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# The Effectiveness of Multimodel-Based Physics Modules on Students' Problem-Solving Ability

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**Abstract**

Student problem-solving abilities refer to students' ability to identify problems, analyze problems, develop, and implement these solutions effectively. But in fact, this ability rarely gets attention in school. This study aimed to describe the effectiveness of the multimodel-based physics module on students' problem-solving abilities. This module was developed using Flip PDF Professional with the ADDIE development model and implemented in 34 students of class X MIPA at a high school in Banjarbaru. Data collection instruments were obtained from student learning outcomes based on problem-solving indicators. The results showed an increase in students' problem-solving abilities; this was based on the acquisition of a mean pre-test score of 4.63 in the very poor category to a post-test average score of 52.68 in the sufficient category and supported by an n-gain of 0.50 in the moderate category. Thus, it can be concluded that the multimodel-based physics module developed is classified as effective in improving students' problem-solving abilities.

**Keywords:** Module; Multimodel; Problem-solving

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## INTRODUCTION

Physics is the science that studies natural phenomena and their interactions related to things that can be seen directly or indirectly. Apart from studying facts and understanding concepts, principles, and laws, physics teaches how to get information, apply technology in everyday life, work collaboratively with scientific knowledge, and train problem-solving skills (Aji et al., 2017; Argaw et al., 2016; Misbah et al., 2022). Problem-solving abilities are required for students because they are the foundation and overall goal of precise learning, which involves using various problem-solving methods, procedures, and the best problem-solving strategies (Rizki et a;., 2021; Saputri et al., 2021; Sumartini, 2016). Furthermore, problem-solving skills are important because they can increase students' sensitivity to various existing problems (Aripin et al., 2021; Prahani et al., 2021; Ramadhani et al., 2021). As a result, learning physics is closely related to problem-solving abilities because learning is always based on concepts and is applied in solving physics problems so students can work scientifically.

According to Ogunleye (2009) in (Azizah et al., 2015), one factor contributing to students' difficulties in problem-solving is a lack of laboratory practicum activities and errors in writing physics unit conversions. Another factor is that students are still weak and do not understand the physics principles and rules, the questions, and have low learning motivation. Furthermore, teacher-centered learning is still used in schools, which results in students not having the opportunity to develop their knowledge to solve given problems. This occurs due to students’ position as objects of receiving information (Aripin et al., 2021). According to Sumarmo’s research (2010) in (Dewi et al., 2018), students' problem-solving ability in several high schools in Bandung is low. In line with such, students' problem-solving ability in one of Banjarmasin's schools is also relatively low, owing to a lack of opportunities for students to learn directly from the teacher’s demonstration of knowledge (Habibi et al., 2017). To overcome this, teaching materials, such as modules, must be created to support students' problem-solving abilities. A module is a teaching material organized systematically, efficiently, and simply. It combines experience with student knowledge, making it easier for students to gain information, knowledge, experience, and skills from their learning (Aji et al., 2017). The module is classified into two types based on its shape: printed modules and electronic modules (Puspitasari, 2019). The module developed in this study is an electronic module.

In addition to improving the teaching materials, the learning model used in the classroom must be considered to support students' problem-solving abilities. Multimodel is a learning process that combines several learning models (Maria, 2010; Syahruddin, 2014), allowing more than one learning model to be used for a single topic of physics material. Such a strategy can assist students from the beginning, namely the procedural stage, in becoming more active in building knowledge that must be achieved in accordance with learning objectives (Fautin et al., 2021). Since it changes the learning model in each meeting, multimodel-based learning can be a solution. The benefit of multimodel learning is that it helps students stay focused and motivates them during the learning process (Syahruddin, 2014). Three learning models were used in this study: direct teaching, guided discovery, and cooperative teaching.

According to Panjaitan (2016) and Wicaksono et al. (2017) in (Lailis et al., 2020), first, the direct instruction model is a learning model in which educators demonstrate to students to improve learning outcomes, facilitates students' understanding of basic concepts of existing material and apply them to problems given, and gradually train students’ abilities. Second, the guided discovery learning model is a learning process that involves students in organizing, developing knowledge, and practicing problem-solving skills, to provide opportunities for students to be actively involved and participate in learning and in assisting students in developing effective ways of working together and sharing information. Furthermore, this model focuses on the mental and physical aspects of students’ motivation, enthusiasm, and concentration in carrying out learning activities (Fitriyah et al., 2017). In addition, the cooperative learning model is a learning model that is used to increase student learning interest and create a more interesting learning environment by having students take a more active role in working together and interacting with one another (Jampel et al., 2018; Nurmairina & Lestari, 2020; Rahman et al., 2016). In line with Sujana's research (2017) in (Tela et al., 2019), students' ability to solve mathematical problems using cooperative models is higher than in classes using controlled lecture teaching models or methods.

