

Profile of High School Students Practicum Performance Ability on the Material Optics Using PhET Virtual Laboratory

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Abstract: Physics is very closely related to finding out and understanding nature systematically, so that physics is not only the mastery of a collection of knowledge in the form of concepts but also a performance process. The purpose of this study was to describe the profile of student's performance assessment abilities using the virtual PhET application. Previously carried out the development of performance assessment instruments and student worksheets using the 4-D model, namely the stages of defining, designing, developing, and disseminating. However, this research was only carried out until the develop stage. The research instrument was the validation instrument for student worksheets and the validation instrument for performance assessment. Research data includes data on the validity of student worksheet, validity of performance assessment instruments, and data on student performance abilities. The subjects of this study were 36 students of class XI MIPA 1 SMA Negeri 3 Sidoarjo. The validators of this study were two lecturers at the Department of Physics, Faculty of Mathematics and Natural Sciences, UNESA. Based on the research results obtained: 1) Student worksheets developed has a validity value of 89.79% with very valid criteria and the performance assessment instrument sheet developed has a validity value of 95.00% with very valid criteria 2) The performance profile of students in formulating problems, formulating hypotheses, identifying variables, designing experimental procedures, collecting data, analyzing data, and drawing conclusions stated to be very good with a value of 97.31% for the reflection experiment and 95.57% for the refraction experiment.

Keywords: *student worksheets, validity, performance assessment instrument, performance profiles of students.*

Profil Kemampuan Kinerja Praktikum Peserta Didik SMA pada Materi Optik Menggunakan Laboratorium Virtual PhET

Abstrak: Fisika sangat erat kaitannya dengan cara mencari tahu dan memahami alam secara sistematis, sehingga fisika bukan hanya penguasaan sekumpulan pengetahuan yang berupa konsep-konsep tetapi juga merupakan suatu proses kinerja. Tujuan penelitian ini adalah untuk mendeskripsikan profil kemampuan kinerja praktikum peserta didik dengan menggunakan aplikasi virtual PhET. Sebelumnya dilakukan pengembangan instrumen penilaian kinerja dan LKPD menggunakan model 4-D yaitu tahap pendefinisian (*define*), perancangan (*design*), pengembangan (*develop*), dan penyebaran (*disseminate*). Namun pada penelitian ini hanya dilakukan sampai tahap pengembangan (*develop*). Instrumen penelitian yaitu instrumen validasi untuk LKPD dan instrumen validasi untuk penilaian kinerja. Data penelitian meliputi data validitas LKPD, validitas instrumen penilaian kinerja, dan data kemampuan kinerja siswa. Subjek penelitian ini yaitu 36 peserta didik kelas XI MIPA 1 SMA Negeri 3 Sidoarjo. Validator dari penelitian ini yaitu dua orang dosen jurusan Fisika FMIPA UNESA. Berdasarkan hasil penelitian diperoleh: 1) LKPD yang dikembangkan memiliki nilai validitas sebesar 89,79% dengan kriteria Sangat Valid dan lembar instrumen penilaian kinerja yang dikembangkan memiliki nilai validitas sebesar 95,00% dengan kriteria Sangat Valid 2) Profil kinerja peserta didik dalam merumuskan masalah, merumuskan hipotesis, mengidentifikasi variabel, merancang prosedur eksperimen, mengumpulkan data, menganalisis data, dan menarik kesimpulan dinyatakan sangat baik dengan nilai 97,31% untuk percobaan pemantulan dan 95,57% untuk percobaan pembiasan.

Kata Kunci: *LKPD, validitas, instrumen penilaian kinerja, profil kinerja peserta didik.*

INTRODUCTION

Performance is an activity to carry out, to complete tasks and responsibilities in accordance with the expectations and goals that have been set (Ketut, 2012). Performance assessment is also one way to assess student skills which are very well applied in learning physics with the aim of being able to see the extent to which student's abilities in carrying out scientific activities such as problem formulation, hypothesis formulation, experimentation and conclusion drawing can run systematically and directed.

