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Development of Student Worksheet on Fluid Material by Integrating Guided Inquiry Model to Promote Students' Science Process Skills

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ABSTRACT

The teaching materials used by schools experience a lack of quality teaching materials or are not available at all. The standard of teaching materials that do not meet student requirements causes them to be unable to accommodate various levels of student ability, including in training student skills. In the era of competency-based curriculum, teaching materials should be capable of supporting the enhancement of student skills. The focus of this problem is a cause of weak science process skills amongs students. This study purpose to produce a Guided Inquiry Student Worksheet (SWS) Model to Develop Science Process Skills in Fluid Material for Class XI / Phase F that is valid and practical. The research approach is Research and Development (R&D) using 4D. Research is limited to the practicality stage in small group tests. The instruments used are validation questionnaires and practicality questionnaires. The data source obtained from the validation results by 3 experts. The practicality data source obtained from teachers and students of class X SMAN 16 Padang. The data analysis technique to analyze the level of validity of Students Worksheet (SWS) uses a Likert scale with the Aiken's V formula and analyzes the practicality of Students Worksheet (SWS) using a statistical analysis formula. The validation results of the Guided Inquiry model students worksheet obtained a value of 0.87 in the very valid category. The teacher's practicality score of 99% places it in the very practical category, while the student's score of 90% also falls within this category.

INTRODUCTION

Physics is a scientific field that explores the signs and phenomena found in nature (Pratama & Istiyono, 2015). Physics as science in learning is used by students to grasp the phenomenha and alterations resulting from human behavior (Asrizal & Dewi, 2018). Physics has 3 characteristics, namely physics as a process, physics as a commodity and physics as an attitude. Physics as a process means in physics studying natural phenomena, conjecturing, making observations, measurements, investigations and publications. Physics as a product

means findings as facts, principles, regulations, and procedures in physics. Physics as a stance means that there are attitudes that arise from physics learning activities. Essentially, physics is a discipline that examines all natural occurrences and events manifested as data, ideas, rules, and regulations tht hav been verified through experimentation within the scientific method (Murdani, 2020).

Physics learning is a science that packages facts and principles through scientific procedures to develop analytical skills and solve problems of surrounding events (Sinaga et al., 2024). In physics learning, students are asked to be active in using studentsmental processes so that they can directly gain experience to find concepts (Murni, 2020). These mental processes such as observing, inquiring, posing problems, formulating hypothes, creating and carrying out experiments, gathering and examining data, making inferences, presenting results. In physics learning process not solely to grasp ideas, however student will also be taught to get used to thinking to solve problems. So that students' understanding of the three nature of physics becomes good as a procedure, outcome, and mindset (Lesmono et al., 2012). In physics learning, teachers no longer dominate the process so far known as conventional learning that focuses on teacher provision. Meaningful learning will not be realized only by hearing the experience of others (Asrizal et al., 2017).

The natural knowledge learned must make sense to students, the concepts learned and the activities carried out can be connected to real conditions including showing problems that must be solved and resolved (Ahmad, 2024). The underlying reason that students can readily grasp ideas paired with tangible real examples is the advancement of scientific process skills. Aligned with what was said by Nugraha et al (2017) that the intention of natural science including physics serves to aid student in cultivating high-level thinking skills, critical thinking and science process skills. Science process skills involve thinking processes employed to build understanding, contemplate an issue, and articulate the findings of a study (Aydin, 2013). Science process skills is crucial abilities that students need to have. These skills require studnts to be able to increase their sense of participation and active and can cultivate the skill to ponder and behave like a scientist (Darmaji et al., 2018). Students' mindset can be trained scientifically and systematically within the educational process and daily life by the way students construct and has science process skills.

Teaching materials that can see students' science process skills are Learner Worksheets (Citra et al., 2021). Students Worksheet is teaching material that is systematically packaged containing interesting pictures and various information, as well as relevant questions (Anggraini et al., 2016). Students Worksheet is also equipped with various series of experimental activities and work steps carried out by students. Yazidi (2020) stated that by using Students Worksheet, teachers can provide learning materials with student activities that can increase student activity and facilitate interaction between teachers and students. Students Worksheet is efficient in enhancing students' knowledge, academic results, skills n attitudes because the use of Students Worksheet trains students' scientific proces abilities so that learners can discover for themselves the facts and concepts they learn through a series of activities (Yohanes Boli Tematan & Oktavius Y.T Mago, 2021).

