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Development of Static Fluid Practicum Modules in the Independent Curriculum to Improve Student Learning Outcomes

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Abstract: Teaching materials available in the field are still minimal and need to be developed. To enhance a more directed learning process, improve student learning outcomes, and increase student independence in learning, it is necessary to develop teaching materials for an independent curriculum. This research aims to develop a scientific-based static fluid practicum module of the independent curriculum. The type of research used is the Research and Development (R&D) using the ADDIE model through the stages of analysis, design, development, implementation, and evaluation. Data collection techniques were feasibility questionnaire, practicality questionnaire and multiple-choice questions for pre-test and post-test. The results of the analysis show that students lack direct observation in learning due to the unavailability of teaching materials that support practicum activities. This research data shows the percentage of the feasibility level of the practicum module which obtained an average of 92.2%, the practicality level of the practicum module obtained an average of 89.9% and the effectiveness level of the practicum module obtained an N-Gain of 0.70. The developed practicum module is feasible, practical, and effective in learning high school physics.

Keywords: Practicum Module; Scientific Approach; Static Fluid.

INTRODUCTION

Education is increasingly developing and competitive, requiring schools to participate in the developments that occur. The independent curriculum demands student independence, students have the freedom to choose and acquire knowledge through formal and informal learning processes (Manalu et al., 2022). Teaching modules are learning tools that are systematically arranged to include various elements such as media, methods, instructions, and guidelines. In the context of an independent curriculum, teaching modules are designed by considering the phase of student development, as well as considering the relevance of the material to the learning objectives. Teaching modules require students to be able to think critically, creativity, collaboration and communication (Triandini et al., 2023). Implementing an independent learning curriculum also requires learning materials and guidelines so that students can achieve effective learning objectives. These materials and guidelines can be actualized in the form of teaching materials both in class and practicum (Sari et al., 2023).

Learning tools that include learning materials, learning methods, and assessments are called teaching materials. Teaching materials function as a guide for teachers in assisting and supporting the learning process so that students can understand, and achieve learning objectives (Djumingin et al., 2022). Teaching materials include knowledge, skills, and attitudes that students need to learn by predetermined learning objectives. This includes learning instructions, additional information, exercises, evaluations, and responses to evaluation results (Cahyadi., 2019). There are two types of teaching materials: printed and non-printed. Printed teaching materials are in the form of modules, books, LKS / LKPD, handouts, brochures, leaflets, and images. Meanwhile, non-print teaching materials can be audio, visual, audiovisual, and interactive such as CDs, radios, videos, and interactive media. One form of teaching material for independent learning facilities is modules (Izzah et al., 2021).

Modules are teaching materials prepared by teachers to assist students in understanding and learning learning materials independently. Modules can be electronic or printed. The purpose of the module is to make the message clearer, overcome time constraints, and increase student learning motivation. The use of modules allows students to learn according to their abilities, and interests, and students can measure their learning outcomes (Najuah et al., 2020). A module is a method or instrument for learning that consists of content,

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approach, and boundaries. Teachers prepare these elements systematically, interestingly, and according to student's needs so that students can learn independently. Modules have characteristics, namely self-instruction, complete, stand-alone, up-to-date, and user-friendly (Puspitasari., 2019).

The scientific approach is a teaching method that has been carefully designed so that students actively build concepts, laws, or principles through several steps including observation (identifying or finding problems), problem-solving, problem formulation, hypothesis formulation, data collection, data analysis, conclusion making, and communicating the results found (Wijayanto et al., 2023). The scientific approach is a learning process that combines inductive and deductive methods. When students learn, students use theories that have been learned to be linked to direct observations (Ikhlas., 2020). Module development with a scientific approach is a must, because the scientific approach has an important role in encouraging learning that is more active, and student-oriented, and emphasizes the ability to solve problems (Dalimunthe & Ginting., 2022). The developed practicum module emphasizes freedom, independence, and relevance to real life. The independent curriculum practicum module is designed to enhance the Pancasila student profile and emphasize intended learning outcomes (Laili & Fardhani., 2023).

Research conducted Khairah et al., (2023) found that practicum activities were not optimally carried out, this was due to the unavailability of practicum modules as a guide to student practicum and students faced challenges in understanding learning materials which caused students' interest in learning tended to be lacking. This is in line with research at Madrasah Aliyah that students have a low level of cognitive ability on the material so students have difficulty in carrying out independent practicum. Similar problems are also still found in several schools, especially in Medan City (Yuliana et al., 2023).

