ISSN (PRINT) : 2549-9955 ISSN (ONLINE): 2549-9963
JURNAL ILMIAH PENDIDIKAN FISIKA
https://ppjp.ulm.ac.id/journals/index.php/jipf/index

The Effectiveness of Quiz-Assisted Particle Dynamics E-Module in Practicing Problem-Solving Ability

Dina Selvia[1], Abdul Salam M[1], Surya Haryandi[1], and Mohd Ali Ibrahim[2]
[1]Universitas Lambung Mangkurat, Banjarmasin, Indonesia
[2]Universiti Teknologi Malaysia, Johor Bahru, Malaysia
*dinaselvia.1903@gmail.com

Abstract
The lack of problem-solving skills students possess impacts the low completion of physics description questions in class. The purpose of this study is to determine the effectiveness of the e-module with the help of questions to train students' problem-solving skills that are suitable for use in learning activities in terms of their effectiveness in improving learning outcomes and achieving minimum completeness criteria. The type of research used is research and development using the ADDIE model, tested on 20 students of class X MIPA 2 Public High School in Banjarmasin. The data collection instrument used is the learning outcome test. The data analysis technique used is descriptive quantitative. The results showed that the electronic module was declared valid with an average validity score of 3.47 in the very good category, which was then continued at the field test stage to determine the effectiveness assessment of the electronic module so that it could be declared effective with an N-gain of 0.69 in the medium category. The research concludes that the electronic module developed is suitable for learning activities and can be applied to other learning.
Keywords: Effectiveness; Electronic Module; Problem-Solving Ability

Received : 7 November 2022
Accepted : 27 June 2023
Published: 12 July 2023
DOI : https://doi.org/10.20527/jipf.v7i2.6781
© 2023 Jurnal Ilmiah Pendidikan Fisika

How to cite: Selvia, D., M, A. S., Haryandi, S., & Ibrahim, M. A. (2023). The effectiveness of quiz-assisted particle dynamics e-module in practicing problem-solving ability. *Jurnal Ilmiah Pendidikan Fisika*, 7(2), 229-236.

INTRODUCTION

Education in the 21st century places a high value on a wide range of abilities that must be mastered. According to Philosopher Khun in Jayadi (2020), the 21st century requires quality human resources, with output provided by institutions that aspire to produce superior output while being managed professionally. Creativity and invention, critical thinking, problem-solving, communication, and cooperation are some of the abilities required in the 21st century (Misbah et al., 2022; Saputri et al., 2021; Suyidno et al., 2019). Students will need problem-solving abilities as part of their 21st-century capabilities as they

This is an open access article under the CC–BY-SA license

prepare to meet the difficulties of increasingly challenging times. Riwu et al. (2019) conducted a study that supports this, stating that problem-solving abilities should be provided to kids for their future life. These problem-solving abilities are acquired through time through practice, learning, and direct experience. Physics is one of the topics that stresses problem-solving abilities (Abidin, 2016).

According to Abidin (2016), learning physics plays an important part in teaching 21st-century skills to children in school because physics is a lesson that relies on the ability to count, reason, and logic correctly. As stated by Hartini & Martin (2020), delivering problem-solving exercises that are not the same as usual would assist pupils in developing their problem-solving abilities. In the words of Heller (2010), systematic steps are required in problem-solving in learning physics to ensure difficulties can be guided and easily solved. One method of learning that must be mastered is problem-solving so that learning becomes more efficient in achieving the desired results. Agree that problem-solving abilities are described as the capacity to discover solutions to obstacles faced in accomplishing the intended goals (Hadiansah et al., 2019; Rizki et al., 2021; Wati et al., 2021).