In practicum activities, of course there needs to be an assessment carried out by the teacher. Assessment is

needed by teachers to obtain information objectively, continuously and thoroughly about the process and student learning outcomes, the results of which are used as a basis for determining further treatment (Sukmawa et. Al., 2019). Assessment in practicum can be used to assess the ability of students in discussions, problem solving, participation of students in discussions, using laboratory equipment, operating a tool, and other activities that can be observed (Usman et. Al., 2014).

According to Ketut (2012), performance assessment is a procedure that uses various forms of tasks to obtain information about what and to what extent students have learned. Performance assessment requires students to

complete performance tasks using their knowledge and skills which are manifested in the form of deeds, actions or performance. Performance tests ask students to realize actual assignments that represent the overall performance to be assessed, such as preparing tools, using tools / assembling tools, writing data, analyzing data, concluding, compiling reports and so on. In particular, the performance assessment explains the ability of student's abilities, conceptual understanding, the ability to apply knowledge and skills, the ability to carry out performance and the ability to carry out a process (Nuril, et. Al., 2016).

Currently, the government is trying to implement assessments not only in the form of written tests, but towards authentic assessments that measure the competence of attitudes, skills and knowledge based on processes and results. This kind of assessment is applied through the 2013 curriculum which is currently used by most schools in Indonesia. Attitude competency assessment can be observed from the daily behavior of students while in school. Skills competency assessment is carried out by directly observing the performance of students. The assessment of knowledge competencies can be observed from the results of the final exam assessment given to students (Permendikbud, 2013).

Assessment is one of the important stages in the learning process. Widoyoko (2009: 4) states that assessment must be seen as an important factor that determines the success of the learning process and outcomes. The results of the assessment received can be used as a measure of their success in understanding a concept or material for students. Suwandi (2009: 7) explains that assessment is a process to determine whether the process and results of an activity program are in accordance with predetermined goals and criteria.

In 2013 curriculum development the implementation of the assessment refers to the Assessment Standards for the Regulation of the Minister of Education and Culture. One of the principles of assessment stated in the Regulation of the Minister of Education and Culture Number 66 of 2013 is that the assessment of student learning outcomes at the primary and secondary education levels is carried out based on educational assessment standards that apply nationally. Where the national assessment scale is an assessment that requires students to demonstrate a certain competency using practical tests, projects, and portfolio assessments (Awaluddin et. Al., 2016).

Performance assessment can be used to assess student's abilities in discussions, problem solving, student participation in discussions, applying laboratory equipment, operating a tool, and other activities that can be observed (Ketut, 2012). Performance assessment also affects student's understanding of physics concepts (Dungus et. Al., 2013).

Performance assessment have begun to be carried out by some teachers. But the teacher only conducts performance assessment on offline practicums (practicum in schools). Based on the results of interviews with a physics teacher at SMA Negeri 3 Sidoarjo, the teacher has never conducted a practicum performance assessment

which is done virtually. Because practicum is only done in school laboratories and many teachers do not recognize applications that support practicum virtually.

In the current era of the COVID-19 pandemic, all technological media plays an important role in the field of education. All human activities have been replaced by sophisticated technology. One technology that is often used is a mobile phone. Practicum which is usually done in school laboratories can also be replaced with virtual labs or virtual laboratories, where the virtual lab can also be done on each student's cell phone. The virtual laboratory application is a PhET Simulation.

In the PhET Simulation application, there are several practical materials that can be used by students to retrieve data according to their needs. In this study, the material to be used is "optics" where the basic competencies are discussed, namely (3.11) Analyzing the workings of optics using the properties of light reflection and / or refraction by mirrors and / or lenses and (4.11) Assessing investigations about application the principle of reflection and/or refraction on mirrors and/or lenses. The indicators that will be used in the basic competencies 4.11 laboratory performance assessment are formulating problems, formulating hypotheses, identifying variables, designing experimental procedures, collecting data, analyzing data, and drawing conclusions.

