

## VALIDITY OF PROBLEM-BASED LEARNING TOOLS WITH THE STEAM APPROACH TO IMPROVE STUDENT LEARNING OUTCOMES ON THERMODYNAMICS MATERIAL

Sarmila B. Ali, Mursalin, and Trisnawaty Junus Buhungo\*

Physics Education Study Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Gorontalo, Gorontalo, Indonesia

\*Email: [trisnawaty.buhungo.@ung.ac.id](mailto:trisnawaty.buhungo.@ung.ac.id).

Received: August 10, 2023. Accepted: September 25, 2023. Published: September 29, 2023

---

**Abstract:** The purpose of this research is to describe the level of validity of learning devices that use problem-based learning models with the STEAM approach to improve student learning outcomes in thermodynamics material. This research is a type of research and development (R&D). This research was conducted in class XI IPA I SMA Negeri 1 Limboto Barat, Kec. Limboto Barat, Kab. Gorontalo for the 2022/2023 academic year. This study uses the ADDIE development model: analysis, design, development, implementation, and evaluation. The results of this study indicate that learning tools that use the problem-based learning model with the STEAM approach are declared valid and suitable for use in the learning process. It can be seen from the validation results which show that the average validation of the developed learning tools obtains very valid criteria.

**Keywords:** *Validity, Learning Devices, Problem-Based Learning, STEAM Approach*

---

### INTRODUCTION

Education is a conscious and planned effort to realize a pleasant learning and learning atmosphere so that students actively develop their potential to have religious and spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves and the community. Education is all learning experiences that last throughout life in all environments and situations that positively influence each individual's growth. In a narrow sense, education is an effort for results cultivated in institutions against students who are handed over to them to have good competence and full awareness of student relationships and social problems [1].

Permendikbud number 65 of 2013 stated that the learning process in the education unit is held interactively, inspiring, fun, and challenging, motivating students to participate actively and providing sufficient space for initiative, creativity, and independence following talents, interests, and physical development as well as the psychology of students [2].

Learners have the potential to develop, and they try to develop their potential through the educational process on certain paths and types of education. In developing these students, they have needs that must be met. Fulfillment of the needs of students grows and develops to reach physical and psychological maturity. The needs that students must meet include physical needs, social needs, and intellectual needs.

In addition, teachers are one of the important components in the teaching process. A teacher participates to form potential human resources in the field of development. Professional teachers must be able to play the role of a good manager. They must carry out all activities and learning processes with good management to achieve the expected learning

goals with satisfactory results [3]. As a professional, the teacher should be able to apply an approach tailored to the goals to be achieved, namely improving student learning outcomes in physics subjects. A teacher should refrain from continuously conveying material to students. Therefore, the STEAM approach (science, technology, engineering, art, and mathematics) and the problem-based learning model must be developed in teaching and learning.

STEAM is a learning method that uses an inter-science approach, and its application is accompanied by problem-based active learning [4]. In contrast, the Problem-Based Learning (PBL) learning model acts as a learning model that involves students solving problems through several stages of the scientific method so that students are expected to learn knowledge related to problems and involve skills in solving problems [5]. Problem-based learning has been tested, and this model affects improving student learning outcomes. The problem-based learning model is a learning model that trains and develops the ability to solve an authentic problem in the student's actual life scientifically, which is arranged systematically. The discovery is centered on the student and does not depend on the teacher. Still, the teacher repeatedly provides direction and guidance to the student so that the student can solve the problems the teacher gave [6]. Problem-based learning involves students explaining various problems through various stages of logical strategy [7].

In improving student learning outcomes, good and appropriate teaching methods are needed. The teacher uses the teaching method to deliver the subject matter by focusing on the entire learning situation to achieve the goal. A good teaching method is a method that demands

the activeness of students in improving learning outcomes and developing accepted and mastered subject matter, especially in physics lessons.

Physics lessons teach various knowledge that can develop reasoning analysis so that almost all problems related to nature can be understood. To be able to understand physics broadly, it must start with the ability to understand the basic concepts that exist in physics lessons. Whether or not a student succeeds in understanding physics lessons is determined by understanding concepts. A student studying physics is said to be less successful if the behavior changes that occur have not been able to determine their wisdom to achieve a result that has been set correctly within a predetermined time. To achieve a maximum learning result, many aspects affect it, including aspects of teachers, students, learning methods, and others.