The independent curriculum uses a scientific approach and in its use there are activities of observing, questioning, reasoning, processing and communicating (Rohman & Muttaqin, 2022). One of the learning models that applies the scientific approach is *guided inquiry*. Guided inquiry learning is acquiring knowledge that provides space for students' to carry out problem formulation, hypothesis formulation, identify variables, collect data and analyze data or information from an experiment to produce conclusions or information that students will communicate (Ningtiyas, 2019). Using the guided inquiry model, students can

learn to master the scientific method, think analytically and can try to solve problems and can help to develop students' experimental skills.

Derived from field facts that have been carried out by distributing questionnaires at SMA Negeri 16 Padang, a presentation of data points from the teacher's view is obtained, namely the *first* aspect, the guided inquiry learning model has not been applied too often by teachers with 0.78 points. The second aspect, student competence, found that students' creative thinking got 0.68 points which were categorized as quite feasible. The third aspect, it is found that the material that is difficult to teach is fluid. With the instrument used, it was found that the factors originating from the teacher were learning strategies that were not appropriate with a percentage of 100%, teaching materials and media used were not innovative with a percentage of 66.7% and other factors with a percentage of 33.3%.

The questionnaire was also distributed to students and the resultsants of students' assessment of the teacher tendency to teach with several points categorized as lacking such as, learning (investigation, and tracking, lack of activities in the laboratory, lack of application of scientific processes in learning and lack of student attitudes in solving problems. The expectations desired by students in order to achieve learning success are obtained as follows improvement of learning strategies by 72.6%, improvement of teaching materials 49.3% and learning evaluation 45.6%. Student worksheets are effective in improving students' knowledge, learning outcomes, skills, and attitudes because the use of student workdsheeet can train students' science process skills and students can discover for themselves the facts and concepts they learn through a series of scientific investigation activities Setiawan et al, 2014 in (Yohanes Boli Tematan & Oktavius Y.T Mago, 2021).

Based on these problems, the researcher will make products in the shape of Students Worksheet guided inquiry model to develop students' science process skills on fluid material class XI / Phase F at SMAN 16 Padang. The research aims to see the level of validity and practicality of the student worksheet developed. This research will focus on making an inquiry model Student Worksheet that will help students in developing their science process skills on fluid material. Thus, needs analysis is the first step in the process of making guided inquiry model Students worksheet to develop science process skills.

METHODS

This study falls under development research, also referred to as Research & Development (R&D). It employs the 4D (four-D) development framework, which includes four stages: defining, designing, developing, and disseminating. Nonetheless, this research was restricted to the 3D stages and the *disseminate* phase was not carried out. The resulting product is Students Worksheet fluid material using the guided inquiry model.

The object of this research is Students Worksheet guided inquiry model to develop students' science process skills on fluid material class XI / phase F SMAN 16 Padang. The object of this research underwent validation by 3 expert lecturers, namely UNP physics lecturers. The instruments used in this research are needs analysis instruments, teacher tendency instruments for students and teacher view instruments, validity instruments and practicality instruments. The development model applied in this research is 4D (*four D*). This model is made up of four developmental stages: define, design, develop, and disseminate. However, researchers limit it to the 3D stage, namely development and small group trials.

The *define* stage is the stage for conducting direct analysis. This phase intends to analyze the requirements in education by analyzing information to determine the need for

product development. The results obtained are used as a reference for making Students Worksheet at the design stage and designing Students Worksheet guided inquiry models. The define stage involves multiple phases, including end-start analysis, learner analys, task analyze, concept analyses, and analysis of learning objectives.

