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E-Module Based on Role-Playing Learning Model with Scientific Approach to Improve Conceptual Mastery and Problem-Solving Skill on Fluid Dynamics

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DOI:10.20527/bipf.v11i2.16216

Received: 13 May 2023 Accepted: 30 June 2023 Published: 8 July 2023

Abstract

Fluid dynamics is the basic knowledge of technology development that is important to be mastered, but students still have difficulties with it. This research aims to determine the students' increased conceptual mastery and problem-solving skills using e-module. The method of this study uses the quasi-experimental pre-test-post-test control group research design. Each student is given questions on pre-test and post-test conceptual mastery in multiple-choice and problem-solving skills in the form of descriptions. Student answers were analyzed with descriptive statistics, the Wilcoxon, and the n-gain tests. After the e-module was implemented, the increase in conceptual mastery of the experimental class was higher than the control class, with an n-gain value of 0.69 (moderate) for the experimental class and 0.46 (moderate) for the control class. The increase in the problem-solving skill of the experimental class was higher than that of the control class, with an n-gain value of 0.59 (intermediate) for the experimental class and 0.28 for the control class (novice). So, this e-module can improve students' conceptual mastery and problem-solving skills. The reason is caused by the learning process of experimental students who can learn actively, independently, intensively, and repeatedly using the e-module for conceptual mastering by the stages of the scientific approach through role-playing.

Keywords: Conceptual Mastery; E-Module, Fluid Dynamics; Problem Solving Skill; Role-Playing, Scientific Approach

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How to cite: Martha, C, Supriana, E, & Sunaryono, S. (2023). E-module based on role-playing learning model with scientific approach to improve conceptual mastery and problem-solving skill on fluid dynamics. *Berkala Ilmiah Pendidikan Fisika*, 11(2), 197-206.

INTRODUCTION

One of the problems that many Physics teachers are still facing is the students' low conceptual mastery and problem-solving skills. The study of Eryilmaz et al. (2011) shows that the problem faced in Physics education is that the students cannot master the Physics concepts

effectively and adequately (Kabil, 2015; Armani, 2021).

One of the causes of low Physics learning outcomes starting from cognitive levels C1 to C6 is the learning process that does not involve students actively. Here, students just listen to the teacher without doing contextual



learning in class. So, they just receive too much information without knowing the purpose of it (teacher-centered) (Sutrisno, 2018; Armani, 2021).

Students who experience problems and are unable to master concepts will impact problem-solving skills, becoming one of the 21st-century skills (Santhalia, 2020; Wong, 2021). Problem-solving skill is the person's ability to solve problems (Ince, 2018; Saputri et al., 2021; Yuberti et al., 2019). One of the materials in Physics that trains students to be able to solve problems in everyday life is the fluid dynamics chapter. Fluid dynamics material is very important for students to master because it is the basic concept of engineering technology. However, in studying this material, there are still many weaknesses, namely, students only memorize many fluid dynamics formulas and use them to work on problems based on formula derivatives. Therefore students experience difficulties in learning the concept (Ding, 2011; De Cock, 2012; Azizah, 2015; Saputra, 2017).

The research by Azizah et al. (2015) stated that 76% of students forgot and did not understand how to solve problems, 19% did not understand how to solve the problems, and only 5% could solve these questions. The research of Saputra et al. (2017) concluded that 65.32% of students had misconceptions, 13.06% did not understand, 6.76% had low self-efficacy, and 14.86% understood the concept of fluid dynamics.

The learning delivery causes the reason for difficulties had not been taught properly. According to them, the fluid dynamics problems they received were not related to the daily phenomena; there was no relevance to what material they learned for daily life (Besson, 2014). Students can master concepts and solve problems if they can process information or knowledge received through their five senses so that it can be processed and stored in their brain memories.

Practice and repetition can help the students to save information longer inside the brain. This mechanism can make the information that has been learned can last longer inside the brain (Stout, 2020). Exercise and repetition can be done in class and independently using a learning media that can make students learn independently and fun. One of the media that has been developed is an electronic module, which is shortened to e-module (Armani, 2021). E-module is the teaching media that is packaged systematically and intact, which can be used to help students master specific learning objectives in the form of designing a set of planned learning experiences (Dewantara et al., 2021; Muhammad et al., 2021; Seprida, 2015).