Preliminary observations made at one of the public high schools in Banjarmasin through an initial ability test using a test instrument revealed that most students in class X MIPA 2 still lacked problem-solving abilities. This is most likely due to a lack of training for students with specific questions or in the processes to solve them, such that when students are presented with difficulties, they are less able to analyze and solve them because they have not been trained to apply problem-solving methods that make it easier for students. Several approaches can be applied based on the needs analysis, including electronic modules, which are believed to be an alternative that can integrate technical improvements with the demands of the 21st century. This approach was chosen based on the findings of relevant research on electronic modules conducted by Sasmita (2020) dan Erlena (2021), the findings of which have shown useful for problem-solving practice. According to Sriwahyuni's research, learning activities employing electronic modules as a medium were able to train students' problem-solving skills (Ramadhani et al., 2019; Rosida et al., 2019; Sriwahyuni et al. 2019).

Electronic modules, similar to e-books, contain images and text in the form of learning materials or experiments created from digital content and can be presented on a monitor screen or printed in physical form Herawati & Muhtadi, (2018); Gunadharma (2011). As for the conditions that must be met so that the electronic module can be used in classroom learning, it must be declared feasible first.

Relevant study findings are required to support efforts to construct electronic modules. Several relevant studies have been discovered thus far, including those conducted by Rosida et al. (2019), who suggested that students' problem-solving abilities increased when they were taught utilizing electronic modules. Seruni et al. (2019) stated that electronic modules can be created with the *Flip PDF Professional* application to aid in the science learning process. Mahardika (2019), through his dissertation results, stated that electronic modules can be built into physics learning and have been shown to boost students' problem-solving abilities.

Based on observations and needs analysis, there are still issues with students' problem-solving skills in one of the schools in the Banjarmasin area. This cannot be overstated because problem-solving abilities are among the 21st-century skills that students must possess. This must be addressed by creating modules that aid in developing problem-solving abilities. The researchers discovered changes in the creation of e-modules compared to previous e-modules in other studies; notably, these e-modules were introduced with quizzes. Other earlier research created e-modules with practice questions, but no questions were offered in the form of interactive quizzes. It is intended that by using interactive questions and quizzes, students will become accustomed to coping with the challenges presented, allowing their problem-solving abilities to gradually improve.

METHOD

This research and development project employed the research methodology popularized by Reiser and Mollenda, particularly the ADDIE model with a schema similar to Figure 1.

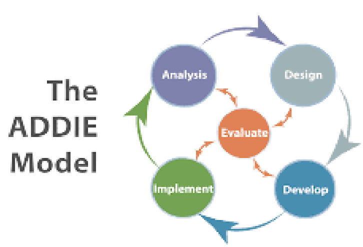

Figure 1 Development of the ADDIE adaptation model (Sutarti & Irawan, 2017)

The study was carried out by comparing the results of observations before and after using the electronic module (O_1), by comparing the values of O_1 and O_2 and then calculating the average gain score used to assess the effectiveness of the electronic module under development (Sugiyono, 2016). Before the e-module development could be employed in the field testing stage to see how effective the development outcomes were, the content and display validity of the development product must first be evaluated. According to specified indicators (Depdiknas, 2008), the overall evaluation of the validity of the produced e-module was in the very good category with a value of 3.47 and a reliability value of 0.82, making the effectiveness of the development could be evaluated in the learning process.

The effectiveness of the electronic module is assessed using the learning achievement test instrument's pretest and posttest. The success of the development is evaluated using the *normalized gain* (*N-gain*) value. Table 1 shows the parameters for determining the effectiveness of the constructed electronic module.

Table 1 Criteria for the effectiveness of the electronic module (Ayuningtyas et al., 2015)

No	Score	Criteria
1	$g > 0.7$	High
2	$0.3 \leq g \leq 0.7$	Medium
3	$g < 0.3$	Low

If the achievement percentage of learning indicators is $\geq 0{,}75$, learning indicators are deemed to be accomplished (Zakarsyi et al., 2007). Students calculate the success of learning markers using the following formula based on the results of the posttest:

$$Indicator\ completenss = \frac{\sum achievement\ score\ of\ each\ indicator}{\sum indicator\ score\ in\ basic\ competencies\ (KD)} \times 100\% \quad (1)$$

RESULTS AND DISCUSSION

The teaching material in this electronic module was meant for three meetings and was organized into three sub-materials, as illustrated in Figures 2 and 3 regarding the Revised 2013 Curriculum. Each sub-material is intended for a single meeting lasting 2 hours (60 minutes). Newton's laws were contained in the initial meeting, the sub-material. The sub-material of the second meeting contained diverse styles of items. The third sub-material meeting presented a quantitative examination of the Particle Dynamics problem.