The problem students face in the teaching and learning process is the difficulty of understanding the material taught by the teacher using a learning model that has yet to activate all students. So far, teachers still use conventional learning models. Generally, the problem is dominated by less varied teachers in using learning models. Teachers still use a monotonous traditional teaching style, such as demonstration methods, discussions, and others. As a result, students experience soreness in learning and difficulty understanding physics lessons, so students' learning outcomes could be better. Teachers need to change the old teaching strategy or model with the new one to overcome the learning difficulties faced by students and allow students to be active in learning to improve student learning outcomes.

The low learning outcomes of students in physics subjects are influenced by the concentration and focus of students when following and receiving the material provided. Physics subjects are one of the subjects that are less in demand by students. They assume that physics subjects are difficult to understand because there are many mathematical formulas in them. It causes students to be unprepared in the teaching and learning process, which results in ineffective learning so that the understanding of the material in physics concepts is minimal. Finally, the learning results in physics lessons have been different than expected.

Based on the description above, problem-based learning tools are developed with the STEAM approach to improve student learning outcomes in thermodynamic materials. This research aims to see the validity of problem-based learning tools with the STEAM approach to improve student learning outcomes on thermodynamic materials.

## RESEARCH METHOD

The method used in this research is development research (R & D). Development research is a process to develop and validate products used in education and learning [8]. The research was

carried out in class XI IPA I SMA Negeri 1 Limboto Barat, Kec Limboto Barat, Gorontalo Regency, for the 2022/2023 school year. This research is compiled and developed based on the ADDIE model developed by Reiser and Molenda. The ADDIE model was used in this study because it was product-oriented.

The instrument used in this study is a learning tool validation sheet. Learning tool validation sheets are used to see the developed tool's feasibility level. The learning tools that are developed need to be valid. It is done so that learning tools are suitable for learning [9]. Validity is an absolute requirement for the development design before the development trial is carried out in the next stage (implementation) [10]. In conducting validation, the validator uses the validation sheet instrument to be assessed and commented on. Device validation is done by two validators using the validation sheet. The validity data of learning tools is validated by expert validators who review and assess aspects of content and learning activities that are construct validity [11]. The average validation value of experts or validators is determined based on the criteria in Table 1.

Table 1. Validation and Analysis

Score Interval	Assessment Criteria	Information
$3.5 \leq P < 4$	Very Valid	It can be used without revision
$2.6 \leq P < 3.5$	Valid	It can be used with a little revision
$1.6 \leq P < 2.5$	Less Valid	It can be used with many revisions
$1 \leq P < 1.5$	Invalid	Unable to be used, and there are still many revisions

[12].

## RESULTS AND DISCUSSION

The results of the development of problem-based learning tools with the STEAM approach begin with the analysis stage, which is carried out into two stages, namely the curriculum analysis stage and the needs analysis stage. The two stages, namely design according to Uzain [13], are carried out in preparing the device design and the equipment to produce a draft 1. The final stage, namely development at this stage, is used for device validation and revision, resulting in draft 2. The validity of the learning tools in this study was obtained through the results of data analysis obtained from the validation stuffing on the validation sheet [14].

The learning tools must be validated by experts or validators to be known to be valid or not the learning tools used. Validation of learning tools can be viewed through comments or suggestions from experts on the validation sheet. The validator comprises two lecturers in the Faculty of Mathematics and Natural Sciences physics department at Gorontalo State University. Validation results containing comments or suggestions about learning tools and instruments must be revised again to be used in research. The following are the results of validation by Hli, who provided comments and suggestions on learning tools and research instruments on the validation sheet made by the researcher, which can be seen in Table 2.

