



Development of Student Worksheets Based on a Scientific Approach using the Group Investigation Model

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ABSTRACT

This study aims to obtain student worksheets based on a scientific approach using the group investigation model that is feasible to apply to collision topic in High School. The research model used in this study refers to the ADDIE development model, namely: 1) Analysis, 2) Design, 3) Development, 4) Implementation and 5) Evaluation. The feasibility of student's worksheets (SW) is measured by the results of SW validation, student learning outcomes and student response questionnaires. The SW is assessed by a team of experts. The overall results of the SW validation showed an average score of 4 was included in the good category. After the implementation of SW the learning outcomes have increased, namely the overall average of students is in the medium category and the average result of the overall response of students shows a score of 4 which is included in the agreed category. Based on the three measurements of the feasibility of the SW, it shows that the SW is feasible to be applied in learning.

Keywords: Students worksheet, collision, scientific, investigation model

INTRODUCTION

Physics is a branch of science that studies natural phenomena and their interactions (Ritonga and Tanjung, 2014: 158). In physics learning, it is hoped that students will not only learn about scientific concepts, theories, and facts but also the application of physics in everyday life (Wardani, 2013: 251). Based on this quote, it can be explained that the concepts of physics have a very strong relationship between one concept and another, and examples of physics material can be observed in everyday life.

One of the subjects taught in high school is physics. Most students find physics lessons most difficult to understand. According to Prasetyarini et al (2013: 7) "Physics as a science that has objects in the form of real objects, if it is delivered only by lecture method, the material received by students will only be understood as abstract formulas or concepts." It can be explained that physics lessons are difficult to understand because of the problems of teacher delivery, where concrete material becomes abstract so that students are required to memorize.

The collision material is one of the concrete materials which can be observed directly. This material will be better understood by students if the right media is used in learning. This is by Permendikbud No. 65 of 2013 "Learning media in the form of learning process aids to convey subject matter". In learning it is very important to have learning media because it helps strengthen knowledge in students. One of the appropriate media in the teaching and learning process, especially in physics, is the student worksheet (LKPD)

Based on the results of observations at one of the SMAN and MAN in Banda Aceh with a physics teacher, that teacher has used LKPD by general LKPD standards. but it does not fully reflect the scientific approach (scientific approach). The LKPD that is often used has not provided opportunities for students to be able to work scientifically to observe or reveal objects around them. Besides, the general LKPD did not contain material or activities that were by the conditions of the students. The teacher uses the LKPD because to implement the LKPD that is by the approach and learning model in the 2013 curriculum requires a lot of time so that the teacher prefers LKPD with general standards in learning.

LKPD is one of the learning media that can support practicum activities that function to evaluate students in the teaching and learning process and can be used as a guide for students to understand problems (Pratiwi et al, 2015: 33). Meanwhile, according to Murlin et al (2015: 177) "LKPD contains information, teacher orders to students in the form of practice which aims to facilitate the achievement of indicators. Through a structured LKPD, students are expected to be more focused and independent. Based on the quote, it can be explained that the LKPD is used as a guide to making it easier for students to understand theory in the form of practicum activities.

The results of research conducted by Herman and Aslim (2015: 112) on students of SMA Negeri 15 Makassar show that the device for temperature and heat material meets the practical and effective criteria so that the LKPD used can be applied in learning. Because from the LKPD, the science process skills of students in formulating problems, formulating hypotheses, identifying tools and materials, writing work steps, and finding physics concepts by answering questions in the LKPD can be measured. The results of research that have been conducted by Diani (2016: 91) on class XI students of SMA PERINTIS 1 Bandar Lampung on style material show that using the scientific approach assisted by LKPD is more influential on students' physics learning outcomes compared to not using the scientific approach.