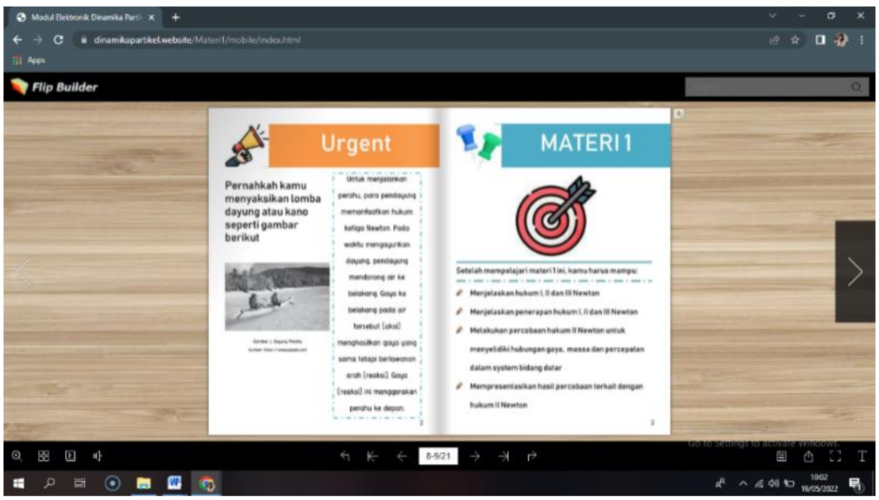

Figure 2 Display on the e-module

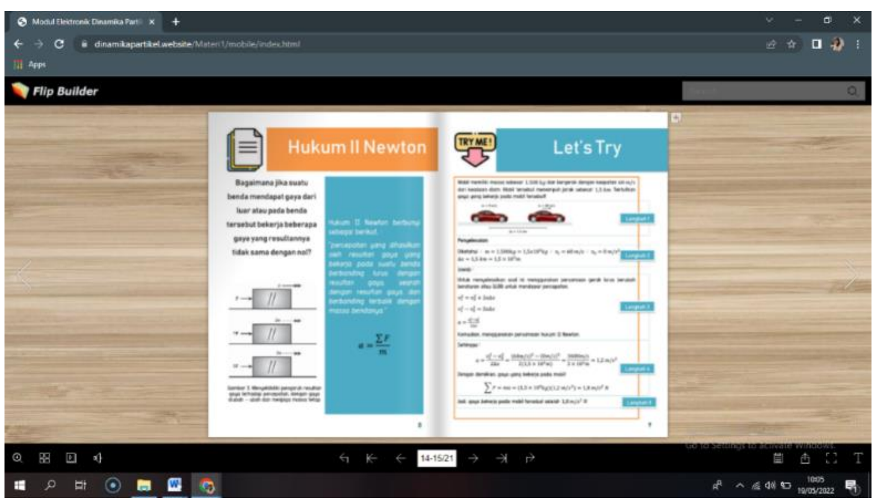

Figure 3 Display quiz on e-module

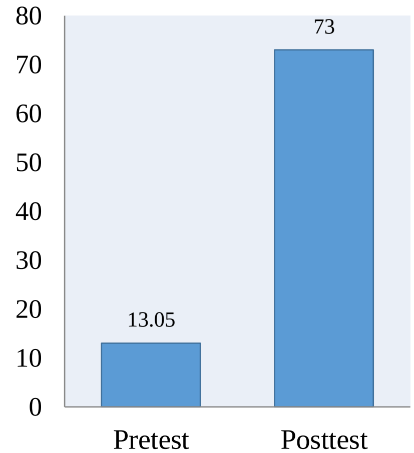

Figure 4 Graph of pretest-posttest improvement

The *N-gain* score test, data from the pretest and post-test results of 20 subjects from public high schools in Banjarmasin showed the usefulness of the electronic module, as shown in Figure 4.

