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Research Article

Developing Student Worksheets Using Inquiry-based Learning Model with Scientific Approach to Improve Tenth Grade Students' Physics Competence

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Abstract

Students' Physics Competencies are not still optimal. One of the causes is the use of student worksheets as the teaching materials that have not yet been suitable for the structure of good student worksheets. In addition, the student worksheets are not developed using the inquiry-based learning model and scientific approach. The purpose of this study is to describe the characteristics and produce valid, practical, and effective student worksheets using the inquiry-based learning model with a scientific approach to improve the tenth-grade students' physics competencies. This research used the Plomp model as the design, which consisted of preliminary research, development or prototyping, and assessment. The data were analyzed using a descriptive percentage technique, describing the student worksheets' validity, practicality, and effectiveness. Based on the preliminary research results, it was found that needs analysis, student analysis, and material analysis were required to be a reference in developing student worksheets using the inquiry-based learning model with a scientific approach. The design stage results show that the student worksheets have been designed using an inquiry-based learning model with a scientific approach. The results of the development phase show that the student worksheets meet the valid criteria of 0.94. The implementation phase results show that the student worksheets meet the very practical criteria based on the teacher's and students' responses, with the percentage of 91.05% and 78.39%, respectively. The results of the evaluation phase show that the student worksheets meet the effective criteria, including attitude (85.81%), knowledge (85.46%), and skills (85.69%). Based on the results of the study, it is concluded that the student worksheets using the inquiry-based learning model with an effective scientific approach to improve the tenth-grade students' physics competencies.

Keywords: *student worksheets; inquiry-based learning; scientific approach*

Pengembangan Lembar Kerja Siswa Menggunakan Model Inquiry-based Learning dengan Pendekatan Saintifik untuk Meningkatkan Kompetensi Fisika SMA Kelas X

Abstrak

Kompetensi Fisika peserta didik masih belum optimal. Salah satu penyebabnya yaitu penggunaan bahan ajar berupa lembar kerja siswa yang belum sesuai dengan struktur lembar kerja siswa yang baik, belum memuat penggunaan model inquiry-based learning dan pendekatan saintifik. Tujuan penelitian ini adalah untuk mendeskripsikan karakteristik dan menghasilkan lembar kerja siswa menggunakan model inquiry-based learning dengan pendekatan saintifik untuk meningkatkan kompetensi Fisika SMA kelas X dengan kriteria valid, praktis, dan efektif. Jenis penelitian ini adalah design research dengan menggunakan model Plomp yang terdiri dari tahap preliminary research, development or prototyping phase, and assessment phase. Teknik analisis data yang digunakan adalah deskriptif persentase yaitu dengan mendeskripsikan validitas, kepraktisan dan efektivitas lembar kerja siswa. Hasil penelitian pada tahap penelitian pendahuluan diperoleh bahwa analisis kebutuhan, analisis peserta didik dan analisis materi diperlukan untuk menjadi acuan pengembangan lembar kerja siswa menggunakan model inquiry-based learning dengan pendekatan saintifik. Hasil penelitian pada tahap desain diperoleh lembar kerja siswa dirancang menggunakan model inquiry-based learning dengan pendekatan saintifik. Hasil tahap pengembangan lembar kerja siswa memenuhi kriteria valid 0,94. Hasil tahap implementasi lembar kerja siswa memenuhi kriteria sangat praktis dari angket respon guru adalah 91,05% dan peserta didik 78,39% dengan kriteria praktis. Tahap evaluasi lembar kerja siswa memenuhi kriteria efektif dengan nilai sikap 85,81%, pengetahuan 85,46%, dan keterampilan 85,69%. Berdasarkan hasil penelitian dapat disimpulkan lembar kerja siswa menggunakan model inquiry-based learning dengan pendekatan saintifik efektif untuk meningkatkan kompetensi Fisika SMA kelas X.