Based on the problems found, research was carried out on the development of a practicum performance assessment instrument to describe the profile of class XI students of SMA Negeri 3 Sidoarjo. Data collection according to Basic Competence will be done virtually using a PhET simulation application with the title "Bending Light" experiment.

METHODS

This type of research uses a Research and Development (R & D) design. This research is using the 4-D model of research and development. The 4-D model (four-D models) developed by Thiagarajan et. al. (1974: 5), namely the stages of defining, designing, developing and disseminating. However, this research was only carried out until the develop stage. In this study, the development was carried out to determine the profile of student's practical performance abilities using the virtual PhET application.

The define stage aims to defining the student worksheets requirements. The determination of learning requirements is carried out by analyzing core competencies, basic competencies, and learning materials based on the standard content of the 2013 Curriculum. The design stage aims to prepare a prototype or draft of the student worksheets that will be developed. The development stage consists of testing the validity of the student worksheets and the performance assessment instrument sheet aimed at evaluating the student worksheets that has been developed.

This research was conducted at SMA Negeri 3 Sidoarjo. The implementation time is February 2021. The resulting product is student worksheets on optics and laboratory performance assessment instruments using the

PhET virtual laboratory. The subjects of this study were 36 students of class XI MIPA 1 SMA Negeri 3 Sidoarjo.

The research instrument was a student worksheets validity questionnaire and a performance assessment instrument sheet. The validity questionnaire relates to the evaluation of the student worksheets that has been

1 = Not Very Good
 2 = Not Good
 3 = Enough
 4 = Good
 5 = Very Good

The research data were analyzed using qualitative and quantitative analysis. Data for the defining and design stages were analyzed qualitatively and presented in descriptive form. Data from the development stage, namely validity and practicality, were analyzed quantitatively.

1. Analyze the validity of the student worksheets and the performance assessment instrument sheet

developed and the performance assessment instrument at the student worksheets. The components contained in the student worksheets validity questionnaire and assessment are construction, content feasibility, and language. The validity test observation sheet is prepared based on a Likert scale with five alternative answers as follows.

Validity data is obtained by analyzing the validity questionnaire that has been filled in by the validator. The analysis was carried out by the following steps.

- a. Provide score answers with indicators based on a Likert scale.
- b. Determines the highest score
 Highest score = number of validators x number of indicators x maximum score.
- c. Determine the total score of each validator by adding up all the scores obtained from each of the assessment indicators.
- d. Determine the score obtained by adding up the scores of each validator.
- e. The determination of the validity value is in the following way.

$$\text{Validity Value} = \frac{\text{number of scores obtained}}{\text{maximum number of scores}} \times 100\%$$

Table 1. Validation Questionnaire Interpretation Criteria

Percentage (%)	Criteria
81 – 100	Sangat Valid
61 – 80	Valid
41 – 60	Cukup Valid
21 – 40	Kurang Valid
0 – 20	Tidak Valid

(Riduwan, 2013).

2. Analysis of the performance profile of students
 The criteria for the performance profile of students are assessed from the aspects of formulating problems, formulating hypotheses, identifying variables, designing

experimental procedures, collecting data, analyzing data, and drawing conclusions. Student performance profile data can be analyzed by percentage (%), using the following formula.

$$\text{Performance Profile Value} = \frac{\text{number of scores obtained}}{\text{maximum number of scores}} \times 100\%$$

Table 2. Student Performance Profile Criteria

Percentage (%)	Criteria
81 – 100	Sangat Baik
61 – 80	Baik
41 – 60	Cukup Baik
21 – 40	Kurang Baik
0 – 20	Tidak Baik

(Riduwan, 2013).