Table 2. Validation Results of Learning Devices and Instruments

No.	Learning Tools and Instruments	Average Overall Validator	Criteria
1.	Syllabus	3.87	Very Valid
2.	Lesson plan	3.55	Very Valid
3.	Teaching Materials	3.6	Very Valid
4.	Student worksheet	3.55	Very Valid
5.	Study Result Test Sheet	3.49	Valid
6.	Teacher Response Questionnaire	3.72	Very Valid
7.	Teacher Response Questionnaire	3.65	Very Valid
8.	Student Activity Assessment Sheet	3.7	Very Valid
9.	Learning Implementation Assessment Sheet	3.66	Very Valid

Table 2 shows the results of the validation of the learning instruments and learning instruments from the assessment of the two validators, namely the results of the validation of the syllabus which obtained an average of the overall validators of 3.87 with very valid criteria, the results of the validation of the syllabus of 91.41% with very valid criteria, the results of the lesson plan validation of 3.55 with very valid criteria, the results of the teaching materials of 3.6 with very valid criteria, the results of the LKPD validation of 3.55 with very valid criteria, the results of the validation of the study sheet test of 3.49 with valid criteria this is in line with the research

## CONCLUSION

Based on the results of research on the development of learning tools that use a problem-based learning model with a STEAM approach to improve student learning outcomes in thermodynamic materials at SMA Negeri 1 West

conducted by, the results of the questionnaire validation [15]. The response of teachers and students each obtained an average of 3.72 and 3.65 with valid criteria, then the results of the validation of the student activity assessment sheet of 3.7 with very valid criteria and the results of the validation of the learning implementation sheet obtained an average of 3.66 with very valid criteria. The learning tools are based on the assessment of valid selfish experts [16]. It is also in line with the research conducted by Arbie; the learning tools developed are valid [17].

Suggestions and input from validators are: (1) GPA from the syllabus must adjust to KD, (2) The objectives contained in the RPP must follow the GPA and RPP are made every meeting, (3) Teaching materials are added with interesting pictures, (4) student worksheet is made to be more interesting and there must be a practicum, (5) Test results are added to essay questions, (6) Questions must be adjusted to the cognitive level of C4-C6.

Learning tools are validated by two validators and assessed based on instrument analysis by each validator. Validation of learning tools is an activity carried out to determine an instrument's validity level. Validity is a measure that shows the level of reliability or validity. Validity performed includes content validity, construct validity, and language validity. The validity of the content is declared valid by the validator because the learning tools developed follow the material that should be presented. Construct validity is to test the validity of construction can be used by experts. The validity of the language shows the language components used following the good and correct Indonesian language rules, clarity of information, and effective use of language [18]. The results of this learning tool's validity are based on the assessment analysis of learning tools with assessment instruments [19]. It means that an instrument is valid if it can measure what is desired. The results of the data analysis are the assessment of the validator as a whole about the product being developed, which has very valid criteria based on the validity criteria. It aligns with research; the average percentage of validation of Physics learning tools based on generative learning models with an open-ended problem approach is 91.213% with a very valid category [20].

Limboto, West Limboto District, Gorontalo Regency is declared valid and worthy of being implemented or used in learning.

## REFERENCES

- [1] Pristiwanti, D., Badariah, B., Hidayat, S., & Dewi, R. S. (2022). Pengertian Pendidikan. *Jurnal Pendidikan Dan Konseling (JPDK)*,