Based on the results of this study, it can be explained that the existence of LKPD based on a scientific approach in the teaching and learning process can help educators in improving student learning outcomes and it is hoped that students will actively find knowledge, gain skills, and spiritual attitudes, and social attitudes. According to Fathurrohman (2015: 115) "Learning with the scientific method has the following characteristics: 1). Learner-centered; 2). Involves science process skills in constructing concepts, laws, or principles; 3) Involving cognitive processes that have the potential to stimulate intellectual development, especially high-order thinking skills of students; 4). Can develop the character of students; 5) The substance of learning is based on facts or phenomena that can be explained by certain logic or reasoning,

not just a mere imagination, legend, or fairy tale, 5) learning objectives are formulated, but the presentation system is interesting.

Problem of Research

In order for LKPD to be used properly with students, a model is needed that can help the teaching process. There are various learning models known in learning, one of which is the group investigation (GI) model. Where group investigation involved students since planning, both in determining the topic and how to study it through investigation. So that it can improve student learning outcomes using the group investigation model. This is in accordance with the research conducted by Huniati (2014) on students of SMPN 1 Baitussalam on straight motion material which shows that there is a significant effect using the scientific approach with the group investigation learning model on learning outcomes.

Research Focus

Based on the description of the problem above, the authors conducted a study entitled "Development of Worksheets Based on a Scientific Approach Using a Group Investigation Model on Collision Materials in SMA / MA".

METHODOLOGY OF RESEARCH

General Background of Research

The approach used in this research is qualitative and quantitative approaches. Qualitative research is used to obtain descriptive data (Sugiyono, 2014: 15). Meanwhile, quantitative research is used to obtain data which is analyzed using statistics (Sugiyono, 2014: 15). In this study, using two approaches because the researcher examined several variables. Each variable studied will be adjusted to the approach that must be used.

The type of research used in this research is research and development or commonly abbreviated as R & D. This type of research is intended as a research method that will produce certain products, and test the effectiveness of the resulting products (Sugiyono, 2014: 297). In the R&D method, there are several models in research and development. The research model used in this study refers to the ADDIE development model. According to Rangkuti (2015: 241) the ADDIE model consists of 5 stages, namely: 1) Analysis, 2) Design (design), 3) Development (development), 4) Implementation (implementation) and 5) Evaluation (evaluation). In this study, the product produced and tested was LKPD based on the scientific approach with the group investigation model.

This research was conducted at one of the SMA / MA in Banda Aceh, when this research was conducted in the even semester (one) of the 2019/2020 academic year, this research started from 27 March to 03 April 2019.

Subject of Research

Sources of data in this study are using primary data (data obtained from respondents). And the research subjects in this study were students of class X, amounting to 28 people.

Instrument and Procedures

A research instrument is a tool used by researchers in collecting data during research. The research instruments used in this study include; (a) LKPD validation sheet, used to assess whether the LKPD developed is feasible or not to be used to be applied in learning on collision material. (b) Pretest and posttest, a pretest is done to determine students' initial understanding of the collision material. Meanwhile, the posttest was carried out to determine the understanding obtained by students after the implementation of LKPD based on the scientific approach with the group investigation model. (c) Student response questionnaire, containing questions related to the research that has been carried out, namely analyzing the needs of students for learning on collision material and students' responses to LKPD based on a scientific approach.

The process of developing Student Worksheets (LKPD) based on a scientific approach with the Group Investigation model is shown in Figure 1.