The design stages follows the define phase. Thus phase seeks to design the guided inquiry model Students Worksheet products to be developed. There are several stages carried out including the choice of teaching materials, format, and preliminary design. In selection of teaching materials, the selection of teaching materials Instructional tools to be created and suitable to help the learning process is carried out. Then the format selection stage aims to design learning content, select approaches, learning resources, and design the content of the Students Worksheet developed. Finally, the initial design stage, making designs on the Students Worksheet to be developed according to the analysis that has been obtained. The design made will be given input by the supervisor and the Students Worksheet is improved according to the input.

Quantitative descriptive data analysis is the method of data analysis employed in this study. The data analysis technique is split into 2 phases, specifically the Students Worksheet validity analysis stage and the Students Worksheet practicality analysis stage. A Likert scale questionnaire with a range of 1–4 was used as a tool to analyze the validity of the Students Worksheet. Then the questionnaire is given to experts to get the assessment results. The validity formula from *Aiken's V* was used to examine the assessment outcomes.

Validity Analysis of Students Worksheet

At the validity analysis stage after obtaining the findings of the expert's validation evaluation, the next step is to process the data from the assessment using the validity formula by *Aiken's V*. The formula used in the validity test:

$$\mathrm{V} = \frac{\sum \mathrm{s}}{\mathrm{n}\,(\mathrm{c}-1)} \; with \; s = \; r \; - \; I_0$$

Following the acquisition of the agreement index, the value's index category is determined as presented in Table 1:

Table 1. *Aiken's V* index

Interval	Category
≤ 0,4	Invalid
0,4 < V ≤ 0,8	Valid
0,8 < V	Very Valid

(Retnawati, 2016)

Practicality Analysis

The next step, after obtaining the feasibility index of the developed product, a practicality analysis is carried out. Practicality analysis assessment is based on teachers and students. The instrument used in the practicality analysis is a teacher and student practicality questionnaire. Then the questionnaire will be given to three teachers and nine students to fill in the statements that have been provided. The assessment of the results of the practicality

analysis test is utilizing the categories shown in Table 2 below and a Likert scale with a range of 1 to 4:

Table 2. Likert scale

Scale	Category
4	Strongly Agree
3	Agree
2	Disagree
1	Strongly Disagree

The assessment questionnaire will then be processed using the percentage technique with the equation :

$$nilai = \frac{skor\ yang\ diperoleh}{skor\ maksimum} \times 100$$

The categories used to determine the practicality of the product is shown in **Tabel 3**:

Table 3. Practicality Level Decision

Interval	Criteria
85 - 100	Very High
75 - 85	High
60 - 75	Simply
55 - 59	Low
<54	Very Low

(Purwanto, 2009)

RESULTS AND DISCUSSION

Result

1. Defining Stage Results

The first stage is the beginning-end analysis. Based on the views of students, aspects that are lacking in learning are obtained. There are four problems obtained, including improvements to the educational resources utilized for instruction, improvements to the learning strategies applied, improvements to learning media and learning evaluation.

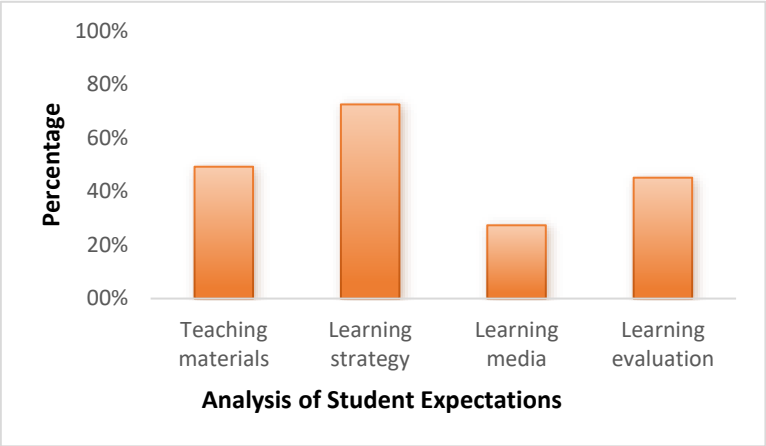

Figure 1: Results of Analysis of Student Expectations

In the results of the definition stage, students' expectations of the teacher's tendency to learn for the achievement of success in learning have been obtained, including improving teaching materials obtained a value of 49.3%, improving the application of learning strategies obtained a value of 72.6%, improving the use of learning media obtained a value of 27.4% and improving learning evaluation obtained a value of 45.2%. So students' expectations in improvement for the achievement of success in learning lie in improving the teaching materials used and the learning strategies applied by teachers in the learning process.

