana Untuk Peserta Didik Dengan Gaya Belajar Kinestetik. *Prosiding Seminar Nasional Fisika (E-Journal)*, *8*, SNF2019-PE-51–62. https://doi.org/10.21009/03.SNF2019.01.PE.07

Tolino, F., & Astuti, D. P. (2020). Students' verbal communication skills using e-handout aided Schoology with problem-based learning model on lup-optic topics. *In Journal of Physics: Conference Series*, 1440 (1), 012033. IOP Publishing.

Widiyanti, R. A., & Guru Mapel, P. K. N. (2015). Pemanfaatan kelapa menjadi VCO (Virgin Coconut Oil) sebagai antibiotik kesehatan dalam upaya mendukung visi Indonesia sehat 2015. *In Prosiding Seminar Nasional Pendidikan Biologi*, 21, 577-584.

Yunitasari, R., & Hanifah, U. (2020). Pengaruh pembelajaran daring terhadap minat belajar siswa pada masa covid 19. *Edukatif: Jurnal Ilmu Pendidikan*, 2(3), 232-243.