

Development of Phys-FLUIDS Learning Media to Improve Problem Solving Skills of Prospective Physics Teacher Students

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ABSTRACT

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The study aims to analyze the validity results of the development of Phys-FLUIDS (Physics-Fundamental Learning & Ultimate Insights in Dynamic Statics) to improve the problem-solving skills of prospective physics teacher students. The study was structured as R&D development research, employing the Borg and Gall model approach. In the needs analysis stage, samples were obtained from several physics students at Surabaya State University. The validity of Phys-FLUIDS was assessed through a product test with three expert validators in their respective fields. The study's results indicate that Phys-FLUID was developed to meet the very valid category, with an average Aiken's value score of 0.90, serving as a teaching material to improve the problem-solving skills of prospective teacher students. With the construction of materials, questions, problem reasoning, problem-solving approaches, and attractive designs, Phys-FLUIDS can increase the enthusiasm of prospective teacher students in providing effective teaching in the classroom. Phys-FLUID is designed in the form of E-Books and conventional books, which are considered less dynamic and interactive. Therefore, it is recommended that Phys-FLUIDS be developed in a virtual application design. Although this research is limited in its development design, which only reaches the validation stage, it can provide a clear picture of whether the Phys-FLUIDS developed meets the very valid category.

INTRODUCTION

The development of knowledge in the 21st century is rapid, with the way of thinking and problems arising in various fields of activity becoming increasingly complex (Anggraeni et al., 2022; Avdiu et al., 2025). The ability to think realistically, logically, and systematically to solve problems is a skill that every individual must possess today (Sinnema et al., 2023; Jamil et al., 2024). The process of reconstructing knowledge and ways of thinking is most often found in the world of education (Whitehead & Huxtable, 2023; Nieminen et al., 2024). As a student or teacher, it is mandatory to have good problem-solving skills. Problem-solving skills are considered very important because they enable the ability to analyze, identify, and evaluate solutions practically and effectively (Dwikoranto, 2022; Lintangesukmanjaya, Ramadhana et al., 2025). Problem-solving is the basis for improving 21st-century skills, as each skill requires a good solution analysis.

However, the reality is that the lack of competence among students and teachers in the world of education today is something that needs to be addressed. Indonesia's PISA scores ranked 74th out of 79 OECD countries in the reading, mathematics, and science assessment categories from 2018 to 2022 (Pramana et al., 2021; Chu et al., 2024). Learning difficulties and low learning outcomes are attributed to the impact of low

problem-solving skills (Mursid et al., 2022; Harefa et al., 2023). It is well known that students excel under competent teachers. However, upon examining current facts, it becomes apparent that many teachers lack practical problem-solving skills, particularly physics and science teachers who require extensive learning experiences and knowledge due to the abstract and complex nature of the material (Lintangesukmanjaya et al., 2025; Deta et al., 2023). The government has made various efforts to improve the quality and skills of teachers, one of which is the Merdeka Belajar program, which is given to prospective teachers at the university level (Karatas & Arpaci, 2021; Khairunnisa & Syofyan, 2025).

The Merdeka Belajar activity provides prospective teacher students with access to carry out PPL (Teaching Practicum) activities, undergo orientation, and become accustomed to being a teacher before entering the real world of education (Anis & Hasan, 2025). However, even though the Teaching Practicum activity has been carried out, this has not been optimal in preparing competent prospective teachers. The problem analysis of this is due to the material readiness of prospective teachers who are not optimal in educating students at school (Mutohhari et al., 2021; Ben Gurion & Nasir, 2024).

The need for suitable teaching materials in PPL (Teaching Practicum) activities is one of the problems that require a solution. Especially teaching materials that contain guidelines and learning activities to make it easier for prospective teachers to carry out learning in Teaching Practicum activities (Maulana et al., 2024; Maulisa et al., 2024). Additionally, the teaching materials must be able to enhance problem-solving skills, particularly in science or physics learning (Adhelacahya et al., 2023). Therefore, the Phys-FLUIDS (Physics-Fundamental Learning & Ultimate Insights in Dynamic Statics) teaching materials were developed as an innovation to improve the problem-solving skills of prospective teacher students.