RESULT AND DISCUSSION

1. The definition stage
 - a. Final preliminary analysis

At first the student worksheets was made by the teacher and in the process of collecting data using school laboratories. However, in the condition of the COVID-19

virus outbreak, all aspects of learning are carried out online and the practicum process must eventually be hampered. Finally, the researchers developed a practicum that can be done online through the PhET application.

b. Analysis of learners

The results of the analysis of students through observation showed that students who sat in class XI SMA had an age of 16-18 years. Based on Piaget's learning theory in Budiningsih (2008), at the age of 11-18 years, he is at the formal operational stage with the main characteristics of his development being able to think abstractly, logically, draw conclusions, interpret, and develop hypotheses. The results of the analysis become the basic assumption that students who are in class XI have been able to develop cognitive and psychomotor potential, so that they are skilled to use learning media including teaching materials such as student worksheets.

c. Task analysis

This analysis was carried out to detail the learning material to be written in the student worksheets. This analysis includes content structure analysis which includes analysis of core competencies and basic competencies for Optical material so that indicators of competency achievement can be formulated.

1. Concept analysis

In Optical material, the concept identified by the occurrence of reflection on the air and water medium then the occurrence of refraction on the glass medium. The concept of light reflection is the process of changing the direction of light propagation to the side of the original medium, after hitting the interface of two mediums. In simple terms, reflection of light is the process of being scattered back from the surface of an object that is exposed to light. The concept of light refraction is the bending of light when a beam of light crosses the boundary plane of two mediums with different refractive indexes. The absolute refractive index of a material is the ratio of the speed of light in a vacuum to the speed of light in that material. After identifying the concepts of Optical material, learning objectives are generated that are referred to as indicators of competency achievement that are in accordance with the 2013 Curriculum.

2. Analysis of experiment objectives

In the reflection experiment, the objective of the experiment was to investigate the relationship between the angle of incidence and the angle of reflection in the air

and water medium. In the refraction experiment, the objective of the experiment is to investigate the comparison of the refractive index of the glass from the experimental results with the theory in the literature. The reference for the formulation of the objectives of this experiment is an indicator of competency achievement that refers to the 2013 Curriculum, that is students are able to analyze the workings of optical devices using the properties of light reflection and refraction by mirrors and lenses to finish making works that apply the principle of reflection and/or refraction on mirrors and lens.

3. Analysis procedure

There are two experiments, namely reflection and refraction. In the reflection experiment, open the phet simulation application, select the light & radiation menu, select the Bending light experiment, then select the more tools icon, the second click the angels icon (angle) to show the incidence and reflection angle values, and the third manipulate the incident angle by moving it. laser to the right and to the left. In the refraction experiment, open the phet simulation application, select the light & radiation menu, select the Bending light experiment, then select the more tools icon, second click the angels icon to show the incidence angle and refractive angle values, and third after getting the incidence angle value (i) and the refractive angle (r) then calculate $\sin i$ and $\sin r$ and divide $\sin i$ and $\sin r$ using a calculator.

2. The design stage

LKPD is developed in accordance with the development steps prepared by the Depdiknas (2008). The sequence of activities at student worksheets is formulating problems, formulating hypotheses, identifying variables, designing experimental procedures, collecting data, analyzing data, and drawing conclusions.

3. The development stage

a. Student worksheets validation and performance assessment instrument sheet

Student worksheets validation and performance assessment instrument sheets were carried out by two Physics Department lecturers. The analysis of the validity of the student worksheets and the performance assessment instrument sheet are briefly shown in Table 3 and Table 4.

Table 3. The results of the student worksheets validation on Optical Materials

No.	Rated Aspect	Validator 1 (%)	Validator 2 (%)	Average (%)	Criteria
1.	Construction	85,00	95,00	90,00	Very Valid
2.	Content Eligibility	80,00	93,33	86,66	Very Valid
3.	Procedure	80,00	90,00	85,00	Very Valid
4.	Language	95,00	100,00	97,50	Very Valid
Total Average Value				89,79	Very Valid

The results of the validity of student worksheets in Table 3 obtained a value of 89,79% with very valid criteria. This

means that student worksheets can be used in the learning process.