Learning media published in similar scientific journals are interesting to use as references in this research, namely the fluid dynamics e-module, which can improve HOTS, conducted by Suyatna (2020). Because this media can create interesting, interactive, and flexible learning, another similar research is the fluid dynamics e-module which can improve student learning outcomes Nikita (2018). However, this media does not yet use a scientific approach or a role-playing learning model. Research by Pereira (2021) uses a simulated role-playing learning model for MBA program students, which makes students understand management theory well because learning is based on experience according to the role given. However, this research still does not use a scientific approach or teach fluid dynamics material (Pereira, 2021).

Preliminary research that has used a scientific approach is proven to improve learning outcomes because students are actively involved. According to Setyawan (2017) and Sabrina (2021), this scientific approach can be integrated into learning media or models. However, research that has been published has not yet integrated the role-playing learning

model into e-module media using a scientific approach to fluid dynamics material (Setyawan, 2017; Sabrina, 2021).

This research will use a new design of learning that integrates the role-playing learning model with a scientific approach inside an e-module on fluid dynamics. Role-playing can make the students study actively based on experience to explore knowledge relevant to daily life. Becoming a detective character is suitable with a scientific approach to finish the fluid dynamics mission to solve the problems given. So that conceptual mastery and problem-solving skills can be increased by it (Cherif, 1998; Dracup, 2008; Craciun, 2010; Paudi, 2019; Sherer, 2019; Bawa, 2020, Pereira, 2021). Here, this research aims to determine the effectiveness of e-module to improve students' conceptual mastery and problem-solving skills.

METHOD

This study used a pre-test-post-test control group quasi-experimental design. The sample of this study is taken from class XI population and determined by purposive sampling method that consisted of 30 students in the control class and 30 students in the experimental class at senior high school students. Each student is given questions on multiple choices of conceptual mastery and descriptions of problem-solving skill pre-test and post-test. Student answers were analyzed using descriptive statistics, the Wilcoxon test, and the n-gain test to determine the effectiveness of using e-module media in increasing students' conceptual mastery and problem-solving skills in class XI (Razali, 2011; Oyeka, 2012; Cresswell, 2015).

The hypothesis test that is carried out if the data obtained is not normally distributed and not homogeneous is the Wilcoxon test as in Equation (1), where the significance level used is 0.05 (5%) (Oyeka, 2021).

$$Z = \frac{T - \frac{n(n+1)}{4}}{\sqrt{\frac{n(n+1)(2n+1)}{24}}} \dots\dots\dots(1)$$

The effectiveness test to determine how effective the e-module learning media was in improving students' conceptual mastery and problem-solving skills in conceptual mastery. The data taken is a pre-test and post-test, whose results will be calculated using Equation (2) (Hake, 1998).

$$g = \frac{PostTest - PreTest}{100 - PreTest} \dots\dots\dots(2)$$

The n-gain test value can show the magnitude of the improvement before and after treatment in the experimental class for the dependent variable conceptual mastery and problem-solving skills. The results can be matched with the criteria in Table 1.

Table 1 N-Gain criteria

N-Gain	Criteria
$g > 0.70$	High
$0.30 \leq g \leq 0.70$	Moderate
$g < 0.30$	Low

The results of the n-gain analysis to determine student categories in problem-solving skills can be determined by level criteria based on Table 2 (Bao, 2021).

Table 2 Problem-solving skill level

Total Score	Level
0 – 0.30	Novice
0.31 – 0.80	Intermediate
0.81 – 1.00	Expertlike

RESULT AND DISCUSSION

The e-module based on the role-playing learning model with a scientific approach to fluid dynamics material has been developed by PowerPoint application. It has been validated and revised to be implemented into learning in class XI of senior high school students. The following preview of the e-module is shown in Figure 1(a), which is the Home Page, and Figure 1(b), which is the five doors of the scientific approach that students will enter while playing the role of Detective-C character (DC Boy played by a male student and DC Girl played by

female students) and DC's Guide played by the teacher according to the setting inside the e-module.