These data, the pretest and posttest results, and the *N-gain* score test results were checked for normality before being utilized to determine the *N-gain* findings in Table 2.

Table 2 The results of calculating the effectiveness of *N-gain*

***Pretest* Average**	***Posttest* Average**	**<*g*>**	**Category**
13.10	73.38	0.69	Medium

Figure 5 compares the number of students who completed and did not complete the course.

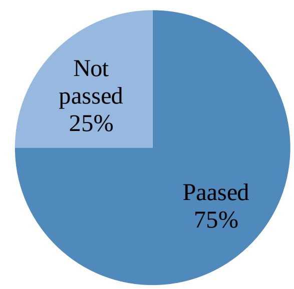

Figure 5 Completeness diagram of student learning outcomes

Table 3 shows the findings of the number of learning objectives met.

Table 3 The proportion of Learning Objectives Achieved

Indicator	**Proportion**	**Criteria**
3.6.1 Explaining Newton's I, II, and III Laws	0.98	Achieved
3.6.2 Explaining the application of Newton's I, II, and III Laws	0.95	Achieved
3.6.3 Calculating the acceleration of objects in a system of flat planes and/or inclined planes	0.74	Not Achieved
3.6.3 Calculating the acceleration of objects in a system of flat planes and/or inclined planes	0.68	Not Achieved
3.6.4 Analyzing the speed of objects in a system with or without the influence of frictional forces	0.48	Not Achieved

Based on Table 3, indicators 3.6.1 and 3.6.2 were achieved with respective values of 0.98 and 0.95. The other three indicators were still in the incomplete group, with values of 0.74, 0.68, whereas indicator 3.6.4 had the lowest score of 0.48. The assessment above was acquired by training students on problem-solving steps when working on questions at each meeting. This was also in accordance with the opinion of Misbah (2016), who stated that in order for students to be able to understand the problems given from the start to ensure they can identify and check the answers found, they must be trained and habituated to solving problems with complete steps. According to Annisah (2018), if students solve difficulties more frequently, they will be able to conquer the problems offered, both in the form of examples in everyday life and through the questions supplied, with clear procedures, and can be done in stages by students before the final test.

Rohmawati (2015) discovered that the efficacy of learning depends on how engaged students are in participating in the learning. Students' problem-solving abilities will increase as questions in guided practice and advanced exercises in learning are provided. According to Anderson & Kratwohl (2015), in order for students to reach realm C2, they must first be able to fulfill realm C1, which is remembering the sound of Newton's I, II, and III laws, so that students can understand, explain, and connect new knowledge with the knowledge they have long owned.

Indicator 3.6.2 explained that applying Newton's I, II, and III Laws falls within the total group. This question, such as indicator 3.6.1, was still in the C2 realm, specifically at the understanding level. Students were deemed to understand if they could relate previous information to the knowledge that the participants would gain (Anderson & Kratwohl, 2015). According to Ramadhanti et al. (2020), employing proper teaching materials to improve students' problem-solving abilities is critical to see an increase before and after learning. This was also consistent with the research of Sasmita et al. (2022), who stated that teaching material developed with problem-solving content is urgently needed in 21st-century learning, as problem-solving is one of the skills students must have in 21st-century learning and life in the current era.

Continuous training in learning by presenting problems or questions in it will strengthen students' problem-solving abilities (Sumartini, 2016; Noviantii et al., 2020). It could train students' problem-solving abilities by giving questions or problems. This was consistent with the findings of the researchers' study, which found that the improved outcomes attained were in the moderate category, with an increased value of 0.69. Based on the effectiveness of this development, it was judged practicable according to this assessment.