Table 4. The results of the validation of the performance assessment instrument sheet

No.	Rated Aspect	Validator 1 (%)	Validator 2 (%)	Average (%)	Criteria
1.	Construction	100,00	100,00	100,00	Very Valid
2.	Content Eligibility	80,00	90,00	85,00	Very Valid
3.	Language	100,00	100,00	100,00	Very Valid
Total Average Value				95,00	Very Valid

The results of the validity of the performance assessment instrument sheet in Table 4 obtained a value of 95,00% with very valid criteria. This means that the performance assessment instrument sheet can be used in the learning process.

b. Performance profiles of students

To find out the performance profile of students, it was obtained by analyzing the results of the student worksheets filling in the reflection experiments and refraction experiments on 36 students of class XI MIPA 1 SMA Negeri 3 Sidoarjo. The analysis of the results of the students performance profile data is briefly shown in Table 5 and Table 6.

Table 5. Performance profiles of students in the reflection experiment

No.	Rated Aspect	Percentage (%)	Criteria
1.	Formulating Problems	95,19	Very Good
2.	Formulating Hypotheses	97,89	Very Good
3.	Identifying Variables	98,24	Very Good
4.	Designing Experimental Procedures	97,37	Very Good
5.	Collecting Data	96,69	Very Good
6.	Analyzing Data	97,40	Very Good
7.	Drawing Conclusions	98,37	Very Good
Total Average Value		97,31	Very Good

Based on Table 5, it is known that the percentage average value of the performance profile of student in the reflection experiment is 97,31% with very good criteria.

Table 6. Performance profiles of students in refraction experiments

No.	Rated Aspect	Percentage (%)	Criteria
1.	Formulating Problems	95,92	Very Good
2.	Formulating Hypotheses	98,24	Very Good
3.	Identifying Variables	96,13	Very Good
4.	Designing Experimental Procedures	90,05	Very Good
5.	Collecting Data	95,61	Very Good
6.	Analyzing Data	95,70	Very Good
7.	Drawing Conclusions	97,37	Very Good
Total Average Value		95,57	Very Good

Based on Table 6, it is known that the percentage average value of the performance profile of student in the refraction experiment is 95,57% with very good criteria.

1. Validity of the student worksheets and the performance assessment instrument sheet

Judging from the construction component, student worksheets is declared Very Valid with a value of 90.00%, then on the performance assessment instrument sheet it is declared Very Valid with a value of 100.00%, meaning that student worksheets and performance

assessment instrument sheets have been presented systematically, containing details of the material and learning objectives which is clear, is able to support the smoothness of the learning process, contains motivation, stimulus and response. Depdiknas (2008) explains that the construction component includes clarity of objectives to be achieved, order of presentation, attractiveness and completeness of information.

Judging from the content feasibility component, student worksheets is declared Very Valid with a value of 86.66%, then on the performance assessment instrument

sheet it is declared Very Valid with a value of 85.00%, meaning that the developed student worksheets is in accordance with the applicable curriculum, namely the 2013 curriculum. Depdiknas (2008) which states that the teaching materials developed must be in accordance with the demands of the curriculum.

Judging from the component of the procedure, student worksheets was declared very valid with a value of 85.00%, meaning that the student worksheets developed was in accordance with the experimental procedure by inquiry. The inquiry method is a method that is able to lead students to realize what has been obtained during learning. In the inquiry method in the teacher learning planning process, it is not preparing a number of materials that must be memorized but designing learning that allows students to find material that must be understood through a systematic thinking process (Roida et. Al., 2016).

Judging from the language component, student worksheets is declared Very Valid with a value of 97.50%, then on the performance assessment instrument sheet it is declared Very Valid with a value of 100.00%. The language component deals with the use of clear sentences and does not cause confusion for students. The appropriateness of the instrument in terms of language must fulfill three things, namely communicative language according to the respondent's education level, using standard Indonesian, and not using locally applicable language or taboo (Sukmawa et. Al., 2019).