Figure 1 E-module preview : (a) home page; (b) 5 scientific approach doors

The role-playing learning model in this e-module refers to Cherif (1998) and Craciun (2010) which consists of 4 stages, namely: (1) preparation of activities by the teacher (situation/problem to investigate/ resolve exposition), namely by determining the problem as well as explaining the character/character that will solve the problem; (2) class preparation (material/scenario investigation and organization), namely by providing an explanation of the plot, background and roles of the characters/characters during the course of the role play; (3) implementation of activities (role playing itself), namely each character/character plays a role based on the plot, background and role of the character/character to achieve predetermined targets or solutions to problems given at the beginning; and (4) after implementation (reflection), namely students are asked to submit solutions and discuss them together with the class

whether these solutions can answer/solve problems (Cherif, 1998; Craciun 2010; Paudi, 2019).

Data Analysis of Conceptual Mastery Test Results

The results of conceptual mastery tests of control and experimental classes were analyzed with descriptive statistics to get each student's and class average scores. Data on the average value of the pre-test and post-test conceptual mastery for the control and experimental classes are presented in Figure 2 as follows.

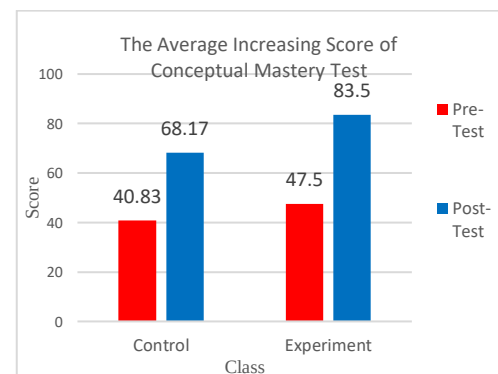


Figure 2 The average increasing score of a conceptual mastery test chart

The information obtained from Figure 2 shows that the experimental class experienced a higher increase in scores than the control class. So, from descriptive statistics, the application of the e-module based on the role-playing learning model on fluid dynamics material is more effective than using textbooks and worksheets. It can be seen that the bar of an experimental class is higher than the control class.

The inferential statistics tests can answer the hypothesis of whether there is an effect from the experimental treatment in both classes. Due to the normality test results, the value of Sig < 0.05 in the experimental class pre-test and post-test, the data is not normally distributed.

Therefore testing the research hypothesis using non-parametric statistics, equivalent to the paired sample

t-test, namely the Wilcoxon test. The results of the control and experimental class are both 0.000. Because of Asymp values. Sig. (2-tailed) <0.05 , which means that there is an influence from the use of instructional media using textbooks and worksheets in the control class on students' conceptual mastery. In addition, there is also the influence of the use of e-module media in the

experimental class on students' conceptual mastery. After knowing the conclusions from the results of the hypothesis testing obtained, there is a significant difference, and we want to know whether this e-module media can improve students' conceptual mastery using the n-gain test, which is presented in Table 3.

Table 3 N-gain test of conceptual mastery problems

Class	Pre-Test		Post-Test		N-Gain
Control	Mean	40.83	Mean	68.17	0.46
	Maximum	60.00	Maximum	100.00	
	Minimum	20.00	Minimum	50.00	
Experiment	Mean	47.50	Mean	83.50	0.69
	Maximum	65.00	Maximum	100.00	
	Minimum	20.00	Minimum	65.00	

Table 3 shows that the n-gain score of the experimental class is greater than the control class. This proves that the differences in media in the two classes have different learning outcomes in students' conceptual mastery. In the control class, the average n-gain value is 0.46, so the average class category is included in the moderate category. The experimental class students have a moderate category because the average n-gain value is 0.69. However, the higher n-gain value for the experimental class proves that the e-module media is more effective than textbooks and worksheets to improve students' conceptual mastery.

Data Analysis of Problem-Solving Skill Test Results

Data on problem-solving ability test results in the control and experimental classes were analyzed with descriptive statistics to obtain each student's and class average scores. Data on the average pre-test and post-test problem-solving skills of the control and experimental

classes are presented in Figure 3.