Based on the description above, educators are expected to be able to create or develop a source/teaching material that can improve students' problem-solving skills, such as physics learning modules. The availability of teaching materials in the form of modules is thought to be capable of assisting students in obtaining efficient learning resources; additionally, the electronic modules developed can be printed independently by students, making it easier for students to access them quickly and flexibly. According to Lailis et al. (2019) in (Nida et al., 2021), the development of physics learning materials responsive to technological advancements makes it easier for students to access them via laptops or smartphones. The developed physics module, in conjunction with the multimodel, emphasizes the diversity of learning models regarding impulse material and linear momentum in improving problem-solving abilities, where learning that was previously teacher-centered is now student-centered, and each meeting emphasizes the 7 steps of problem-solving. These steps are emphasized in each meeting through the use of (1) diagrams or simple sketches, (2) drawing information or data, (3) identifying unknown variables, (4) analyzing problem-solving, (5) writing relevant equations, (6) substituting information and problem-solving, (7) interpretation (Greenstein, 2012; Gaigher, 2006 in Marlina et al., 2021). Since educators play a full role at the beginning and gradually shift to students who play an active and independent role in class, the use of physics modules combined with a multimodel is thought to be capable of optimally achieving learning objectives. Furthermore, multimodel-based learning is thought to be capable of increasing student motivation in learning, attracting attention in reading and studying the module, improving and training students' problem-solving skills, and developing the potential that exists in students so that the pre-designed physics learning objectives are easy to achieve while eliminating negative physics assumptions. Based on previous case studies, multimodel learning activities have improved students' higher-order and conceptual thinking skills during learning (Abidin, 2022). As a result, this research aims to describe the impact of the multimodel-based physics module on students' problem-solving abilities.

## METHOD

Research and Development (R&D) is a type of research applied to and adapted from the *ADDIE* development model. This research developed a multimodel-based physics module with the research design presented in Figure 1.

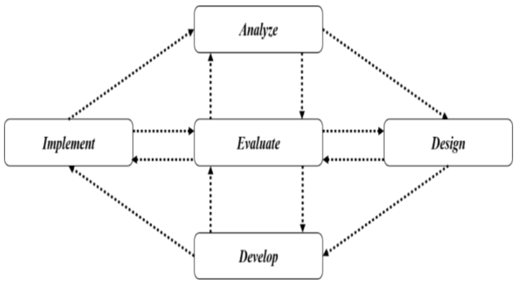


Figure 1 *ADDIE* development research design

(Tegeh *et al.*, 2015)

A draft module of impulse and linear momentum with a multimodel learning model was created on students' problem-solving skills during the analysis, design, development, implementation, and evaluation stages. The implementation test used the one-group pre-test and post-test design methods. It was applied to 34 students of class X MIPA at a high school in Banjarbaru, South Kalimantan, Indonesia. The implementation test was carried out from February to June 2022.

The research began by assessing students' initial problem-solving abilities, so students were given pre-test questions (O1) in the shape of seven essay questions based on problem-solving indicators. During the learning activities (X), the direct teaching-learning model was used in the first meeting to discuss the impulse-momentum concept, the guided discovery learning model was used in the second meeting to discuss the law of conservation of momentum experiments, and cooperative learning models were used in the third meeting to discuss collisions.

Students are accustomed to working on questions with indicators of problem-solving in seven phases for two meetings. Meanwhile, students concentrated on attaining basic competence of 4.10 at one meeting. Furthermore, at the last meeting, students were given a post-test ($O_2$) that contained the same questions as the pre-test, but the sequence of the questions was randomized. The pre-test and post-test findings will be analyzed to determine the effectiveness of the developed module. The N-gain equation was used to determine the increase or degree of progress in student learning outcomes, with data from the pre-test and post-test provided at the beginning and end of the learning process. The calculated findings would be classified using the following criteria: height ≥ 0,7; 0,7 > moderate ≥ 0,3, and 0,3 > low (Hake, 1998). In contrast, the achievement of students' problem-solving abilities was obtained by assigning scores at each level of problem-solving abilities attained by students via learning achievement tests. The obtained findings will be adjusted in accordance with the criteria in Table 1.