The results of data analysis on the validator's assessment of the student worksheets learning tools show that the average expert assessment of all devices is seen from each indicator to be assessed in practicum performance (Usman et. Al., 2014). Overall, the value of the results of the LKPD validity test was 89.79% and the value of the results of the performance assessment instrument sheet validity test was 95.00%. Therefore, it can be said that the student worksheets and performance assessment instrument sheets on the Optical material developed are very valid and can be used in physics learning.

2. Performance profiles of students

Judging from the aspect of formulating the problem, the performance profile of students in the reflection experiment was stated to be very good with a value of 95.19%, then the performance profile of students in the refraction experiment was stated to be very good with a value of 95.92%. At this stage the researcher assesses the ability of students to formulate problems and it is found that many students can formulate problems very well.

In terms of the aspect of formulating hypotheses, the performance profile of students in the reflection experiment was stated to be very good with a value of 97.89%, then the performance profile of students in the refraction experiment was stated to be very good with a value of 98.24%. The hypothesis is a temporary answer to the problem that is the object of the study (Samidi et. Al., 2015). The ability of students to provide temporary answers to research problems or hypotheses has been very good in all experiments.

Judging from the aspect of identifying variables, the performance profile of students in the reflection experiment was stated to be very good with a value of 98.24%, then the performance profile of students in the refraction experiment was stated to be very good with a value of 96.13%. Variables are very decisive in research, especially in quantitative research because errors in determining variables are very fatal and affect the research objectives and research procedures (Sangkot, 2017). At this stage the researchers assessed the student's ability to identify variables was very good.

Judging from the aspect of designing experimental procedures, the performance profile of students in the reflection experiment was stated to be very good with a value of 97.37%, then the performance profile of students in the refraction experiment was stated to be very good with a value of 90.05%. At this stage the researchers assessed the ability of each student in designing experimental procedures in the virtual PhET application. Every student must be active to participate in designing experimental procedures. According to Suryosubroto (2002: 279), participation is a person's mental and emotional involvement in achieving goals and taking responsibility for them.

In terms of the aspect of collecting data, the performance profile of students in the reflection experiment was stated to be very good with a value of 96.69%, then the performance profile of students in the refraction experiment was stated to be very good with a value of 95.61%. The ability of students in collecting data obtained from the PhET application is very good and all data is filled in correctly.

Judging from the aspect of analyzing the data, the performance profile of students in the reflection experiment was stated to be very good with a value of 97.40%, then the performance profile of students in the refraction experiment was stated to be very good with a value of 95.70%. At this stage the researcher assessed the student's ability to analyze data was very good in two experiments, the data were presented and analyzed correctly.

In terms of the aspect of drawing conclusions, the performance profile of students in the reflection experiment was stated to be very good with a value of 98.37%, then the performance profile of students in the refraction experiment was stated to be very good with a value of 97.37%. Drawing conclusions or commonly called verification is an attempt to find or understand meaning, order, patterns, explanations, causal pathways or propositions. Drawing conclusions is part of a complete configuration activity (Miles and Huberman, 2007: 18). The ability of students to draw conclusions is very good and the conclusions presented are in accordance with the formulation of the problem in each experiment.

Overall, the value of the performance profile of students in the reflection experiment was 97.31% and the value of the performance profile of students in the refraction experiment was 95.57%. Therefore, it can be said that the performance profile of students is very good in the reflection and refraction experiment.

CONCLUSION

Based on the results of the research and development that has been carried out, it is concluded that the developed student worksheets has a validity value of 89.79% with very valid criteria and the performance assessment instrument sheet developed has a validity value of 95.00% with very valid criteria.

The performance profile of students in formulating problems, formulating hypotheses, identifying variables, designing experimental procedures, collecting data, analyzing data, and drawing conclusions was stated to be very good with a value of 97.31% for the reflection experiment and 95.57% for the refraction experiment.

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