Kata Kunci: *lembar kerja peserta didik; inquiry-based learning; pendekatan saintifik*

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I. INTRODUCTION

Physics learning is the process of creating conditions and opportunities for students to build their knowledge, process skills, and scientific attitudes. Correspondingly, the Physics learning process in the 2013 curriculum is also carried out using a scientific approach. In its implementation, the learning process is designed in such a way that students actively construct concepts, laws or principles through stages of observing, formulating hypotheses, collecting data, analyzing data, drawing conclusions and communicating [1]. In addition, it corresponds to the nature of Physics which has three aspects, including knowledge, processes, and attitudes [2]. The nature of physics and its application is one of the goals in learning physics, and the basic understanding of concepts in learning physics is very necessary [3]. Understanding students' concepts becomes deeper by

providing direct experience to students so that the three expected competencies can be achieved.

Achievement of all competencies simultaneously in learning Physics can be gained through practical activities that can train students to apply theories to real problems, plan activities independently, and train using special instruments [4]. In this case, if students are directly involved in building their own knowledge, the knowledge acquired will last a long time in themselves. In order to achieve this competency, the teacher's function as a facilitator is needed. Teachers who function as facilitators must be able to facilitate students in developing their abilities, such as providing teaching materials in the learning process for achieving specified learning objectives [5]. The availability of teaching materials makes it easy for teachers to guide students in learning and makes it easy for students to develop competencies in themselves.

The reality found in the field is not in line with the expectations. This can be seen from the students' physics competencies in learning which are not yet optimal. The results of observations on the students at SMAN 2 Padang show that their low achievement in Physics competencies is caused by several factors. First, the direct involvement of students during learning is still low where learning is still centered on the teacher. Second, the students are less motivated to study Physics independently based on direct experience with the process of scientific discovery. This has an impact on the students' creativity so that they become less active and have difficulty in constructing Physics concepts independently.

Furthermore, based on the interviews with Physics teachers at SMAN 2 Padang and direct observation during the learning process, it was found that there were some deficiencies leading to the students' low physics competencies. Some of such deficiencies include: the structure of student worksheets used at school was incomplete, the competencies to be achieved were not detailed, and the steps of the scientific approach and learning model on the student worksheet have not yet been fully visible. The structure of the applicable student worksheets did not fit into a good structure according to the guidelines for the development of student worksheets, and it did not yet contain an inquiry-based learning model and a scientific approach to learning.

The problems found in the field can be overcome by developing student worksheets that contain models and learning approaches. Student worksheets are sheets containing assignments that must be done by students [6]. Student worksheets can also be interpreted as part of teaching material that can be used to develop thoughts, ask questions and answer questions, make connections and assess student learning outcomes [7]. The use of assignments in student worksheets will encourage students' activities and participation in learning. Students will be involved in building knowledge and improving their learning skills [8]. During the learning process, students are guided by student worksheets to carry out an investigative process in a laboratory that is supported by practical tools. Physics learning will become more practical and efficient if supported by certain practical tools [9,8]. In developing student worksheets, several factors should become the consideration: (i) the worksheets should be in accordance with the applicable structure, (ii) the teachers must be careful and have adequate knowledge and skills, and (iii) the worksheets should contain the achievement of basic competencies that must be mastered by students [10]. This is important for students who will like it if they can easily

improve the achievement of competencies.

Efforts can be made to minimize some of the problems that have been presented, one of which is by developing student worksheets in accordance with a good structure according to the development guidelines, and the student worksheet should have an interesting design and are easily understood by students. Student worksheets are developed using a learning model whose orientation can build knowledge independently with a scientific approach [5]. One of the learning models that is suitable for the purpose of developing student worksheets is the Inquiry-based Learning Model. The main purpose of this inquiry-based learning model is to prioritize the activities of students to find their own answers to the problem being questioned, so that it is expected to increase their confidence [11].

The student worksheets developed contain the steps of an inquiry-based learning model with a scientific approach. Student worksheets that contain the steps of the orientation learning model can improve students' abilities in analyzing, solving problems, and doing scientific work [12]. The inquiry-based learning model consists of five phases: orientation, conceptualization, investigation, conclusion, and discussion [13]. Students are directly involved in each phase of inquiry-based learning in which student worksheets are provided for students to learn step by step.

Inquiry-based learning model is learning that involves the direct role of students in building their knowledge by conducting experiments [14]. The use of inquiry-based learning models in learning can develop all aspects of student competence. In this case, according to the results of previous studies, students are very satisfied with their learning experience using inquiry-based learning thereby increasing their complex skills and knowledge [15]. Other research also shows that students in classes using inquiry-based learning models gain better knowledge and skills [16]. This is also in line with Fernandez's research which states that students who use the inquiry learning model show significant results in conceptual understanding and success in themselves [17].