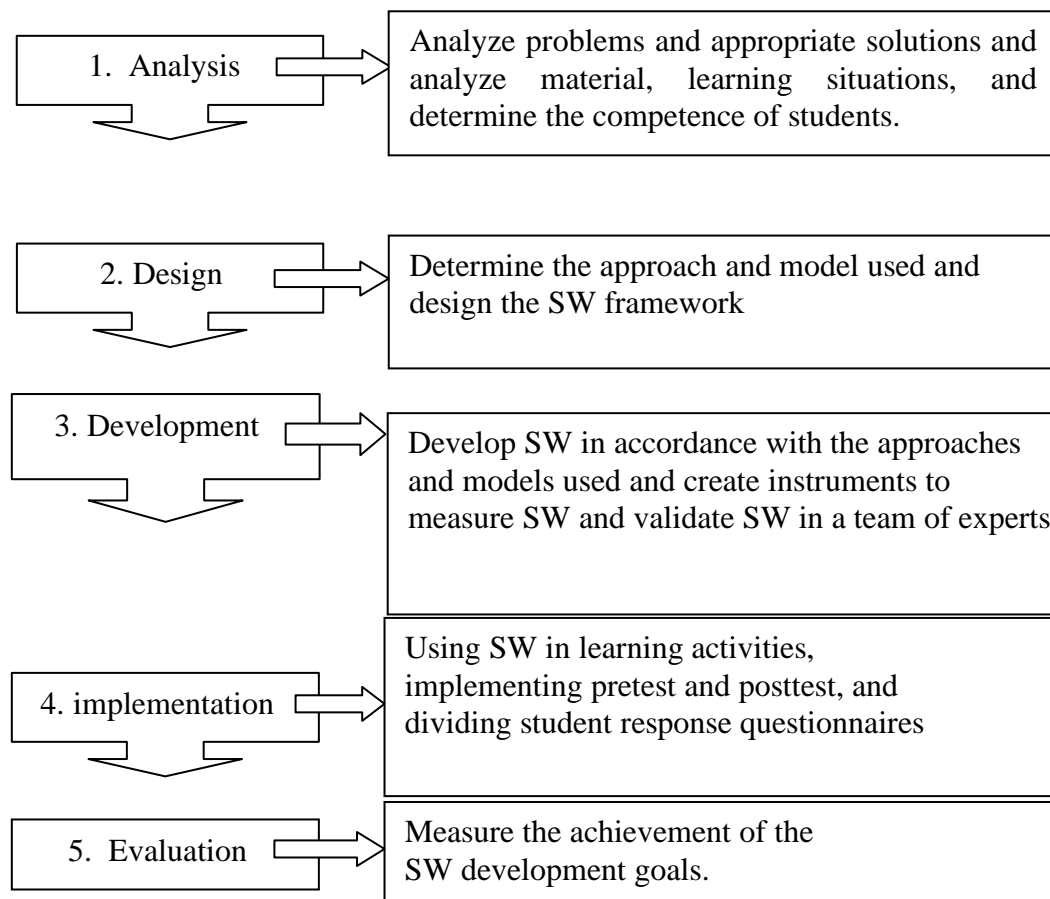


Figure 1. SW development steps with the ADDIE Model

Data collection techniques in this study used a research instrument in the form of LKPD based on a scientific approach on collision material, LKPD validation sheets, pretest, posttest and student response questionnaires.

Table 1. Data Collection Technique

Type of Data	Instruments
Worksheet eligibility	Worksheet validity sheet
	Pretest and posttest
	Student response questionnaire

Data Analysis

The data that has been obtained at the time of data collection will then be analyzed by deciphering the data from the LKPD research results based on the scientific approach with the group investigation model on the collision material in the form of expert validation results. Data analysis was used to obtain student worksheets based on a scientific approach with a group investigation model that was feasible to apply to the collision material as a developed learning medium.

Table 2. Skala Likert

Skor	Kriteria
1	Very Poor
2	Poor
3	Average
4	Good
5	Excellent

Sumber : Siregar 2011:139

Validation of SW.

The LKPD based on the scientific approach with the group investigation model was validated by two expert validators using an instrument in the form of a LKPD validation sheet. The validity of LKPD can be viewed from the aspects that support it. Then it can be calculated using the Likert scale which can be seen in table 2.