The Phys-FLUIDS (Physics-Fundamental Learning & Ultimate Insights in Dynamic Statics) teaching material was developed on static and dynamic fluid material, which is arranged in the form of a textbook and teaching guide. The existence of Phys-FLUIDS is expected to enhance the problem-solving skills of prospective teachers and contribute to the improvement of teacher standards broadly. This study aims to analyze the validity results of the development of Phys-FLUIDS (Physics-Fundamental Learning & Ultimate Insights in Dynamic Statics) to improve the problem-solving skills of prospective physics teacher students.

RESEARCH METHOD

Types of research

The research is conditioned in the form of quantitative descriptive research. Through numerical analysis and relevant studies, generalization of findings is obtained (Hidayat & Aripin, 2023; Khonamri et al., 2024). The research is structured in the form of R&D development research with the Borg and Gall model approach (Purba, 2024; Aprilia et al., 2025)



Figure 1. Research flow R&D model modified by Borg & Gall

In the development of R&D (Research and Development) research with the modified Borg and Gall model (Purba, 2024). In this study, only the needs analysis process, initial product development, expert validation, and product revision were carried out. This limitation was carried out by considering the research objectives and focusing on the quality of the product developed theoretically and needs. The stages passed include needs analysis, initial product design, validation by material and media experts, and product improvements based on input from validators. Thus, the results of this study produced Phys-FLUIDS which has been conceptually validated and declared feasible for use in further development stages (Luzyawati et al., 2025).

Population and Sample

In the needs analysis stage, samples were obtained from several physics students at Surabaya State University. The research sample was taken using a purposive sampling technique (Ismawati et al., 2023) which was adjusted to the needs. Meanwhile, to determine the validity of Phys-FLUIDS, a product test was given to 3 expert validators in their fields.

Data Analysis Techniques

The technique of data collection is adjusted to the type of research used. In addition, data analysis is also obtained through the results obtained from the research instruments used (Creswell, 2009; Shroff et al., 2021). There are 2 types of research instruments used as follows,

Table 1. Research Instrument

No	Instrument Type	Measurement Indicator	Analysis Techniques
1	Questionnaire	Validation Sheet Recommendation of Teaching Materials and Learning Materials	Likert Scale Analysis and Agreement Indicator Analysis
2	Validation Sheet	Content, Display Quality and Construction	Aiken's Value Analysis ($V > 0.60$)

In the test instrument used to measure problem-solving skills, 4 indicators were used according to Polya (Mauliyda et al., 2019; Jahudin & Siew, 2024). All indicators used to complete problem-solving skills are integrated in Phys-FLUIDS.

Table 2. Problem Solving Indicators

No	Indicator	Information
1	Understanding the Problem	Identifying problems and determining main ideas
2	Make a Plan	Understanding the source of the problem and describing strategic steps
3	Implementing the Plan	Implement problem solving solutions systematically
4	Check Back	Conduct evaluation of decision results

The validity results of Phys-FLUIDS are analyzed and evaluated as material for revising the development of Phys-FLUIDS in the future. The analysis is adjusted to the relevant literature review as a support for ideas and findings in the research (Sepasgozar, 2021; Lintangesukmanjaya et al., 2025).

RESULTS AND DISCUSSION

Based on the research results obtained from the existing needs analysis, the following are the results of the distribution of questionnaires related to the need for teaching materials for prospective teacher students.