The application of inquiry-based learning models in physics learning also has a positive impact so as to enhance students' conceptual understanding and develop their attitudes, knowledge, and scientific process skills [18,19,20]. Application of the steps in the inquiry-based learning model and scientific approach in these student worksheets is expected to overcome the real problems experienced by students in increasing their competence in attitudes, knowledge, and skills [21].

Based on the description above, the purpose of this research development is to describe the characteristics of valid, practical, and effective student worksheets using an inquiry-based learning model with a scientific approach so that the student worksheets developed in this research can improve the competency of the tenth grade students' physics competencies.

II. METHOD

The type of the research is design and development research. The development model used in this study is the Plomp model. The Plomp development model consists of three stages, namely preliminary research, development, and assessment [22].

The research subjects were objects, things or people where the data for the research variable were attached to. In a study, the research subjects have a very strategic role because they serve as the variables observed by the study [23]. The test subjects in this study were 3 students of Class X

MIPA 1, 36 students of X MIPA 2 and 9 students of Class X MIPA 3 at SMAN 2 Padang. This research was carried out from 10 January 2019 to 16 February 2019 in SMA Negeri 2 Padang.

Data collection was performed in each study, starting from preliminary research, development research, and research results [22]. Each device has data collected and special instruments according to the research questions on each device.

In the preliminary study, instruments were used consisting of interview sheets, needs analysis, student characteristics analysis, learning material analysis and task analysis. Indicator of complete needs analysis: performance analysis consisting of teacher approval and completeness of facilities and infrastructure; graduation standard analysis consisting of spiritual attitudes, social attitudes, knowledge, and skills; analysis of learning difficulties consisting of student worksheets, learning models and learning. The survey research was conducted on one sample class of X class students of SMAN 2 Padang.

The next stage was the development and manufacture of prototypes. At this stage a research instrument was also designed, namely a checklist sheet to verify the validity and practicality of the product. This instrument consisted of a self-evaluation sheet and product validity. The Self Evaluation Sheet is intended to check for incompleteness and problems that are still needed in a product that was developed before it was validated by an expert. Indicators assessing self-evaluation consisted of completeness and conformity with the format of the product being developed as well as problems in using language, typing letters, and punctuation. The validity assessment sheet was used to find out whether the product was designed correctly or not. Indicators of validity of student worksheets included: components and contents, construction, language, and graphic. This validity questionnaire was provided by lecturers / experts with the criteria provided which were developed from the instrument validation grid.

Before being used to measure the validity of research products, both instruments agreed that the product was validated beforehand. Validators for the second instrument are three people. The self-validity sheet for student worksheets obtained the validity value of 0.93 and the validity sheet for the student worksheets obtained the validity value of 0.93. In this case, both of the instruments were in the valid category because their V values were greater than 0.60. So, both of these instruments are used to validate the research products.

Furthermore, the validity test was done through an expert review. This validity test was done with several iterations to get a valid product. There were three validators for the worksheets in this study. Then the one to one evaluation product, small group and field test are tested. Practicality test instruments consisted of student questionnaire responses and teacher response questionnaires. The indicators of practicality from the questionnaire responses of students and teachers included: usable, easy to use, appealing, and cost effective.

One to one evaluation is product practicality test through individual evaluation. The subjects of the try-out were three students with high, medium, and low ability at Class MIPA 1 of SMAN 2 Padang. Furthermore, a limited try-out was carried out on the small group. Small group evaluation was product practicality test in small groups. The subject of the try-out was the group of ninth grade students of Class MIPA 3 of SMAN 2 Padang, consisting of 9 students. The sample consisted of three

students with low, medium, and high abilities. The practicality of the student worksheet prototype was also tested limited to the field test. The practicality test in the field test was carried out through learning of 36 students from Class X MIPA 2 and two teachers from SMAN 2 Padang.

Before being used to assess the practicality of research products, the two assessment instruments were validated first. There were three validators for the two practical worksheet instruments for students. The validity sheet for the practicality of students' response questionnaire obtained a V value of 0.90. Then, for the instrument validity sheet of the teacher's response practicality, a value of 0.95 was obtained. Both of these instruments are in the valid category because the V value is greater than 0.60, so both of these instruments were suitable for testing the practicality of the product.