Interviews with physics teachers at SMA Negeri 1 Kuala have shown that students lack direct experience in proving the theories they learn, which supports the above conditions. These problems result in frequent misconceptions in students and low student skills when carrying out practicum. This can be seen from some students who scored below the Minimum Completion Criteria (KKM) of 77. Practical activities are less implemented, due to limited tools and materials, and time allocation, and teachers have difficulty teaching practicum because there is no guidebook used during practicum. So, practicum modules are needed as guidelines for carrying out physics practicum activities to meet learning outcomes.

The description of the problems above shows that the progress of learning materials in the form of static fluid practicum modules in the independent curriculum is needed to increase student knowledge and student learning independently. The practicum module developed includes learning outcomes, learning objectives, materials, experiments, and evaluations. With the presence of this practicum module, it is hoped that it can help teachers and students carry out practicum activities.

METHOD

The ADDIE model is utilized in this research and development (R&D). Research and Development (R&D) is a research method applied to creating, improving, and testing products to make them more useful for the general public (Risal et al., 2022). The ADDIE model was developed by Robert A. Reiser and Michael Molenda in designing learning systems. The ADDIE model is a development research model that includes analysis, design, development, implementation, and evaluation stages (Rusmayana., 2021).

The investigation was carried out at SMA Negeri 1 Kuala, situated on Jl. Perintis Kemerdekaan No. 3 Kelurahan Pekan Kuala, Kuala District, North Sumatra, Kuala District, North Sumatra. The time of this development research was carried out in the even semester of the 2023/2024 school year. All students of class XI MIPA SMA Negeri 1 Kuala T.A 2023/2024 were included as the population in this study. The method of sampling employed in this study was cluster sampling. The sample used consisted of class XI MIPA 1, which had 36 students.

The data collection methods used were interview sheets, questionnaires, and tests with 10 multiple choice questions. The method of data analysis consists of feasibility analysis, practicality, and effectiveness. The practicum module's feasibility data was obtained based on the evaluation results of three validators: material experts, media experts, and physics teachers. The validators will assess the components of the practicum module before the module is tested in the field. The components of the practicum module include learning objectives,

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materials, problem illustrations, experimental instructions, exercises, summaries, references, glossaries, and answer keys. The practical module's practicality data is obtained by analyzing student responses to a practicality questionnaire after they have used it. This practicum module activity consists of six experiments, namely on hydrostatic pressure, Archimedes' law, Pascal's law, capillarity, surface tension, and viscosity. The analysis of feasibility data, and practicality data obtained is processed based on the score received for each component, namely the interpretation of the score can be calculated:

$$P = \frac{\sum X}{N} \times 100\% \quad (1)$$

The variable P to describe the percentage of practicum module categories, $\sum X$ represents the number of selected category answer scores, and N refers to the total score. The practicum module's feasibility level is determined by the product validity criteria. The eligibility criteria for the practicum module are presented in table 1.

Table 1. Module Feasibility Criteria (Sani., 2022)

Interval Percentage (%)	Criteria
21% - 40%	Not feasible
41% - 60%	Quite feasible
61% - 80%	Feasible
81% - 100%	Very feasible

The practicum module's practicality criteria determine the category of its practicality level. Table 2 presents the practicality criteria for the practicum module.

Table 2. Criteria for Module Practicality (Riduwan., 2018)

Interval Percentage (%)	Criteria
21% - 40%	Less practical
41% - 60%	Quite practical
61% - 80%	Practical
81% - 100%	Very practical

The practicum module's effectiveness data was obtained by analyzing the results of the pretest and posttest. Data analysis of the effectiveness of the practicum module through two stages, namely calculating the number of students who meet the requirements of the passing score of the KKM (Minimum Completion Criteria) of 77 and calculating N-Gain value. N-Gain can be calculated using the formula:

$$N - Gain = \frac{Skor\ Posttest - Skor\ Pretest}{Skor\ Maksimum - Skor\ Pretest} \quad (2)$$

N-Gain is used to determine if students using the practicum module experience an increase or no increase by comparing the pretest and posttest scores obtained by students. The N-Gain results that have been obtained are then grouped based on the N-Gain average score category scale. Table 3 shows the criterion for N-Gain values.