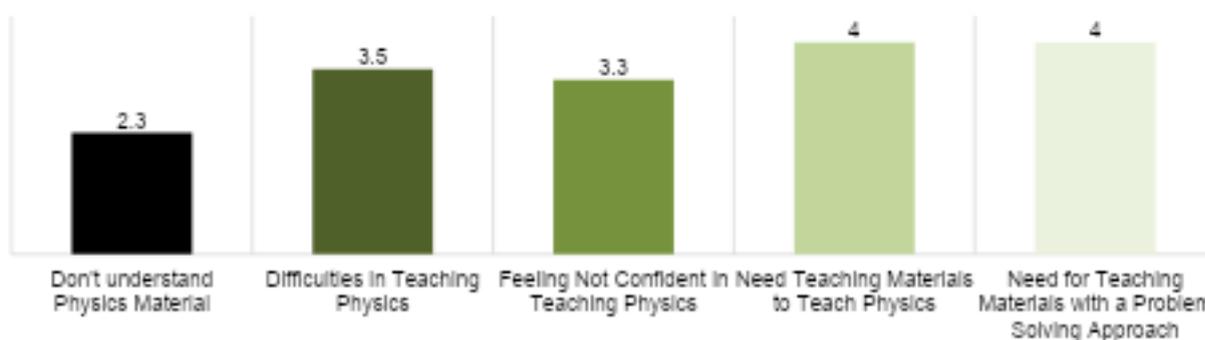


Figure 2. Student Teacher Questionnaire Results

The results of the questionnaire given stated that many prospective teacher students found it difficult to learn physics. This difficulty causes prospective teacher students to also feel less confident in teaching physics in front of students at school (Grokholskyi et al., 2020; Omar et al., 2024). To overcome this, Phys-FLUIDS teaching materials were designed in static and dynamic fluid material as a guide to learning materials to be used by prospective teacher students in PPL (The Teaching Practicum) activities.

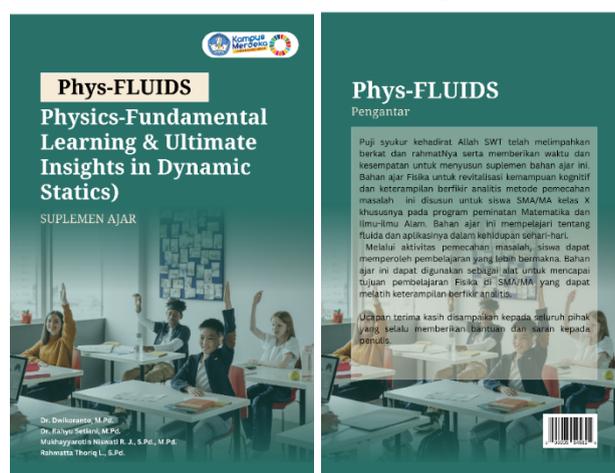


Figure 3. Phys-FLUIDS Cover View

Phys-FLUIDS is arranged in the form of teaching materials that have a display in the form of e-books and conventional books. With materials, questions, work steps and

problem-solving approaches, Phys-FLUID can be used as a guide for teachers in teaching in class. In determining the validity of the development of Phys-FLUIDS, an analysis of the results of the validity given to 3 expert validators was carried out as follows, Cover Phys-FLUIDS.

Table 3. Validity Phys-FLUIDS

No	Rated Aspect	Validator Value				Category
		1	2	3	Aiken's V.	
CONTENT						
1	Suitability of materials to learning objectives	4	4	4	1.00	Very Valid
2	Arrangement of material in a coherent, systematic and easy to understand manner	4	4	3	0.89	Very Valid
3	Suitability of needs and useful for increasing students' insight.	3	4	4	0.89	Very Valid
QUALITY AND APPEARANCE						
5	The Phys-FLUIDS display is clear and attractive.	3	4	4	0.89	Very Valid
6	Visual illustrations can make learning easier.	3	4	3	0.78	Valid
7	The use of media can reduce students' misperceptions of the material being taught.	4	3	4	0.89	Very Valid
8	Phys-FLUIDS is easy to operate	4	3	4	0.89	Very Valid
CONSTRUCT						
8	Use of language in accordance with EYD.	4	4	3	0.89	Very Valid
9	The language used is communicative.	4	4	4	1	Very Valid
10	Compliance with Indonesian language rules and not using taboo language.	4	4	3	0.89	Very Valid
11	Clarity of information	4	4	4	1	Very Valid
Average Assessment Score					0.90	Very Valid

The results of the validity obtained an average assessment score of 0.90 with the decision that the developed Phys-FLUIDS was categorized as very valid (Saraswati et al., 2021; Shroff et al., 2021). Differences in validity values in several aspects are normal where each teaching material developed has advantages and disadvantages to be evaluated and become recommendations for further product revisions.