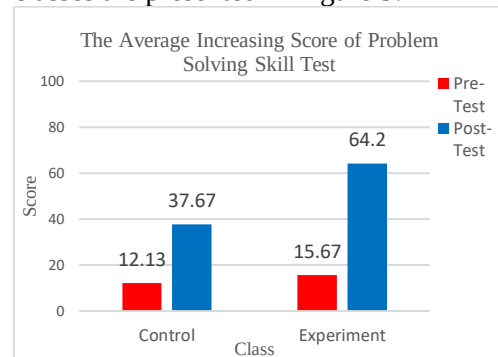


Figure 3 The average increasing score of a problem-solving skill test chart

Based on the information obtained from the data in Figure 3, the experimental class experienced a higher problem-solving skill score than the control class. So, from descriptive statistics, the application of the e-module based on the role-playing learning model on fluid dynamics material is more effective than learning using textbooks and worksheets.

The inferential statistics tests can answer the hypothesis of whether there is an effect from the experimental treatment in both classes. Due to the normality test results, the value of Sig <0.05 in the experimental class pre-test and post-test, the data is not normally distributed. Therefore testing the research hypothesis using non-parametric statistics which is equivalent to the paired sample t-test, namely the Wilcoxon test.

The results of the control and experimental class are both 0.000.

Table 4 N-gain test of problem-solving skill

Class	Pre-Test		Post-Test		N-Gain
Control	Mean	12.13	Mean	37.67	0.28
	Maximum	28.00	Maximum	100.00	
	Minimum	0.00	Minimum	18.00	
Experiment	Mean	15.67	Mean	64.20	0.59
	Maximum	46.00	Maximum	100.00	
	Minimum	0.00	Minimum	26.00	

Table 4 shows that the experimental class's n-gain value is greater than the control class's. This proves that the differences in media in the two classes have different learning outcomes in students' problem-solving skills. Because the control class's n-gain value has an average value of 0.28, the average class category belongs to novice problem solvers who are still not too deep into concepts and are more inclined to only mathematical calculations.

While students in the experimental class have problem-solving skills with an n-gain value of 0.59, included in the intermediate category because students can write down the process of problem-solving skills according to related concepts based on Docktor's rubric indicators (Docktor, 2015). So, it can be concluded that the e-module media is more effective in improving the problem-solving skills of experimental class students than the control class, which uses textbook media and worksheets.

This e-module does not immediately provide material at the beginning of the door because a detective has to build knowledge based on the instructions,

Because of Asymp values. Sig. (2-tailed) <0.05 , which means that there is an influence from the use of instructional media using textbooks and worksheets in the control class and the use of e-module media in the experimental class on students' problem-solving skills. Here, Table 4 shows whether the e-module or textbooks and worksheets can improve problem-solving skills both in control and experimental classes.

experiments, and references found. This follows constructivist learning theory, which states that students build knowledge based on experience through investigation and involvement, such as conducting experiments and discussions. In the process, students who already have the concept of knowledge when they get new knowledge will make adjustments to produce the correct new knowledge structure (Sugrah, 2019).

The higher increase in the experimental class can be analyzed from the learning process that makes the experimental class learn to play roles according to the scenarios in the e-module media by entering the five scientific approach doors. Before working on the "Your Mission" mission, students are directed to enter the "Goal" menu to study learning objectives and scenarios as Detective-C (DC Boy for male students and DC Girl for female students) and follow the "Detective Candidate Orientation" to see the problem of global warming which must be solved immediately using Physics, namely fluid dynamics. Based on Detective-C activities from door I to door

V, students can build their knowledge using the e-module with scientific approach stages. In addition, students can still repeat each stage of the scientific approach if desired. Repetition will make the information settle longer. Experience playing a direct role and conducting experiments will also make students understand concepts better because they are not given knowledge of finished formulas usually learned by teacher-centered learning. This is supported by Stout (2020), who states that practice and repetition will help students memorize whatever they have learned to be saved longer.

