Validation of Student Worksheet (LKPD) Based Argument-Driven Inquiry (ADI) Assisted with PhET to Train Argumentation Skills the Pressure Materials

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Abstract

This study aims to determine the feasibility of student worksheets based on the PhET-assisted Argument-Driven Inquiry (ADI) to train students' argumentation skills on the subject of substance pressure. This research uses Research and Development (R&D) research using a 4-D development model (Define, Design, Development, and Dissemination). This study uses the LKPD validation sheet instrument, which consists of 6 assessment aspects. The research data was obtained from the validation test results by three validators consisting of two physics education lecturers and one science education lecturer at the University of Riau. The validation test results for developing an Argument-Driven Inquiry (ADI) based on PhET from each validator were 3.63%, 3.57%, and 3.53%, respectively. So that the average validator results reach 3.58% in the very valid category. Based on the results of the validity assessment, it can be concluded that the development of PhET-assisted Argument-Driven Inquiry (ADI)-based worksheets on substance pressure materials is included in the appropriate category to be used as teaching materials to train students' argumentation skills in the learning process.

How to Cite

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INTRODUCTION

Science is part of science as it plays an essential role in improving the quality of education, especially in producing quality students. The learning process has an important influence on educational attainment because learning is a interaction process between students and learning resources. Based on the 2013 curriculum in science learning, students are required to be active in learning (Handayani, 2015). So science learning becomes the basis for students to be seen as active and skilled, such as in scientific argumentation and critical thinking (Rustaman, 2011).

Argumentation is one of the practical learning strategies for improving 21st-century skills (Aslan, 2015). Argumentation plays an essential role in science learning because argumentation not only constructs scientific knowledge but also teaches how to construct it (Pitorini, Suciati & Joko, 2020). Although argumentation skills are essential, they are rarely included in science learning in class (Supeno, 2019). Students are often asked to collect data, but when they are involved in scientific arguments in class, students find it challenging to give their arguments. The low argumentation ability of students is because students have never been trained to argue (Arfiany, 2021). Thus, to train students' argumentation skills, an effective learning model is needed that can assist students in constructing scientific explanations (Supeno, 2017). One of the appropriate learning models is the Argument-Driven Inquiry (ADI) model.

In the opinion of Marhamah, Nurlaelah & Setiawati (2017), the Argument-Driven Inquiry (ADI) learning model is a learning model designed to prepare and provide opportunities for students to develop their ideas to obtain the date, conduct investigations, and use data in answering investigative questions. , write and think more reflectively. The ADI learning model can foster students' argument skills (Erika & Prahni, 2017). The ADI model differs from other models, namely that this learning model provides opportunities for students to design research and find their own results, as well as being involved in the argumentation process, giving and supporting their ideas (Demircioglu, Tuba & Sedat Ucar, 2015). The steps for implementing the ADI model were adopted from the stage (1) identifying tasks and guiding questions, stage (2) designing methods and collecting data, stage (3) developing initial arguments, and stage (4) argumentation session (Sampson, 2013).

Along with the development of education in Indonesia and the development of increasingly advanced technology, good learning resources are needed to support the development of science. One of the technological developments that have developed is the availability of a virtual PhET laboratory to support the learning process. PhET users in science learning are an alternative to facilitate students to be more active, think critically, and creatively because they can synchronize virtual laboratories with practicals in natural laboratories (Hasibuan & Abidin, 2020).

In using PhET simulation, a guide is needed in the form of a Student Worksheet or LKPD. LKPD is one of the teaching materials and learning resources essential in supporting the learning process (Hamidah,, 2018). Using LKPD based on Argument-Driven Inquiry (ADI) assisted by PhET can help students be more active in the learning process, develop process skills, and practice argumentation skills and scientific attitudes. LKPD can be used to train students' argumentation skills in learning.

Based on the results of initial observations conducted at SMP Negeri 1 Koto Gasib, it was found that educators did not prepare teaching materials used in learning activities and were not varied because the teaching materials used were conventional, and teaching materials such as LKPD used by teachers did not train students' argumentation skills. This makes it difficult for students to understand the lesson. Therefore, it is essential to develop teaching materials in the form of student worksheets oriented to argumentation skills.