At this stage a field test was carried out to see the effectiveness of using student worksheets on the students' attitudes, knowledge and skills competencies. The sample was the students of Class X MIPA 2 of SMAN 2 Padang. Data collection instruments at the effectiveness evaluation stage were seen from three competencies, namely attitudes, knowledge, and skills.

The data analysis technique used is descriptive data analysis, namely by describing the validity, practicality and effectiveness of student worksheets. The results of the research data were analyzed using descriptive statistics to obtain average and percentage values [8].

III. RESULTS AND DISCUSSION

The results of the development of student worksheets using the inquiry-based learning model with the scientific approach are described based on the development stage of Plomp. The preliminary research phase is the initial stage in developing these student worksheets. The analysis phase consists of needs analysis and analysis of the characteristics of students in developing student worksheets. The need for developing student worksheets that can improve understanding of concepts through the process of discovery is important. This needs to be designed with student worksheets with components that can involve students in the process of concept discovery and also explicitly contain the steps of the inquiry-based learning model and scientific approach. Student worksheets are also expected to make physics learning easier and more enjoyable. Therefore, it is necessary to develop student worksheets using the inquiry-based learning model and scientific approach as an effort to improve students' physics competencies.

The characteristics of students are taken into consideration in the development of this student worksheet. According to Piaget's cognitive development theory, high school students aged 15-17 years are at the stage of intellectual development who can predict all possibilities in a complex manner [24]. In this age, middle school students are at the formal operational stage. At this stage, the students' mindset is systematic and they have understood abstract processes so that they are able to predict various possibilities and make discoveries. In addition, the discovery of concepts and principles of physics also needs to be taken into consideration in developing student worksheets that are in line with the expectations of students in order to make Physics learning easy and fun.

Based on the analysis of the needs and characteristics of students, the prototype student worksheets are designed using the inquiry-based learning model with a scientific approach. Student worksheets are designed based on the defined structure of

student worksheets which consists of six components: (1) learning instructions, (2) competencies to be achieved, (3) supporting information, (4) tasks and work steps, and (5) assessment [25]. Student worksheets contain the structure of the inquiry-based learning model and scientific approach. The structure of the inquiry-based learning model consists of five phases: (1) the orientation phase, (2) the conceptualization phase, (3) the investigation phase, (4) the conclusion phase, and (5) the discussion phase [13]. The scientific approach contained in the student worksheet consists of observing, asking, trying, reasoning, and communicating [26]. The design results at this stage are called prototype one.

The design phase aims to describe the results of the design of the student worksheets according to their needs. Learning design can be used as a starting point for efforts to improve the quality of learning. This means that the improvement of the quality of learning must begin with improving the quality of learning design, and designing learning [27].

The self-evaluation phase is done after the initial design of the prototype is completed and before it is validated by the expert team. In this case, each prototype is re-examined by the researcher (self-evaluation) [13]. The researcher reads, checks every prototype, corrects the incorrectness, and adds the missing parts. The student worksheets have completed their constituent components. However, there are some language usage errors, typing letters and punctuation that researchers have corrected.

The student worksheets that have been designed must be validated first. The purpose of validity is to obtain recognition and validation of the suitability of the device with needs so that it is appropriate and suitable for use in learning [28]. The test results of the prototype validity of the student worksheets were obtained after analyzing the validity sheet data by three experts using Aiken's V statistics [29]. The results of the validity test of the student worksheet prototype can be seen in Table 1.

Table 1. The Value of Validity of Prototypes of Student Worksheets

Aspect	Value V	Criteria
Component of the Student Worksheet	0.97	Valid
Content Feasibility	0.92	Valid
Construction of Student Worksheets	0.88	Valid
Language of Student Worksheets	0.96	Valid
Integrity of Student Worksheets	0.97	Valid
Average	0.94	Valid

The results of the validity test displayed in Table 1 show that the student worksheets developed are in the valid category with an average value of 0.94, because the V value in the aspects of the components, content, construction, and graphics is greater than 0.6. This is in accordance with the expert's opinion that a valid device contains conformity between each of its components [30]. So, this student worksheet can be used in the learning process.