Table 3. N-Gain Value Criteria (Supriadi., 2021)

Interval	Criteria
0,00 – 0,29	Low
0,30 – 0,69	Medium
0,70 – 1,00	High

RESULT AND DISCUSSION

The analysis was conducted through interviews with physics teachers which aim to determine the type of module that is by the characteristics of students and the availability of teaching materials at school. The needs analysis's findings indicate that while most learning activities are still teacher-centered, pupils' level of learning independence is still low. In addition, the teaching materials used by teachers are only physics textbooks that

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focus on learning activities in the classroom and students lack direct observation to directly prove the physics theories studied, especially in static fluid material. The results of the curriculum analysis reveal that the curriculum applied at school is independence. The curriculum analysis included a review of the grade XI physics, materials, learning objectives, and results.

The goal of the second stage, known as the design stage, is to create the practical module. At the module design stage, there are several stages, namely media selection, material design, language design, feasibility instrument design, practicality, and effectiveness. The design process begins with designing a practicum module product that adheres to the independent curriculum. After that, the ideas collected will be forwarded to the design platform, Canva. The practicum module consists of various design elements that enrich the learning experience of students. The visual display of the static fluid practicum module with a scientific approach to the independent curriculum as depicted in Figure 1.

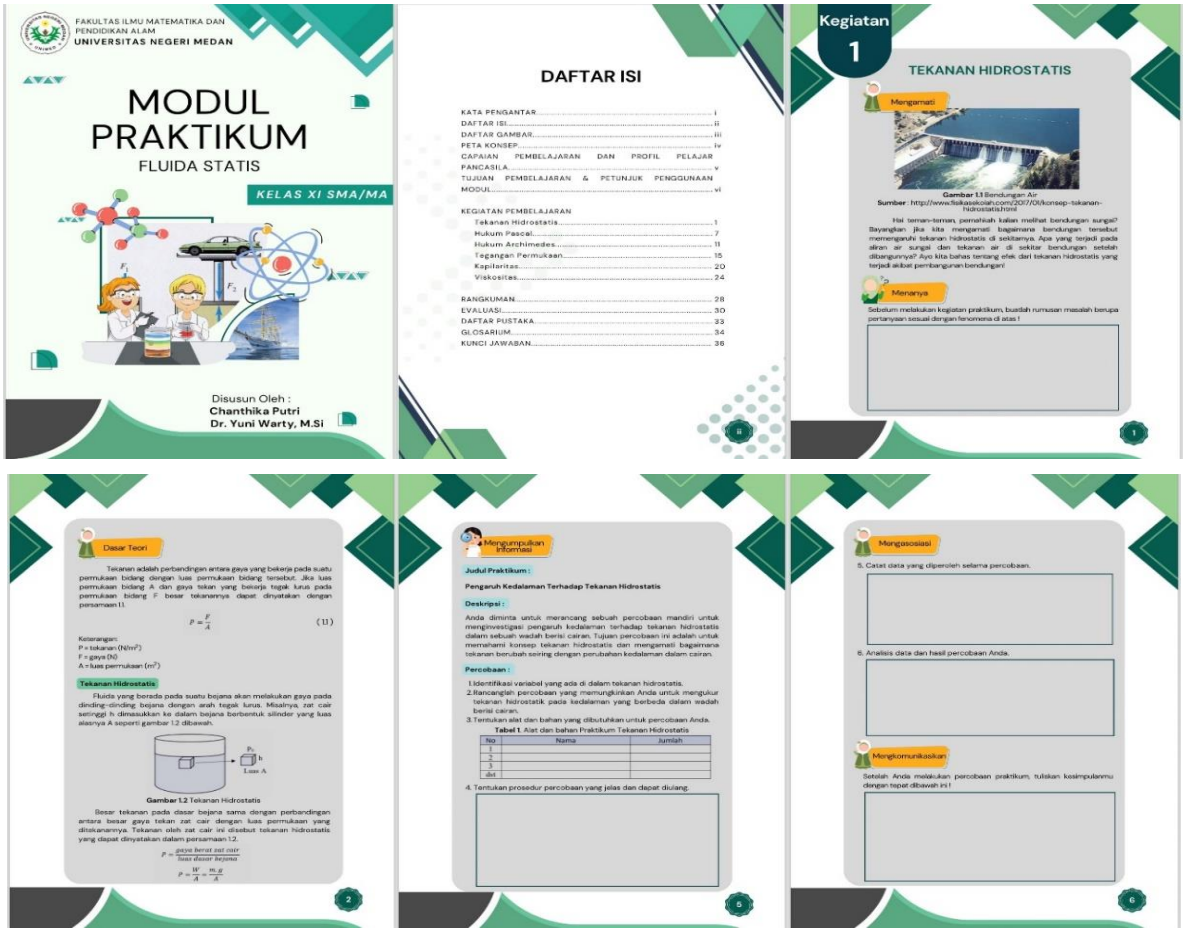

Figure 1. Design of the Developed Practicum Module

The development stage is the third stage of the ADDIE model. At this stage, all module designs and designs that have been prepared at the design stage will be combined. After the practicum module is completed, the module will be validated by three validators. The assessment of the practicum module validation results is presented within Table 4.

Table 4. Practicum Module Feasibility Results

Number	Aspect	Validator Percentage (%)			Percentage (%)	Criteria
		V1	V2	V3		
1	Content eligibility	98,3	81,7	95	91,7	Very feasible
2	Presentation feasibility	96,4	92,9	89,3	92,9	Very feasible
3	Language feasibility	100	83,3	97,9	93,7	Very feasible
4	Scientific assessment	100	75	87,5	87,5	Very feasible
5	Layout feasibility	98,8	92,5	93,8	95,0	Very feasible
Average Score		98,7	85,1	92,7	92,2	Very feasible

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The validity test of the practicum module tries to evaluate the feasibility of the practicum module. Several factors including content feasibility, presentation feasibility, language feasibility, scientific assessment, and graphic feasibility were considered in assessing the validity of the practicum module by the validators. This practicum module obtained an average percentage of validity findings of 92.2% from the assessment results of the three validators, according to the statistics presented in Table 4. This shows that this practicum module has met the 81%-100% range of "very feasible" criteria (Sani., 2022). This research is in line with the results of previous research by Raharja & Kusiana, (2020), which showed that the practicum module with a scientific approach was very feasible based on the validator's