The next stage after analyzing students' expectations of teachers' tendencies in learning is the analysis of students' science process skills in the learning process. The findings from analyzing students' science process skills are outlined in the Table 4:

Table 4. Results of Student SPS Analysis

Assessment Aspect	Percentage	Category
Observing	58%	simply
Inquire	56%	simply
Gathering information	51%	Low
Processing Data	49%	Low
Communicating	58%	simply

The average overall result of the analysis of aspects of students' science process skills is 54%. In the aspect of observing skills assessment, a value of 58% was obtained. This happens because students' curiosity is based on the results of the analysis of science process skills by Wismaningati (2019) categorizing that the value of 54% is categorized as sufficient.

The next stage is the selection of teaching materials tailored to the material to be taught and in accordance with the surrounding conditions. This teaching material involves students directly in the scientific process will be very effective in developing science process skills. Students Worksheet is also equipped with a series of questions or instructions. With Students Worksheet teaching materials also provide opportunities for students to collaborate, and Students Worksheet is also designed with clear and structured instructions that can help students follow the work steps properly and correctly.

2. Validity Test Results

The next stage carried out is the *development of* Students Worksheet which will be tested for product validity. Validity is done to measure the level of validity of the product developed for use in the next stage. The validity test was conducted by three UNP physics lecturers. The validation results are presented in Table 5 :

Table 5. Results of Feasibility Validation of Students Worksheet

Assessment Aspect	Aiken's Index (V)	Description
Content Feasibility	0.91	Very Valid
Model Feasibility	0.87	Very Valid
Presentation Feasibility	0.87	Very Valid
Linguistic Appropriateness	0.87	Very Valid
Graphics feasibility	0.88	Very valid
Feasibility of SPS indicators	0.83	Very Valid
Average	0.87	Very Valid

Based on Table 5, it can be explained that the average value obtained is 0.87 with a very valid category. In the validation stage, improvements or revisions are made to the product according to the suggestions given by the validator so that the resulting product is suitable for use. This states that the Students Worksheet made is valid and efficient in terms of content feasibility, model feasibility, presentation feasibility, linguistic feasibility, graphic feasibility, and feasibility of SPS indicators. Thus, the inquiry model Students Worksheet to develop students' science process skills on fluid material in class XI / phase F is ideal for use and continues at the small group test stage to see the responses of teachers and students to the products produced.

3. Practicality Test Results

The practicality test phase on teachers and students to assess the ease of use of the designed product. This practicality test was conducted by three teachers and nine students from class XI at SMAN 16 Padang. The results of the analysis of the practicality of three physics teachers of SMAN 16 Padang obtained an average percentage value of 99% with a very practical category. Analysis of the results of teacher practicality can be seen in Table 6 :

Table 6: Teacher Practicality Results

Assessment Aspect	Percentage of achievement	Criteria
Useful	100	Very High
Easy to Use	99	Very High
Attractiveness	100	Very High
Clarity	100	Very High

Efficient	95	Very High
Average	99	Very High

Based on Table 6, the results of the teacher's practicality of the guided inquiry model Students Worksheet to develop students' science process skills on fluid material class XI / Phase F obtained an average percentage of the overall assessment of 99 which is categorized as very high. According to the teacher's view, the guided inquiry syntax has been clearly and systematically described, the Students Worksheet components have been fulfilled, presented in an interesting and structured manner and there is a self-reflection assessment at the end of the Students Worksheet which is well presented and students can assess their respective skills.