Nuriyah (2018) states that experiential learning can improve students' conceptual mastery through the role-playing learning model of Detective-C (DC Boy or DC Girl). This role-playing is based on active learning theory, experiential and student-centered learning where students could be physically and intellectually involved in learning so that all student's five senses are involved in building knowledge (McSharry, 2000).

Problem-solving skill is the person's ability to solve problems (Ince, 2018; Maulani, 2020). Students in the experimental class have an average higher increase in their problem-solving skills because students learn to use interactive media that can be learned from time to time and repeatedly. Because this e-module has a greater appeal for students to learn than textbooks and worksheets which are static and not interactive. Based on interviews with male and female students with the highest scores in the experimental class show that this e-module has a very interesting appeal compared to books in general; it is fun and not boring because there are Detective-C avatars (DC Boy and DC Girl). This can make students take longer to study because they don't feel hard to

study. If students feel happy, learning is easier to understand and can be more centered in the brain. Unlike in textbooks and worksheets, practice questions in this e-module provide corrective feedback and clear discussion (Wati, 2019).

The learning process with this e-module starts with the explanation to practice questions and answer keys to help students learn. E-module also has material that is more conceptual and on target because it is the series of lessons from start to finish that is learned. So that when faced with problem-solving skill test questions, students already have the provision of strategies to solve problems given using conceptual mastery that has been built through experiential learning of becoming Detective-C. Here, the integrated scientific approach stages with a role-playing learning model inside the e-module can train students to learn more interestingly and contextually (Suyatna, 2020; Pereira, 2021).

Previous research also supports that this role-playing learning model can train students' problem-solving and social skills. So that this model can involve three aspects of learning, namely cognitive, affective, and psychomotor (Sugihartono, 2007; Santoso, 2011; Oktavianty, 2011). The scientific approach can involve students actively because student-centered learning can enable students to build concepts and train their higher-order thinking skills and character (Setyawan, 2017; Sabrina, 2021). So, this e-module media can be a means to integrate the role-playing learning model using a scientific approach so that it can be used to help students master specific learning objectives in the form of designing a set of planned learning experiences to help students improve their conceptual mastery and problem-solving skill (Seprida, 2015 Hsiao et al., 2020; Pereira, 2021).

CONCLUSION

After analyzing and discussing the results, it can be concluded that the increase in conceptual mastery in the experimental class is higher than in the control class. The n-gain value for the experimental class is 0.69 (moderate), and the control class is 0.46 (moderate). In addition, the increase in problem-solving skills in the experimental class is also higher than in the control class. The n-gain value for the experimental class is 0.59 (intermediate), and the control class is 0.28 (novice). The reason is caused by the learning process of experimental class students that use the e-module are interested in learning actively, independently, intensively, and repeatedly using the e-module, which guides students to build conceptual mastery through the stages of a scientific approach. So that if given a problem-solving skill test, they can use the strategies they have based on the concepts they have mastered.

REFERENCES

- Armani, Alya. (2021). science e-module based on scientific approach using kvisoft flipbook on temperature and heat materials in class vii junior high school. *Jurnal Geliga Sains: Jurnal Pendidikan Fisika*, 9(1), 70-80. <http://dx.doi.org/10.31258/jgs.9.1.70-80>
- Azizah, R. (2015). Kesulitan pemecahan masalah fisika pada siswa sma. *Jurnal Penelitian Fisika dan Aplikasinya*, 5(2), 44–50.
- Bao, L., & Fritchman, J. C. (2021). Knowledge integration in student learning of Newton's third law: Addressing the action-reaction language and the implied causality. *Physical Review Physics Education Research*, 17(2), 1–22. <https://doi.org/10.1103/PhysRevPhysEducRes.17.020116>
- Bawa, A. (2020). *Role-Play*. In R. Kimmons & S. Caskurlu (Eds.), *The Students' Guide to Learning Design and Research*. EdTech Books. <https://edtechbooks.org/studentguide/roleplay>
- Besson, U. (2014). Students' conceptions of fluids. *International Journal Science Education*, 26(14), 37–41.
- Cherif, A. H. (1998). From the los angeles zoo to the classroom: Transforming real cases via role-play into productive learning activities. *The American Biology Teacher*, 60(10).
- Craciun, D. (2010). Role-playing as a creative method in science education. *Journal of Science and Arts*, 1(12), 175-182.
- Creswell, J.W. (2015). *Educational research: planning, conducting, and evaluating quantitative and qualitative research*, (4th Edition). Boston: Pearson Education, Inc.
- De Cock, M. (2012). Representation use and strategy choice in physics problem solving. *Physical Review Special Topics-Physics Education Research*, 8(2), 020117. doi:10.1103/PhysRevSTPER.8.020117
- Dewantara, D., Sofianto, E. W. N., Misbah, M., & Munawaroh, D. (2021). Physics e-module: A review and bibliometric analysis. *Journal of Physics: Conference Series*, 2104(1), 012008.
- Ding, L., Reay, N., Lee, A., & Bao, L. (2011). Exploring the role of conceptual scaffolding in solving synthesis problems. *Physical Review Special Topics-Physics Education Research*, 7(2), 020109. doi:10.1103/PhysRevSTPER.7.020109
- Docktor, J. L., Strand, N. E., Mestre, J. P., & Ross, B. H. (2015). Conceptual problem solving in high school physics. *Physical Review Special Topics - Physics Education Research*, 11(2), 020106.