Based on the above background, the researcher is interested in developing an Argument-Driven Inquiry (ADI) based worksheet with PhET assistance to train students' argumentation skills on the subject of substance pressure.

METHOD

The research design in this study used research and development methods. The research and development method is a research method used to create a new product or develop an existing product and test the validity of the product. The type of research used is the type of R&D development research (Research and Development) according to Sugiyono (2014) namely research and development that designs a product as an alternative to solving a problem through internal testing (opinions of experts and practitioners). The development model that will be used in this research is model 4-D, which stands for Define, Design, Development, and Dissemination. Ho-

wever, in this development research, researchers only conducted research up to the 3rd stage, namely the development stage. The development process is carried out with the assessment of several experts to determine whether the LKPD developed is valid and can be used in learning. Before the trial was conducted, the LKPD had gone through a revision stage based on experts' assessments, suggestions, and input.

The subject of this development research is LKPD based on Argument-Driven Inquiry (ADI). Data collection techniques were obtained from the LKPD validation sheet which consisted of 6 aspects: content feasibility, language feasibility, student activities, time feasibility, attractiveness, and component aspects carried out by Riau University lecturers. The data that has been obtained from the validation results from the validators will be presented in a liker as Table 1 below:

Table 1. Likert scale

Rating	Scale Value
Invalid	1
Less Valid	2
Valid	3
Very Valid	4

(Sugiyono, 2014)

The formula used to calculate the percentage is as follows:

$$K = \frac{F}{N.I.R} \times 100\%$$

Information :
F = Total number of respondents' answers
N = Highest score in the questionnaire
I = Number of questions in the questionnaire
R = Number of respondents.

The results of this validation analysis aim to obtain validity in using LKPD. Furthermore, the average that has been obtained will be confirmed according to the criteria in Table 2. as follows:

Table 2. Validity Level Assessment Criteria

Achievement Level	Validity Level
$01,00\% < x \leq 50\%$	Invalid
$50,01\% < x \leq 70\%$	Less Valid
$70,01\% < x \leq 85\%$	Valid
$85,01\% < x \leq 100\%$	Very Valid

(Sugiyono, 2014)

The development of LKPD based on Ar-

gument-Driven Inquiry (ADI) assisted by PhET in this study is declared valid if all indicators on the validity assessment instrument have an average range of 2.5% - 4.0%. The final result of this research is the LKPD product based on Argument-Driven Inquiry (ADI) assisted by PhET on substance pressure material that has been proven valid to be used to train students' argumentation skills.

RESULT AND DISCUSSION

Define Stage
Preliminary Analysis

This definition stage aims to find out the fundamental problems in science learning, especially in the matter of substance pressure and its application in daily life, to develop an Argument-Driven Inquiry (ADI)-based Student Worksheet with the assistance of PhET to train students' argumentation skills based on in the applicable curriculum to find out how instructional materials occur in the field so that the teaching materials needed are by the problems found in the area. The results of interviews were conducted based on the 2013 revised 2018 curriculum on the chapter on substance pressure and its application in everyday life in class VIII of SMP N 1 Koto Gasib. This analysis uses Basic Competence 3.8, Explaining the pressure of substances and their application in everyday life, including blood pressure, osmosis, and capillarity of plant transport tissues. Based on the results of the interviews obtained, teaching materials are needed that can assist teachers in conveying material to students so that students can understand the substance pressure material.

Task Analysis

At the task analysis stage, it aims to identify tasks that need to be done by students in learning activities that are by the Argument-Driven Inquiry (ADI) learning syntax to train students' argumentation skills. Charges related to the cognitive domain of students based on essential competencies 3.8 Explaining the pressure of substances and their application in daily life, including blood pressure, osmosis, and capillarity of plant transport tissues. The indicators that need to be achieved in this study contained in the LKPD include:
1. Identifying the factors that affect hydrostatic pressure.
2. Identifying the factors that influence floating, sinking, and floating events.
3. Analyzing the relationship between the load

force and the cross-sectional area according to the law Pascal.