Students Worksheets that have been assessed by teachers are also asked for an assessment of the views of students. The results of the practicality of nine students of SMAN 16 Padang on the practicality of the Students Worksheet developed with an assessment in the form of a questionnaire containing 5 aspects of assessment obtained an overall average percentage value of 90%. The results of the practicality test are in very high criteria. It can be described that from the analysis of the practicality of Students Worksheet is feasible to use in the learning process. The analysis results can be seen in Table 7 :

Table 7. Student Practicality Results

Assessment Aspect	Percentage of achievement	Criteria
Useful	91	Very High
Easy to Use	87	Very High
Attractiveness	91	Very High
Clarity	92	Very High
Efficient	90	Very High
Average	90	Very High

Based on Table 7, the results of students' practicality of the guided inquiry model Students Worksheet to develop students' science process skills on fluid material class XI / Phase F obtained an average percentage of the overall assessment of 90 which is categorized as very high. According to the students' views, the developed inquiry model Students Worksheet is very attractive with various color combinations combined. The developed Students Worksheet utilizing online laboratories makes students interested and adds new knowledge to the use of technology in the application of physics learning. The developed Students Worksheet also describes work steps that can be understood.

Discussion

Based on the explanation above, it is obtained that the Students Worksheet guided inquiry model to develop students' science process skills on fluid material class XI / phase F SMAN 16 Padang is categorized as very valid. It can be said that the Students Worksheet developed has met the criteria very valid because the feasibility of content, feasibility of model, feasibility of presentation, feasibility of language, feasibility of graphics and feasibility of SPS indicators have met the criteria. In accordance with what is revealed

according to Depdiknas (2008) that Students Worksheet can be said to be valid if the teaching materials are said to be in accordance with the demands of the curriculum. Then in terms of linguistic feasibility, Students Worksheet is said to be valid if the use of clear sentences, not too long and not ambiguous and uses good and correct Indonesian language. In terms of presentation feasibility, Students Worksheet can be said to be valid if the presentation element encompasses clarity of purpose, sequence of presentation, attractiveness and completeness of information. Then in terms of the feasibility of Students Worksheet graphics, it is said to be valid if the components of graphics contain clear and attractive fonts, layout and design, and appropriate color selection. In terms of the feasibility of the Students Worksheet model, it is said to be valid if the model applied contains scientific activities so that it can stimulate students in discovering concepts and principles independently. This aligns with the perspective of Janbuala et al (2013) that learning using a scientific approach may enhance pupils' knowledge of the scientific method.

The outcome obtained in the analysis of the practicality of teachers and students, obtaned that the Students Worksheet model of Guided Inquiry to Develop Science Process Skills on fluid material in class XI / Phase F SMAN 16 Padang obtained an assessment from the teacher of 99 and an assessment from students of 90 which was categorized as very high. This is in line with Ulumudin et al (2017) Students Worksheet is said to be practical if the clarity of objectives and instructions are easy to understand. In terms of efficient aspects according to Putri & Rosy (2020) Students Worksheet can be said to be practical if it can assist students in finding concepts and principles according to their abilities. Overall, the Students Worksheet developed has very high criteria by teachers and students. This means that Students Worksheet can assist educators and learners in acquiring knowledge. This is in line with what Ariani & Meutiawati (2019) revealed that Students Worksheet serves to facilitate teachers and guide students in developing and obtaining results according to their abilities.

CONCLUSION

From the results and deliberations, It's clear that the students worksheet guided inquiry model to develop science process skills on fluid material class XI/phase F SMAN 16 Padang has been completed and the developed product is categorized as very valid with an average value of 0.87. The results of the validity test conducted by the validator on the student worksheet developed were declared valid. All aspects and indicators in the assessment to measure feasibility have proven valid and can measure the objectives to be achieved according to applicable guidelines. The percentage of the overall value of teacher practicality is obtained at 99% with a very practical category and the overall value of student practicality is acquired at 90% categorized as very practical. The results of the practicality test showed that this student worksheet received a very high score and was easy to use in learning. students and teachers involved in the practicality test gave a positive assessment of the ease of filling in and understanding the existing indicators. This students worksheet can be used by teachers as teaching materials and help students develop their science process skills in physics learning. The results of valid student worksheets can evaluate student performance more accurately and based on the right indicators, while the practicality of student worksheets allows for easier and more efficient implementation in the school environment.

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