- doi:10.1103/PhysRevSTPER.11.020106
- Dracup, M. (2008). Role play in blended learning: A case study exploring the impact of story and other elements. *Australasian Journal of Educational Technology*, 24(3), 294-310.
- Eryilmaz, A., Yildiz, I. & Akin, S. (2011). Investigating of relationship between attitudes towards physics laboratories, motivation and amotivation for the class engagement. *Eurasian Journal of Physics and Chemistry Education*, 59-64.
- Hake, R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for an introductory physics course. *American Journal of Physics*, 66(1), 64-74. <https://doi.org/10.1119/1.18809>
- Hsiao, H. S., Tsai, F. H., & Hsu, I. Y. (2020). Development and evaluation of a computer detective game for microbial food safety education. *Journal of Educational Computing Research*, 58(6), 1144-1160.
- Ince, E. (2018). An overview of problem solving studies in physics education. *Journal of Education and Learning*, 7(4), 191. <https://doi.org/10.5539/jel.v7n4p191>
- Kabil, O. (2015). Philosophy in physics education. *Procedia-Social and Behavioral Sciences*, 197, 675 – 679.
- Maulani, N., Linuwih, S., & Sulhadi, S. (2020). Analisis kemampuan pemecahan masalah fisika dalam asesmen higher order thinking. *Seminar Nasional Pascasarjana 2020*, 1–10.
- McSharry, G. (2000). Role-play in science teaching and learning. *School Science Review*, 82(298).
- Muhammad, N., Hamid, F., Misbah, M., & Dewantara, D. (2021). E-module on elasticity of solids topic through cooperative learning to improve learning outcomes and motivation: validity aspects. *Journal of Physics: Conference Series*, 2104(1), 012015.
- Nikita, P. M. (2018). Pengembangan e-modul materi fluida dinamis untuk meningkatkan kemampuan berpikir kritis siswa sma kelas xi. *Jurnal Pembelajaran Fisika*, 7(2), 175-180.
- Nuriyah, R. (2018). Eksplorasi penguasaan konsep menggunakan experiential learning pada materi hukum newton. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 3(10).
- Oktavianty, E. (2011). Role playing pada perkuliahan fisika lingkungan sub bahasan pencemaran. *Jurnal Pendidikan Matematika dan IPA*, 2(2).
- Oyeka, I. (2012). Modified wilcoxon signed-rank test. *Open Journal of Statistic*, 2, 172-176. <http://dx.doi.org/10.4236/ojs.2012.22019>
- Paudi, Z. I. (2019). Penerapan metode role playing pada pembelajaran fisika untuk meningkatkan hasil belajar siswa. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, 7(2), 111-120.
- Pereira, A. S. (2021). Development and testing of a roleplaying gamification module to enhance deeper learning of case studies in an accelerated online management theory course. *Online Learning Journal*, 25(3), 101-127. doi: 10.24059/olj.v25i3.2273
- Razali, N. (2011). Power comparisons of shapiro-wilk, kolmogorov-smirnov, lilliefors and andersons-darling tests. *Journal of Statistical Modeling and Analytics*, 2(1), 21-33.
- Sabrina, F. (2021). Analysis of scientific literacy of senior high school students on fluid dynamics. *Jurnal Penelitian Pendidikan Sains (JPPS)*, 11(1), 40-51.
- Santhalia, P. W., Yuliati, L., & Wisodo, H. (2020). Building students' problem-solving skill in the concept of temperature and expansion through