Table 1 Criteria for problem-solving abilities

| **Mean Score** | **Category** |
|---|---|
| $80 < X \leq 100$ | Very good |
| $60 < X \leq 80$ | Good |
| $40 < X \leq 60$ | Enough |
| $20 < X \leq 40$ | Poor |
| $0 < X \leq 20$ | Very poor |

(Widoyoko, 2017)

## RESULTS AND DISCUSSION

The modules developed in this study were linked to impulse and linear momentum material and were based on multimodels on students' problem-solving abilities. The modules developed are based on the Revised 2013 curriculum. This multimodel-based physics module ensured that learning activities were carried out successfully during hybrid learning. A hybrid learning exercise combines face-to-face (offline) and online learning (online). Hybrid learning activities necessitate media that can assist students in understanding instructional material, namely modules that can be accessed in various ways (Putri et al., 2022). The title, foreword, list of contents, concept maps, learning objectives and/or basic competencies, a description of the material that refers to several sources of internet literature, textbooks, and student worksheets' that are then developed according to the characteristics of the material and students, formative tests, summary, answer key, glossary, and bibliography were all included in this module. It can be accessed via the following link: https://impulsdanmomentumlinear.on.drv.tw/modulfisika/mobile/.

The following products developed are shown in Figure 2.

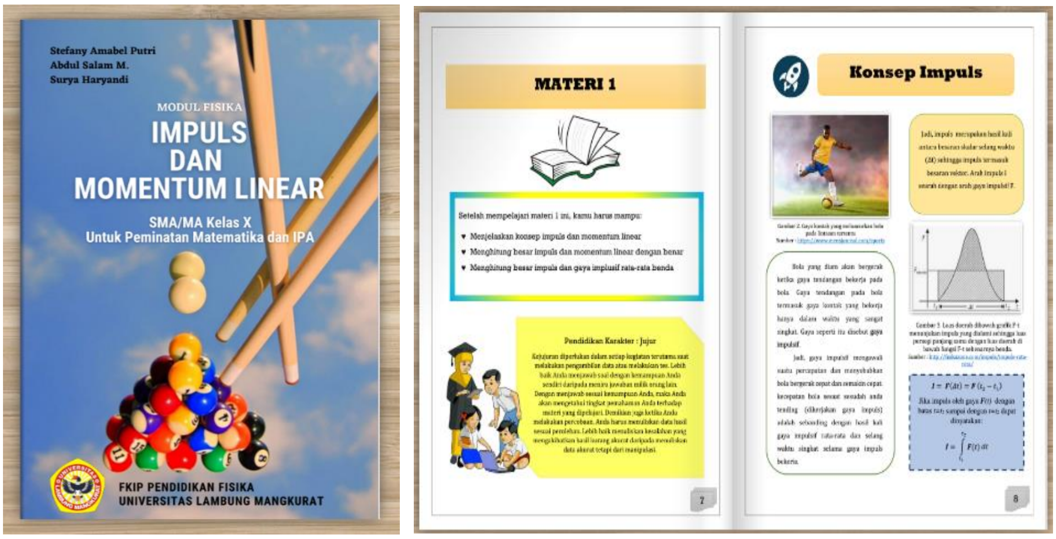


Figure 2 (a) Module cover and (b) The material for the first meeting (the concept of impulse)

Effectiveness is the degree to which someone who performs a task is aligned with the objective or goal to be achieved, where the results received from carrying out the task are in accordance with the previously established goals (Rohmawati, 2015). However, knowledge transfer from educators to students can be said to be ineffective if students lack the ability to comprehend, process, and construct information conveyed by educators (Dewantara et al., 2022), as a consequence, the learning outcomes achieved are poor (Rahmatullah et al., 2022). The effectiveness of the learning resources in this discussion are modules, which can be measured from student learning outcomes tests in the form of pre-tests and post-tests in the cognitive domain to determine the level of achievement of student learning outcomes tests that have used electronic modules (Alfianka, 2018).