assessment. These consistent results indicate that the developed module has high quality standards and is in accordance with the recognized scientific approach. The module was assessed based on various aspects such as content feasibility, presentation feasibility, linguistic feasibility, scientific assessment, and layout feasibility. The validity on all these aspects shows that the practicum module is not only complete and informative, but also presented in an effective and easy-to-understand way by students. Good validation results are also supported by research by Putra et al., (2019), which shows that the Saintifik-based Physics Practicum Module is feasible to use after being validated by material experts, design experts, and linguists with an average validation of 82% in the "good" category. This shows consistency in the development of quality practicum modules. Although there were recommendations for revision of several components in the module based on Astuti et al., (2019) research, the final results showed that this module still met the criteria for feasibility with an average score of 81%. The suggested revisions show that module development always prioritizes improvement and quality improvement based on input from experts. This module uses a scientific approach that has been recognized in previous research as an effective approach in improving the quality of learning.

The implementation stage is the stage of applying the practicum module in learning activities at school. The process of implementing teaching materials is by providing student response sheets and tests before the module is distributed and after the practicum module is used. The practical module tries to assess the degree of applicability of the practicum module using student response sheets. The assessment of the practicum module practicality results is presented in table 5.

Table 5. Practicality Result of Practicum Module

Number	Aspect	Percentage	Criteria
1	Presentation	86,7	Very practical
2	Material	87,4	Very practical
3	Language	95,6	Very practical
	Average	89,9	Very practical

The information yields table 5 state that during learning activities, the percentage of each aspect is obtained with very practical criteria. The average percentage obtained from the three aspects including aspects of assessment, material, and language is 89.9%, which meets the criteria of very practical. This is in accordance with the statement of the module practicality percentage score range in the very practical category, namely 81%-100%. The practicum module developed was declared very practical to be used in learning activities. The material presented is complete, relevant, and in accordance with the curriculum, and is arranged systematically and structured to make it easier for students to understand the concepts taught and carry out practicum activities more independently and confidently. The use of simple, clear, and easy-to-understand language ensures that students of different levels of understanding can follow this module without difficulty. Positive responses from students indicate that this module is easy to use and understand, and motivates students in the learning process. The scientific approach used in this module encourages students' independence and critical thinking skills. The neat and organized structure and layout of the module facilitate navigation and use of the module, with a user-friendly design that helps students understand and apply the material learned.