CONCLUSION

Based on the discussion and data gathered in this study, it is possible to infer that the produced e-module is capable of training problem-solving abilities and is practicable in terms of its effectiveness, which is in the moderate range, namely 0.69. It is advised that future researchers be able to optimize the strengths in this study further while also improving the inadequacies that remain.

REFERENCES

Abidin, A. (2016). *Desain sistem pembelajaran dalam konteks kurikulum 2013*. Refika Aditama.

Anderson, L. W., & Kratwohl, D. R. (2015). Kerangka landasan untuk pembelajaran, pengajaran, dan asesmen revisi taksonomi pendidikan bloom. *Pustaka Pelajar*, *1*.

Annisah, S. (2018). Pengembangan bahan ajar matematika materi geometri untuk meningkatkan kemampuan pemecahan masalah mahasiswa PGMI IAIN metro. *Al Ibtida: Jurnal Pendidikan Guru MI*, *5*(1). https://doi.org/10.24235/al.ibtida.snj.v5i1.2491

Ayuningtyas, P., W, W. S., & Supardi, A. I. (2015). Pengembangan perangkat pembelajaran fisika dengan model inkuiri terbimbing untuk melatihkan keterampilan proses sains siswa sma pada materi fluida statis. *Jurnal Penelitian Pendidikan Sains*, *4*(2), 636–647.

Depdiknas. (2008). *Pembuatan modul*. Departemen Pendidikan Nasional.

Gunadharma, A. (2011). *Pengembangan modul elektronik penggabungan dan pemberian efek citra BITMAP kelas XI multimedia SMK Negeri 1 Klaten*.

Hadiansah, H., Safitri, T. A., & Suhada, I. (2019). Perbandingan kemampuan pemecahan masalah siswa melalui pembelajaran berbasis masalah dan pembelajaran ICARE. *Quagga: Jurnal Pendidikan Dan Biologi*, *11*(1), 1–5. https://doi.org/10.25134/quagga.v11i1.1525

Hartini, T., & Martin, M. (2020). Pengaruh penggunaan model pembelajaran problem solving sistematis terhadap hasil belajar fisika dasar 2 materi listrik arus searah pada mahasiswa pendidikan fisika. *Silampari Jurnal Pendidikan Ilmu Fisika*, *2*(2), 163–174. https://doi.org/10.31540/sjpif.v2i2.1101

Heller. (2010). *Cooperative problem solving in physics a user's manual*. Univercity of Minnesota.

Herawati, N. S., & Muhtadi, A. (2018). Pengembangan modul elektronik (e-modul) interaktif pada mata pelajaran Kimia kelas XI SMA. *Jurnal Inovasi Teknologi Pendidikan*, *5*(2), 180–191.

Jayadi, A., Putri, D. H., & Johan, H. (2020). Identifikasi pembekalan keterampilan abad 21 pada aspek keterampilan pemecahan masalah siswa SMA kota Bengkulu dalam mata pelajaran fisika. *Jurnal Kumparan Fisika*, *3*(1), 25–32. https://doi.org/10.33369/jkf.3.1.25-32

Mahardika, N. (2019). *Pengembangan Modul Fisika Berbasis Model Problem Based Learning Terintegrasi Polya's Problem Solving untuk Meningkatkan Kemampuan Pemecahan Masalah Peserta Didik*. Doctoral dissertation, Universitas Negeri Padang).

Misbah, M. (2016). Identifikasi kemampuan pemecahan masalah mahasiswa pada materi dinamika partikel. *Jurnal Inovasi dan Pembelajaran Fisika*, *3*(2).

Misbah, M., Hamidah, I., Sriyati, S., & Samsudin, A. (2022). A bibliometric analysis: research trend of critical thinking in science education. *Journal of Engineering Science and Technology*, *17*, 118-126.