In general, the student worksheets are in valid criteria. Several revisions have been made to the prototype according to the validator's suggestion. Among the revisions made are the use of punctuation marks, conjunctions, structure of student worksheets, and activities in the syntax of inquiry-based learning models. The revised results at this stage are called prototype two.

The Prototype Practical Test results consist of three stages, one to one evaluation, small group evaluation, and field test [13]. In the one to one evaluation phase, the student worksheets that will be assessed are given without being taught and students only read and understand them well. The subjects of the try-out were three students in Class X MIPA 1 of SMAN 2 Padang. The sample selection is done randomly by taking into account the level of students' ability (high, medium and low). The value of practicality of student worksheets at stage one to one evaluation can be seen in Table 2.

Table 2. The Value of Practicality of the Student Worksheet in One to One Evaluation Phase

Aspect	Value	Practical Criteria
Usable	84.52	Very Practical
Easy to use	83.33	Very Practical
Appealing	88.10	Very Practical
Cost effective	83.33	Very Practical
Average	84.82	Very Practical

Based on Table 2, in general all the three sample subjects stated that they had understood the student worksheet easily in terms of its language, work instructions and contents. This can be seen from the average value of student worksheets in the one to one evaluation phase, which is 84.82 with very practical criteria. The practicality of student worksheets based on the level of sample ability can be seen in Figure 1.

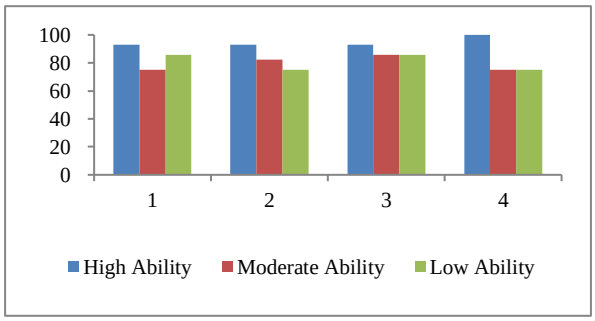

Figure 1. The Practicality of Student worksheet in Stage One to One Evaluation

In Figure 1 it can be seen that the students with low ability state that the student worksheets are easier to understand and they get the benefits from the worksheets, while the students with high ability state that the student worksheets are more interesting. However, the students with moderate ability state that the time spent on the student worksheets is less effective. The practicality of the three samples shows that student worksheets are on very practical criteria. The results of the one to one evaluation phase are called prototype three.

Then a limited trial is carried out on a small group evaluation. The trial subjects were a group of 9 high school students of MIPA 3 of SMAN 2 Padang. The sample consisted of three students with low, medium, and high abilities. The Prototype Practical Test results in Small Group Evaluation are seen for the four practicality assessment indicators in Table 3.

Table 3. The Value of Practicality of Student Worksheets in Small Group Evaluation Phase

Aspect	Value	Practical Criteria
Usable	80.16	Practical
Easy to use	78.97	Practical
Appealing	86.90	Very Practical
Cost effective	86.11	Very Practical
Average	83.04	Very Practical

The results of the Prototype Practical Test displayed in Table 3 show that the student worksheets are practical based on the interesting and efficient aspects, but they are very practical based on the easy and usable aspects. This indicates that the nine sample subjects agree that they understand the student worksheets easily in terms of the language, instructions for work, appearance and contents of the student worksheet. This can be seen from the average value of student worksheets in the small group evaluation stage which is 83.04 with very practical criteria. The practicality of student worksheets based on their level of ability in the small group evaluation stage can be seen in Figure 2.

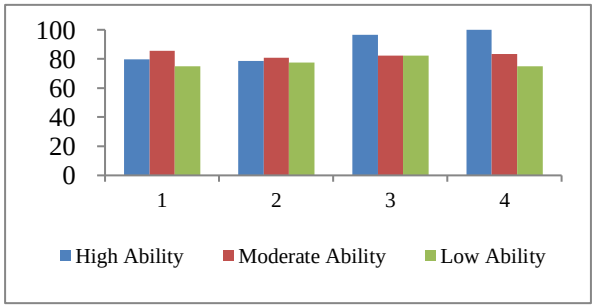

Figure 2. Practicality of Student Worksheets in the Small Group Evaluation Stage

Figure 2 shows that for the sample of high ability, moderate ability, and low ability the student worksheets are practical because they are easy to use, interesting and effective in learning. In this case, the student worksheets have no revisions and qualify for field testing. The results in the small group evaluation stage are called prototype four.