- 4(6), 1707–1715.
- [2] Rahmi, M. S. M., Budiman, M. A., & Widyaningrum, A. (2019). Pengembangan Media Pembelajaran Interaktif Macromedia Flash 8 pada Pembelajaran Tematik Tema Pengalamanku. *International Journal of Elementary Education*, 3(2), 178.
- [3] Hamid, A. (2017). Guru Profesional. Al-Falah: Jurnal Ilmiah Keislaman Dan Kemasyarakatan, 17(2), 274–285.
- [4] Tirka, Rizal Allanta. Pengaruh PjBL (Project Based Learning) dengan pendekatan STEM (science, technology, engineering and mathematics) terhadap keterampilan berpikir kritis dan self efficacy peserta didik. Diss. UIN Raden Intan Lampung, 2021.
- [5] Amaliyah, A. I., & Rosy, B. (2020). Pengaruh Model Pembelajaran Problem Based Learning Pada Mata Pelajaran Otomatisasi Tata Kelola Humas dan Keprotokolan Terhadap Hasil Belajar dan Kemampuan Berpikir Kritis Siswa Kelas XI OTKP SMK Ketintang Surabaya. *Jurnal Pendidikan Administrasi Perkantoran (JPAP)*, 9(1), 17–27.
- [6] Fauzan, M., Gani, A., & Syukri, M. (2017). Penerapan Model Problem Based Learning Pada Pembelajaran Materi Sistem Tata Surya Untuk Meningkatkan Hasil Belajar Siswa *Jurnal Pendidikan Sains Indonesia*, 05(01), 27–35.
- [7] Djou, A., Buhungo, T. J., Supartin, S., & Arbie, A. 2020. Practicality of learning devices in problem-based learning implementation in contextual teaching and learning approach. *Jurnal Pijar Mipa*, 17(6).
- [8] Tegeh, I. Made, and I. Made Kirna. "Pengembangan Bahan ajar metode penelitian pendidikan dengan addie model." *Jurnal Ika* 11.1 (2013).
- [9] Ibrahim, Gunawan, & Kosim. 2020. Validitas Perangkat Pembelajaran Fisika Berbasis Model *Discovery* Dengan Pendekatan Konflik Kognitif. *Jurna Pijar MIPA*. 15(3).
- [10] Nababan, N. (2020). Pengembangan media pembelajaran berbasis geogebra dengan model pengembangan addie di kelas XI SMAN 3 Medan. *Inspiratif: Jurnal Pendidikan Matematika*, 6(1).
- [11] Dewi, S. M., Gunawan, G., Susilawati, S., & Harjono, A. 2019. Validitas Perangkat Pembelajaran Fisika Berbasis Model Generatif Berbantuan Laboratorium Virtual. *Jurnal Pendidikan Fisika dan Teknologi*, 5(1).
- [12] Purnomo, Budi. 2014. "Pengembangan Bahan Ajar Ilmu Pengetahuan Sosial Terpadu Dengan Pendekatan Kontextual Pada SMP Kelas IX Semester 1". *Jurnal ilmiah Universitas Batanghari* 14(2).
- [13] Uzain, Soleh. Prabawa A, E. & Widjayanti, B. D. (2016). Pengembangan Perangkat Pembelajaran dengan Pendekatan Saintifik Berbasis PBL yang Berorientasi pada Kemandirian dan Presetasi Belajar. Universitas Negeri Semarang.
- [14] Siregar, Y. E. Holila, Anni. & Ahmad, Marzuki. (2020). Validitas Perangkat Pembelajaran Dengan Pendekatan Konsektual Dalam Upaya Meningkatkan Kemampuan Pemahan Konsep. *Jurnal Akademika*, 9(2), 145-159
- [15] Khoiriah, Miftachul., & Kholiq, Abd. 2020. Validitas Perangkat Pembelajaran Fisika Berbantuan E-Book Literasi Sains Pada Materi Fluida Dinamis. *Jurnal Inovasi Pendidikan Fisika*, 9(1)
- [16] Fatmawati, A. (2016). Pengembangan Perangkat Pembelajaran Konsep Pencemaran Lingkungan Menggunakan Model Pembelajaran Berdasarkan Masalah Untuk SMA Kelas X. *Edu Sains: Jurnal Pendidikan Sains dan Matematika*. 4(2), 94-103.
- [17] Arbie, A. Satri, P. S. F, Gede, D. S. E, & Nuayi, A. W. 2021. Pengembangan Perangkat Pembelajaran Team Based Learning-Problem Solving Berbantuan Whatsapp Dan Zoom Meeting Pada Pembelajaran Daring. *Jurnal Orbita*, 7(11)
- [18] S. M., Budiman, M. A., & Widyaningrum, A. (2019). Pengembangan Media Pembelajaran Interaktif Macromedia Flash 8 pada Pembelajaran Tematik Tema Pengalamanku. *International Journal of Elementary Education*, 3(2), 178.
- [19] Makhrus, M., Wahyudi, W., Taufik, M., & Zuhdi, M. (2020). Validitas perangkat pembelajaran berbasis ccm-cca pada materi dinamika partikel. *Jurnal Pijar MIPA*, 15(1), 54-58.
- [20] Rahayu, C., & Festiyed. (2019). Validitas Perangkat Pembelajaran Fisika SMA Berbasis Model Pembelajaran Generatif Dengan Pendekatan Open- Ended Problem Untuk Menstimulus Keterampilan Beroikir Kristis Peserta Didik. *Jurnal Pendidikan Fisika*, 7(1), 1–6.