The consistency of the results of this study with previous research, Raharja & Kusiana, (2020) states that the practicum module developed can motivate student learning and help students to learn independently by conducting a practical test of the practicum module which meets the practical category with a range of 61%-80%. Research by Rachmat Rizaldi et al., (2023) which states that the physics practicum E-module based on the PBL model is in the practical category after a practical test is carried out to see student responses to the E-module. Based on student responses, the E-module is stated to be easy to understand, can motivate learning and can be

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used for independent learning. Another study conducted by Asih et al., (2018) obtained an average practicality test of 92% with very strong criteria. Based on the results of this study, it can be seen that the physics practicum module with a scientific approach to static fluid material can be used to carry out practicum activities independently by students, and can motivate learning.

The evaluation stage is the stage to determine the improvement of data based on pretest and posttest. Analysis of pretest and posttest data shows a significant increase in learning outcomes using the developed practicum module. There is a difference in the scores between the pretest and posttest, with an average starting ability test score of 42.2 rising to 81.9 in the final test, according to the data analysis results displayed in Figure 2. These findings show that students' understanding of static fluid content can be enhanced through the use of practicum modules.

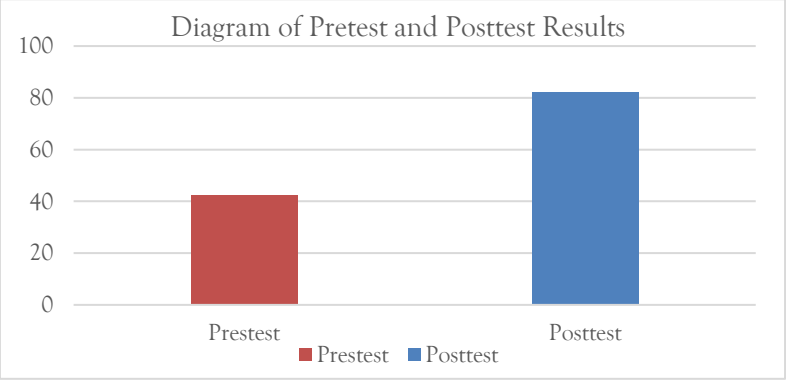

Figure 2. Average Pretest and Posttest Values

Pre-test and post-tests are used as assessment instruments to gauge how well students are learning. The pretest helps assess the students' initial understanding of the material, while the posttest helps identify the improvement following the learning process, of the students' learning outcomes. Learning by using a practical module helps students to get direct observation in proving the physics theory learned. This practicum module includes materials, images, equations with descriptions, and instructions for designing independent experiments by applying the syntax of the scientific approach. Students must therefore solve problems using both critical and creative thinking. Students can learn static fluid theory more effectively by utilizing practical modules. Table 6 displays the outcomes of the pretest and post-test scores.

Table 6. Pre-test and Post-test Scores

Score	Average	*N-Gain*	Category
Prestest	42,22	0,70	High
Posttest	81,94		

The N-gain analysis's findings demonstrated that learning outcomes for students, improved when they used the practicum module, with an average N-gain value of 0.7 in the high category. Students' posttest results, which are compared to the KKM (Minimum Completeness Criteria) value of 77, also demonstrate the practicum module's efficiency. According to the analysis's findings, up to 29 pupils passed with a score higher than 77. The increase occurred in all multiple-choice questions totaling 10 items about hydrostatic pressure, Archimedes' law, Pascal's law, capillarity, surface tension and viscosity. Learning using practicum modules can increase the relevance of static fluid material in students' daily lives and motivate pupils to participate more fully in the process of learning physics. This is to the research of Thalib et al., (2020) that the practicum module developed obtained an N-gain of 0.70 which met the effective criteria based on student learning outcomes obtained from pretest and post-test scores.

CONCLUSION

The static fluid practicum module of the independent curriculum is declared feasible, practical, and effective in physics learning and can increase student knowledge. The pretest and posttest findings analysis concluded that the use of static fluid practicum modules of the independent curriculum in learning was able to increase student knowledge. In addition, the evaluation of student response data shows a high level of practicality

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towards the practicum module, so that it can be used as a significant supporting element in the learning process in the school environment. The static fluid practicum module in the independent curriculum is considered feasible to be used as physics teaching material based on the results of the data analysis that has been done.

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