Then, the field test stage is carried out to test the practicality of the student worksheet. The purpose of this stage is to produce student worksheets in practical categories. The level of practicality seen from teachers considers the material easy and can be used by teachers and students well. The product will also be declared practical if the learning activities using the product are made clear and can be learned for students [31].

The practicality test results of student worksheets according to students are seen from the value of the practicality of 36 sample people. These results indicate that student worksheets are on practical criteria in terms of usable, easy to use, interesting and efficient. The practicality value of student worksheets for student responses in the field test stage can be seen in Table 4.

Table 4. Value of Practicality of Student Worksheets According to Students in the Stage Field Test

Aspect	Value	Practical Criteria
Usable	80.46	Practical
Easy to use	77.21	Practical
Appealing	80.15	Practical
Cost effective	75.74	Practical
Average	78.39	Practical

Furthermore, the assessment of the practicality of student worksheets in the field test stage is seen from the teacher's response which includes usable, easy to use, appealing, efficient aspects. The practical value of two teachers shows that student worksheets are on very practical criteria in terms of usability, ease of use, attractiveness and efficiency. The practicality value of student worksheets according to the teacher in the field test stage can be seen in Table 5.

Table 5. Value of Practicality of Student Worksheets According to the Teacher in the Stage Field Test

Aspect	Value	Practical Criteria
Usable	92.86	Very Practical
Easy to use	91.67	Very Practical
Appealing	92.19	Very Practical
Cost effective	87.50	Very Practical
Average	91.06	Very Practical

The research results of the Assessment Phase include the attitudes, knowledge and skills competencies. Competency assessment of students' attitudes is conducted every time a meeting is held by one observer through the observation sheet of the attitude of the students. Assessment on student attitudes was conducted at three meetings of Newton's legal material. This assessment was conducted to see the extent to which the students' willingness and good attitude responds to the learning process. The results of observations on the students' attitudes can be seen in Table 6.

Table 6. Recapitulation of Students' Attitude Competency Assessment Results

Attitude Aspect	Meeting Value (%)			Average	Criteria
	1st	2nd	3rd		
Curiosity	82.43	84.46	85.81	84.23	Very Good
Conscientiousness	85.14	83.78	87.16	85.36	Very Good
Cooperation	83.11	86.49	87.84	85.81	Very Good
Responsibility	85.81	87.84	89.86	87.84	Very Good

Table 6 shows that the students' attitudes are in the excellent category. At each meeting the attitudes of students have increased and decreased. The attitude that experienced the most significant improvement was curiosity. This shows that the student worksheets developed based on the inquiry models can increase the students' curiosity about Physics subject matter. Furthermore, the attitude of cooperation and responsibility of the students also increases significantly, this is because they are encouraged to conduct experiments in order to understand and build their own Physics concepts. However, their conscientiousness attitude has decreased in the second meeting. This is due to lack of conscientiousness in obtaining, analyzing, and interpreting data during Newton's II legal experiments. In general, the attitude of students in using the student worksheets in the inquiry-based learning model with a scientific approach is better during the learning process. This shows that the student worksheets using the inquiry-based learning model with the scientific approach are effective because it can improve the competency of students' attitudes in the form of curiosity, conscientiousness, cooperation, and responsibility.

Knowledge competency analysis results can be seen from the increase in the learning outcomes obtained through the assessment of student worksheets during the learning process and the results of the pretest-posttest assessment. Knowledge competency improvement can be seen by analyzing the results of the assessment in each step of the inquiry-based learning model and the scientific approach on the student worksheets used by the students. The results of the analysis on the students' improved knowledge competence for the assessment of student worksheets during the learning process can be seen in Table 7.

Table 7. Results of Knowledge Competency Enhancement Analysis

Meeting	Lowest Value	The Highest Score	Average	Individual Completeness		Classical Completeness (%)
				Complete	Not Completed	
First	65	94	86.11	28	8	77.78
Second	75	92	86.08	30	6	83.33
Third	78	93	87.36	31	5	86.11

Table 7 shows that the range of the students' knowledge competency values after learning using the student worksheets is 65 to 94. At the first meeting, the students' average value is 86.11. At the second meeting, the students' average value is 86.08. At the third meeting, the students' average value is 87.36. The acquisition of students' knowledge competency values can be seen as an increase. The results of the assessment indicate that the student worksheets using an inquiry-based learning model with an effective scientific approach improve students' knowledge competencies.