Based on the results of the study in obtaining responses from prospective teacher students to find recommendations for interesting and appropriate teaching materials, Phys-FLUIDS was obtained as a teaching material to improve problem-solving skills. The initial condition analysis that many prospective physics teachers find it difficult to teach is in accordance with Figure 2. Apart from the lack of knowledge and understanding of physics material, this is also influenced by a lack of self-confidence

(Awanis et al., 2024). In educational science, the teaching process not only requires knowledge but also requires good pedagogical skills (Ibragimovich et al., 2021). Teachers must be able to master the classroom environment, material and students' feelings. This is often forgotten by prospective teachers today (Arpentieva et al., 2021). The relationship with teaching materials is that teaching materials are a medium to assist teachers in carrying out the learning process. With teaching materials, teacher activities and activities become lighter and not too heavy (Riard & Kaur, 2022). Especially teaching materials that are equipped with procedural techniques, worksheets and evaluations in them. So it is not surprising that prospective teacher students now tend to need teaching materials that are equipped with certain materials and approaches. In accordance with the initial analysis, it is known that problem-solving skills are very important and in accordance with the results of the prospective teacher questionnaire (Samadun & Dwikoranto, 2022), it was obtained that teaching materials are needed with integrated learning materials that can improve problem-solving skills. In this regard, Phys-FLUIDS was developed as an alternative teaching material that seeks to improve the problem-solving skills of prospective teacher students in learning fluid physics. The validity results of Phys-FLUID are categorized as very high with an average Aiken's value of 0.90. There are several notes on the results of the Phys-FLUIDS development where this is related to the difference in the results of the validation score. The lowest score is the illustration visualization, where Phys-FLUID is only designed in the form of an E-Book and a conventional book. The weakness of visualization in the form of digital or conventional books is only visible in 2D and is not dynamically interactive (Susilawati et al., 2023; Saphira et al., 2024). This can be a note for the recommendation that Phys-FLUIDS be developed in application design. On the other hand, with the validation results given by 3 expert validators, it can be said that Phys-FLUIDS is very valid and can be implemented in fluid learning. With the construction of materials, questions, problem reasoning, problem-solving approaches and attractive designs, Phys-FLUIDS can increase the enthusiasm of prospective teacher students in teaching in class (Mulyadi et al., 2020; Choirudin et al., 2025). Phys-FLUIDS is indeed designed as a material handling book which will later become a summary as well as question materials for students when carrying out PLP ((The Teaching Practicum). Although this research is limited in the development design which only reaches the validation stage, this research is able to provide a clear picture if the Phys-FLUIDS developed meets the very valid category. It is hoped that future research can be carried out with efforts to implement Phys-FLUIDS with a wide implementation scale to test the validity, practicality and effectiveness of the Phys-FLUIDS developed.

CONCLUSION

Phys-FLUID was developed to meet the very valid category with an average Aiken's Value score of 0.90 as a teaching material to improve the problem-solving skills of prospective teacher students which are still relatively low. The development of Phys-FLUIDS is in accordance with the recommendations and initial analysis given to prospective teacher students. With the construction of materials, questions, problem reasoning, problem-solving approaches and attractive designs, Phys-FLUIDS can increase the enthusiasm of prospective teacher students in providing teaching in class. The weakness of Phys-FLUID is that it is designed in the form of E-Books and

conventional books which are considered less dynamic and interactive so it is recommended that Phys-FLUIDS can be developed in a virtual application design. Although this research is limited in the development design which only reaches the validation stage, this research is able to provide a clear picture if the developed Phys-FLUIDS meets the very valid category. It is hoped that future research can implement Phys-FLUIDS to test the validity, practicality and effectiveness of the developed Phys-FLUIDS.

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