Noviantii, E., Yuanita, P., & Maimunah, M. (2020). Pembelajaran berbasis masalah dalam meningkatkan kemampuan pemecahan masalah matematika. *Journal of Education and Learning Mathematics Research (JELMaR)*, *1*(1), 65–73.

Ramadhani, F. D., Wati, M., Misbah, M., & Wiyono, K. (2021). The validity of electronic learning materials optical instruments based on authentic learning to train students' problem solving skills. *Kasuari: Physics Education Journal (KPEJ)*, *4*(2), 78-89.

Ramadhanti, R., Mastuang, M., & Mahardika, A. I. (2020). Pengembangan bahan ajar fisika topik elastistas menggunakan model pengajaran langsung untuk melatihkan kemampuan pemecahan masalah peserta didik. *Jurnal Ilmiah Pendidikan Fisika*, *4*(2), 65. https://doi.org/10.20527/jipf.v4i2.2066

Riwu, I. U., Laksana, D. N. L., & Dhiu, K. D. (2019). Pengembangan bahan ajar elektronik bermuatan multimedia pada tema peduli terhadap makhluk hiduo siswa sekolah dasar kelas IV di Kabupaten Ngada. *Journal of Education Technology*, *2*(2), 2239–

2253. https://doi.org/10.23887/jet.v2i2.16182

Rizki, M., Wati, M., & Misbah, M. (2021). Electronic thermodynamics teaching materials based on authentic learning to practice students' problem-solving skills: Aspects of validity. *Journal of Physics: Conference Series*, 2104(1), 012018.

Rohmawati, A. (2015). Efektivitas pembelajaran. *Jurnal Pendidikan Anak Usia Dini*, *9*(1), 15–32.

Rosida, E. N., Kurniati, L., & Kusumawati, R. (2019). Analisis pemecahan masalah matematika berdasarkan pemanfaatan teknologi digital siswa. *Square : Journal of Mathematics and Mathematics Education*, *1*(1), 33–39. https://doi.org/10.21580/square.v1i1.4089

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.

Sasmita, F. D., Purwaningsih, E., & Amelia, R. (2022). Analisis kebutuhan video pembelajaran bermuatan keterampilan pemecahan masalah untuk meningkatkan hasil belajar. *Jurnal Ilmiah Pendidikan Fisika*, *6*(2), 411-420.

Seruni, R., Munawaoh, S., Kurniadewi, F., & Nurjayadi, M. (2019). Pengembangan modul elektronik (e-module) biokimia pada materi metabolisme lipid menggunakan flip pdf professional. *JTK (Jurnal Tadris Kimiya)*, *4*(1), 48–56. https://doi.org/10.15575/jtk.v4i1.4672

Sriwahyuni, I., Risdianto, E., & Johan, H. (2019). Pengembangan bahan ajar elektronik menggunakan flip pdf professional pada materi alat-alat optik di sma. *Jurnal Kumparan Fisika*, *2*, 145–152.

Sugiyono, S. (2016). *Metode penelitian dan pengembangan*. Alfabeta.

Sumartini, T. S. (2016). Peningkatan kemampuan pemecahan masalah matematis siswa melalui pembelajaran berbasis masalah. *Mosharafa: Jurnal Pendidikan Matematika*, *5*(2), 148–158.

Sutarti, T., & Irawan, E. (2017). *Kiat Sukses Meraih Hibah Penelitian Pengembangan*. Deepublish.

Suyidno, S., Susilowati, E., Arifuddin, M., Misbah, M., Sunarti, T., & Dwikoranto, D. (2019). Increasing Students Responsibility and Scientific Creativity through Creative Responsibility Based Learning. *Jurnal Penelitian Fisika Dan Aplikasinya (JPFA)*, *9*(2), 178-188.

Wati, M., Safiah, S., & Misbah, M. (2021). How to train problem-solving skills in physics using authentic learning. In *Journal of Physics: Conference Series*, 1760(1), 012009.

Zakarsyi, W., Lestari, L., & Karunia, E. Y. (2007). *Penelitian pendidikan matematika*. PT Rafika Aditama.