Then an analysis of the argumentation ability of each student is carried out through Argument-Driven Inquiry-based learning.

Concept analysis

At this stage, the aim is to define and identify the concept of the LKPD developed on the substance pressure material. The pictures obtained are linked and arranged systematically to receive ideas relevant to the material pressure of substances. In preparing for this LKPD. first, an analysis of the concepts considered challenging to be understood by students obtained from the results of pre-research that has been carried out at SMP Negeri 1 Koto Gasib was carried out. As many as 83% of students have difficulty with hydrostatic pressure, Archimedes' law, and Pascal's law. Based on the results of the pre-research, the concept of LKPD developed, namely analyzing the image of hydrostatic pressure, Archimedes' law and Pascal's law was obtained.

Design Phase

The design stage is the stage of making LKPD, according to Thiagarajan in (Maydiantoro, 2021). There are four steps in the design of the developed product, namely:

Preparation of materials

At this stage, the researcher looks for phenomena related to everyday life related to substance pressure material and composes student worksheets based on LKPD components, namely LKPD objectives, problem formulation, work steps, data collection, and data analysis to the model syntax. Argument-Driven Inquiry (ADI) learning instruction.

Format selection

Selection of the format used in the preparation of the Argument-Driven Inquiry (ADI) based on PhET-assisted LKPD to train argumentation skills by the components of this LKPD composed of LKPD cover, LKPD content in the form of LKPD exercise syntax using the Argument-Driven Inquiry (ADI) learning model and bibliography.

Learning design

The learning design used to design the offline learning process uses the Argument-Driven Inquiry (ADI) learning model.

The initial design of the device

At this stage, the worksheets are designed using computer applications such as Microsoft Word and Adobe Illustrator to add supporting images to the worksheet designs. The following is

the front cover of the LKPD that was developed.

Figure 1. LKPD Front Cover Display

The LKPD that has been designed then produces draft I. An assessment of the validity of the LKPD is carried out by three expert lecturers of Science Education at the University of Riau. After assessing the validity of the LKPD, it is revised to produce draft II and a valid LKPD. The results of the revision of the validation study can be seen in Table 3.

Stage Development

The LKPD that has been reviewed in the first validation is then revised according to the suggestions from the validator and is continued with the second validation which aims to produce a decent LKPD. The quality of a developed product can be seen from one of the criteria, namely validity (Hulu & Dwiningsih, 2021). LKPD validation is carried out by three validators, namely expert lecturers. The LKPD feasibility test consists of 6 aspects of the LKPD assessment consisting of content feasibility, language eligibility, eligibility of student activities, eligibility time, interests and components (Randa, 2020). The results of the validity can be seen in Table 4.

Based on the results of expert validation analysis shows that overall the results obtained are 89.3% with a very valid validity level or suitable for use in the learning process. LKPD validation consists of 6 aspects, namely the feasibility of content, language, student activities, time, interest and components adapted by researchers from (Ginanjar, Utari & Muslim, 2015). The elaboration of the assessment of the six aspects is:

Content Feasibility Aspect

The criteria for the validity of the presentation relate to the instructions for using the LKPD which directs activities that support the learning process. In this feasibility aspect, there are learning materials in the LKPD that are in
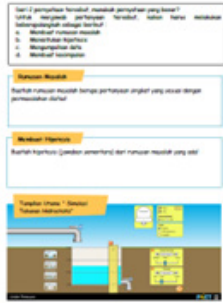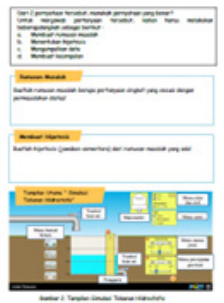
Table 3. Results of Revised LKPD

Revision	Suggestion	
In the main display image of the PhET simulation, make a description of the image such as the name of the ruler, grid and pressure and others.	Before revision	After revision
In the LKPD problem section, fix the narration in simple language, and before the picture, give a narration of the problem first and a description of the picture.	Before revision	After revision
In each LKPD meeting, an LKPD assessment column and notes are added.	Before revision	After revision