The following is a table of N-gain student learning results.

Table 2 Acquisition of N-gain learning results

| Pre-test Mean | Post-test Mean | N-gain | Category |
|---|---|---|---|
| 4.63 | 52.68 | 0.50 | Sedang |

According to Table 2, the developed module was classified as effective because it fell into the moderate group. In line with (Anisah et al., 2016), electronic modules can be deemed effective if the outcomes meet predetermined objectives. Furthermore, the achievement of student problem-solving indicators could determine the module's effectiveness. Achievement of student problem solving indicators is shown in Table 3.

Table 3 Achievement indicators of students' problem-solving abilities

| Problem-solving Indicator | Pre-test | | Post-test | |
|---|---|---|---|---|
| | Score | Category | Score | Category |
| Drawing a simple diagram or sketch | 0.00 | Very poor | 42.62 | Enough |
| Writing down information or data on the image | 10.04 | Very poor | 82.97 | Very good |
| Identifying unknown variables | 18.38 | Very poor | 83.82 | Very good |
| Analyzing problem-solving | 0.00 | Very poor | 40.80 | Enough |
| Writing down the relevant equations | 0.98 | Very poor | 36.10 | Poor |
| Substituting information and solving problems | 0,00 | Very poor | 62.94 | Good |
| Interpretation | 0,00 | Very poor | 36.76 | Poor |

As shown in Table 3, there were indications of increasing achievement of problem-solving indicators based on the findings of the pre-test and post-test. This is consistent with the research (Syahruddin, 2014), which showed that using multi-model-based learning could improve student learning outcomes. This could happen because students become accustomed to interacting with one another during the learning process, increasing student learning outcomes as expected. According to (Ramadayanty et al., 2021 in Annisa, 2022), since the module used as the main reference contained various questions detailing all stages of the problem-solving ability indicator, the electronic-based module had proven to be capable of training students' problem-solving skills in high school. Furthermore, according to research Tristiyanti & Afriansyah (2016), using the cooperative model has greatly improved students' problem-solving abilities based on acquiring moderate N-gain.

Multimodel learning has benefits, such as assisting students in staying focused and boosting student motivation in the learning process (Syahruddin, 2014), so the number of categories in all stages of issue-solving has increased. However, there are two phases with improvements categorized as less; this can occur due to internal or external factors present in these students. Aside from improving students' problem-solving abilities, multimodel learning has been shown to improve students' innovative thinking abilities (Rohana, 2019), this could be proven by the acquisition of an N-gain of 0.70 in the moderate category and a high response with an average score of 3.2 out of a maximum score of 4. This was in line with the research of (Salam et al., 2022), where multimodel-based learning was able to train higher-order thinking skills with an N-gain of 0.54 in the moderate category. In the research of (Nida et al., 2021), multimodel learning was thought to improve students' analytical abilities and thus increase student learning outcomes.

Each indicator's problem-solving capacity improved when this study was taken as a whole. This was predicated on income N-gain learning outcomes and improved problem-solving achievement. Furthermore, it was known that the developed module was useful in improving problem-solving abilities and could be used in school to study physics. Previous research by Noviyani (2021), Intan and Krisnadwipayana (2020), Rajabi et al. (2015), and Riefani (2020) showed that multimodel learning improved learning outcomes and was important for learning implementation. The module or product in use was the result of development and was shown to be pertinent because it had been validated, effective, and practical. The material was also in accordance with the latest curriculum, the 2013 Curriculum Revision, and the most important adjustments to the learning objectives to be achieved (Agustina et al., 2022).

## CONCLUSION

According to the findings of the research, the effectiveness of the multimodel-based physics module on students' problem-solving abilities was classified as effective. This refers to the acquisition of n-gain learning outcomes of 0.50, which is in the moderate category and can improve students' problem-solving abilities with an average score of 52.68, which is in the sufficient category. If similar research is conducted in the future, the findings of this study can be used as a reference source to overcome the shortcomings of previous research, in which students are intensively guided in the use of problem-solving indicators for the given problems and make the module even more interesting with the presence of additional features that support an in-depth understanding of physics concepts, so that students are enthusiastic and interested in engaging in learning, as well as proper time management based on various learning models that will be applied later. Furthermore, this multimodel learning can be used in the study to train students' higher-order thinking skills and increase students' creative thinking skills.

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