Furthermore, the assessment of students' knowledge is also determined by carrying out the tests before and after the use of worksheets using the inquiry-based learning model with the scientific approach. The students perform pretest and posttest with multiple choice format with a number of questions about 20 items. The results of the pretest and posttest test of students in using the student worksheets can be seen in Table 8.

Table 8. Pretest and Posttest Calculation Data

Statistics Parameters	Pretest	Posttest	Gain
Average	53.06	85.28	0.69
Variance	66.11	99.92	
Standard deviation	8.13	10.00	
The lowest value	35.00	60.00	
The highest value	65.00	95.00	
Median	55.00	85.00	
Mode	55.00	95.00	
Range of Value	30.00	35.00	

Based on the comparison between the results of the pretest and posttest, it can be calculated that the student worksheets increase the students' knowledge competency indicated by the gain score. Based on the analysis of knowledge competencies using the gain score, it can be stated that there is an increase in the students' average learning outcomes [32]. It is seen from the results of the increase in the gain score of 0.69 with the medium category. Thus, it can be concluded that the student worksheets using an inquiry-based learning model with a scientific approach can improve students' knowledge competencies and are declared effective for use in learning.

The results of the Skills Competency Analysis were also obtained from the observations on the students' skills during experiments on the material of Newton's law. The skills assessment for three meetings consisted of nine indicators. The nine indicators are observing, formulating problems, composing hypotheses, conducting experiments, collecting data, describing the relationship of variables, concluding the concept, communicating, and reflect learning [33]. The data from the observers' skills

competency observations in brief can be seen in Table 9.

Table 9 shows that the average value of students' competency skills is above the minimum completeness criteria with the B (Good) qualification, and more than 75% of students gain the score above the minimum completeness criteria. This means that the use of student worksheets using inquiry-based learning models with a scientific approach to class X learning is effective in the learning process. This is evidenced by the increased skills of students in accordance with the indicators assessed.

Table 9. Results of Data Analysis on Students' Skills

Aspect	Meeting Value (%)			Average
	I	II	III	
Observe	80.41	81.76	83.11	81.76
Formulating the problem	83.11	84.46	85.14	84.23
Arrange hypotheses	84.46	85.81	86.49	85.59
Conduct an experiment	83.11	85.14	86.49	84.91
Collect data	85.81	86.49	87.84	86.71
Describe the variable relationship	86.49	87.84	88.51	87.61
Concluding the Concept	85.14	86.49	87.84	86.49
Communicate	85.81	87.84	88.51	87.39
Reflecting learning (M9)	85.81	86.49	87.16	86.49
Average	84.46	85.81	86.79	85.69

Overall, students get scores above the minimum completeness criteria in competing attitudes, knowledge and skills. This shows that the student worksheets using the inquiry-based learning model with the scientific approach to learning class X is in the effective category of its use in the learning process. The effectiveness assessment is assessed from the level of student competency achievement and produces a valid, practical and effective student worksheets [14,34,35].

The student worksheets using inquiry-based learning models with a scientific approach are valid, practical, and effective in improving students' physics competencies. This valid student worksheet is in accordance with the validity goal of obtaining recognition and validation of the suitability of the device with the needs and suitability of each component so that it is appropriate and suitable for use in learning [22,25].

IV. CONCLUSION

The research development gains four important results: (1) The student worksheets using the inquiry-based learning model with a scientific approach have been produced. The worksheets are developed based on the five structures of inquiry-based learning models, including orientation, conceptualization, investigation, conclusion, and discussion. Besides, the worksheets have accommodated the five indicators of the scientific approach, including observing, asking, trying, reasoning, and communicating; (2) The student worksheets use an inquiry-based learning model with a scientific approach that has met the valid criteria; (3) The student worksheets use an inquiry-based learning model with a scientific approach that has met the practical criteria; and (4) The student worksheets use the inquiry-based learning model with a scientific approach that has met the effective criteria.

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