Table 4. LKPD Validation Results

No	Aspect Validity	Percentage (%)	Category
1	Content eligibility,	88,9	Very Valid
2	Language eligibility	90,0	Very Valid
3	Eligibility of student activities	91,7	Very Valid
4	Eligibility time	83.3	Valid
5	Interests	88,9	Very Valid
6	Components	88,3	Very Valid
Average		89,3	Very Valid

accordance with the KD, so that they can develop the knowledge of students in accordance with the expected learning objectives. The presentation of material in the LKPD reflects the latest news in the form of problems as facilitation in learning. Learning is carried out using virtual PhET simulations on hydrostatic pressure experiments, buoyancy forces and Pascal's law in training students' argumentation skills. The content feasibility aspect obtained a percentage of 88.9% including the very valid category.

In the LKPD there are instructions for using the LKPD and there is a learning syntax used, namely ADI (Argument-Driven Inquiry). In addition to the instructions for use in the PhET-assisted LKPD, teachers are also needed as tutors who guide to help students who have problems. The following is the syntax for the Argument-Driven Inquiry in the LKPD used in Figure 2.

Figure 2. Syntax Display on LKPD

Language Eligibility Aspect

On the language aspect regarding the writing of the LKPD by the General Guidelines for Indonesian Spelling (PUEBI). The punctuation used in the LKPD must be by its designation, and the sentences used in the LKPD are simple so that it is easy to understand. The sentences used do not cause interpretation and are communica-tive and standard so that readers can understand the contents quickly and clearly. LKPD on the aspect of language feasibility obtained a percentage of 88.9% with a very valid category. This shows that the writer uses excellent and correct language, is simple, and does not cause double interpretation. So that the writing and language used in the LKPD are included in the appropriate category for use

Aspects of Student Activities

Time eligibility criteria related to the activities provided in the LKPD can provide direct experience to students. The stages carry out the activities contained in the LKPD to provide opportunities for students to learn independently and find learning concepts. This activity also facilitates the presentation of the data processing results found and discussion with classmates to create a learning process that can build students' argumentation skills. Aspects of student activities are carried out according to the learning steps using the Argument-Driven Inquiry model. The percentage of the feasibility aspect of student activities was obtained 91.7%, with a very valid and feasible category.

Time Feasibility Aspect

The criteria for time eligibility relate to activities to carry out experimental activities. The time used to carry out learning activities in LKPD must be effective and efficient. The aspect of time feasibility obtained a percentage of 83.3% included in the very valid category. So that the LKPD on the time feasibility spec is suitable for use.

Interesting Aspect

The attractiveness aspect of LKPD includes several things, namely the combination of images, text, and background to attract students' attention. The attractive appearance of the LKPD cover page, equipped with a clear identity, makes students active in learning. As well as the placement of layouts such as titles, subtitles, and pictures of the LKPD page must be consistent by setting a specific pattern to make it easier for students to understand. The percentage of the feasibility of the attractiveness aspect of the display is 88.9%, with a very valid category and the LKPD is feasible to use.

Component Aspect

The feasibility of the LKPD component contains instructions for using the LKPD, includes a column as a place for student identity

and a clear title for the learning material. In the LKPD component, the activity's objectives are also obtained and provide a column for student answers. The percentage of the feasibility of the LKPD component obtained was 89.3%, with a very valid category suitable for use in the science learning process.

CONCLUSION

Based on the results of research, data analysis, and discussion obtained that aspects of content feasibility, language feasibility, student activity feasibility, time feasibility, attractiveness and LKPD components in each aspect has an average of 3.34 in the valid category. The results of the LKPD validation in terms of the assessment of the 3 validators obtained a percentage of 3.53%, 3.57% and 3.63% with a very good level of validity.

So, the Argument-Driven Inquiry (ADI)-based LKPD assisted by PhET to train argumentation skills on substance pressure material for Class VIII SMP students is said to be suitable for use in the learning process.

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