- phenomenon-based experiential learning. *Journal of Physics: Conference Series*, 1422(1). <https://doi.org/10.1088/1742-6596/1422/1/012021>
- Santoso, S. (2011). Pengaruh metode pembelajaran role play dan story telling berbantuan video terhadap keterampilan berbicara bahasa inggris ditinjau dari motivasi belajar. *Jurnal Teknologi Pendidikan dan Pembelajaran*, 2(3), 393 – 414 .
- Saputra, O. (2017). Identifikasi miskonsepsi siswa sekolah menengah atas (sma) pada topik fluida dinamis. *Jurnal Kreatif Online*, 7(3), 22–33.
- Saputri, S. R., Wati, M., & Misbah, M. (2021). Simple harmonic motion electronic teaching materials based on authentic learning to train students' problem-solving skills: aspects of validity. *Journal of Physics: Conference Series*, 2126(1), 012016.
- Seprida, H. (2015). Pemanfaatan e-learning berbasis lcms moodle sebagai media pembelajaran untuk mata kuliah sistem informasi akuntansi. *Jurnal Riset Akuntansi dan Bisnis*, 15(1), 86-99.
- Setyawan, D. N. (2017). The using of scientific based physics module in learning to enhance high school students' critical thinking skills on rotation dynamics and equilibrium of rigid body. *Journal of Education and Learning*, 11(2), 213-218.
Doi: 10.11591/edulearn.v11i2.6017
- Sherer, P. D. (2019). The researcher as detective: Another way of looking at professions and organizations. *Journal of Professions and Organization*, 6, 91–102
doi: 10.1093/jpo/joy020
- Stout, P. J. (2020). New media technologies and information processing theory— george a. miller and others. Springer Nature Switzerland AG 2020 B. Akpan and T. Kennedy (eds.), Science Education in Theory and Practice, *Springer Texts in Education*, https://doi.org/10.1007/978-3-030-43620-9_9
- Sugihartono, S. (2007). Analisis penerapan metode discussion dan role playing untuk meningkatkan prestasi belajar mahasiswa pada mata kuliah manajemen kinerja. *Jurnal Ilmiah Manajemen & Bisnis*, 18, (1), 23-29.
- Sugrah, N. (2019). Implementasi teori belajar konstruktivisme dalam pembelajaran sains. *Humanika, Kajian Ilmiah Mata Kuliah Umum*, 19(2), 121-138.
- Sutrisno, F. H. (2018). Eksplorasi LOTS dan HOTS materi optik geometri siswa sma. *Momentum: Physics Education Journal*, 2 (1), 21–28 .
- Suyatna, A. (2020). Dynamic fluid e-module with stem approach to stimulate hots of high school students in distance learning. *Jurnal Pendidikan MIPA*, 21 (2), 2020, 132-145.
<http://dx.doi.org/10.23960/jpmipa/v21i2.pp132-145>
- Wati, D. K. (2019). Pengembangan e-book fisika berbasis multi representasi dengan corrective feedback pada materi gerak lurus kelas x sma/ma. *JRPF (Jurnal Riset Pendidikan Fisika)*, 4(1), 34-41.
- Wong, S. S. H., Kim, M., & Jin, Q. (2021). Critical literacy practices within problem based learning projects in science. *Interchange*, 52(4), 463–477.
- Yuberti, Y., Latifah, S., Anugrah, A., Saregar, A., Misbah, M., & Jermisittiparsert, K. (2019). Approaching problem-solving skills of momentum and impulse phenomena using context and problem-based learning. *European Journal of Educational Research*, 8(4), 1217-1227.