LKPD Trials

When the LKPD was tested, an assessment was made of the learning outcomes of students and students' responses to the LKPD that had been applied.

a. Outcomes Learning

Student learning outcomes data, namely the pretest and posttest were analyzed using N-gain. The data analysis was used to see the improvement in learning outcomes after the application of LKPD based on the scientific approach with the group investigation model. The normalized gain formula (N Gain) according to Hake (Murlin et al, 2011: 170). The results of the score are then interpreted based on the criteria for obtaining an N Gain score which can be seen in Table 3.

$$g = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}}$$

Table 3. Criteria for N-Gain Level

Score	Category
$g \geq 0,7$	High
$0,3 < g < 0,7$	Medium
$g < 0,3$	Low

(Sources : Murlin dkk 2011:183)

b. Students' Responses

The data obtained from the results of questionnaires that have been given to students in the form of students' responses to LKPD based on a scientific approach with a group investigation model on the collision material. The analysis technique for the student response questionnaire was analyzed using the references in table 4.

Table 4. Likert Scale

Score	Criteria
1	Strongly Disagree
2	Disagree
3	Slightly Agree
4	Agree
5	Strongly Agree

Sources : Siregar 2011:139

RESULTS AND DISCUSSION

Research on the development of LKPD based on a scientific approach using the group investigation model on the collision material was carried out in MAN 3 Banda Aceh class X MIA2 for the 2017/2018 school year. In this chapter, the researcher focuses on the feasibility of the product, namely LKPD based on a scientific approach using the group investigation model with 5 stages of development. The development model used is the ADDIE model. The stages in this development model are Analysis, Design, and Development. Implementation (Implementation) and Evaluation (Evaluation). Another thing that will be seen is the learning outcomes and student responses to the LKPD that have been developed on the collision material.

Analysis Stage

The analysis stage is the stage of thinking for new products that want to be developed according to the goals of students and learning objectives (Rangkuti, 2015: 241). At this stage, the researcher conducted an analysis of the old LKPD and also analyzed the need to obtain information on how the willingness of LKPD was in accordance with the 2013 curriculum. The old LKPD that had not been developed can be seen in Figure 2.

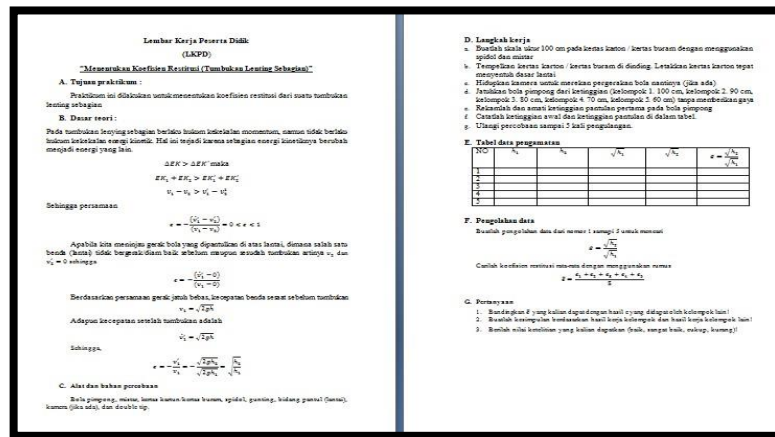


Figure 2. Old of SW

Figure 2 is one of the existing LKPD and has not undergone development. Overall, it can be seen that the LKPD is in accordance with the general standards in a LKPD however, it does not fully reflect the scientific approach and the design is less attractive which does not have images and colors. In this case the researcher develops LKPD based on a scientific approach using the Group Investigation model on the collision material.

Design Stage

Based on the results of the analysis that has been done, the researcher designed the initial product. The design stage is carried out to design the product concept that you want to develop (Rangkuti, 2015: 241). The product to be produced was LKPD based on a scientific approach using the group investigation model on the collision material. The initial design of LKPD can be seen in Figure 3.



Figure 3. The initial design of outer and inner shell and 2nd page of LKPD

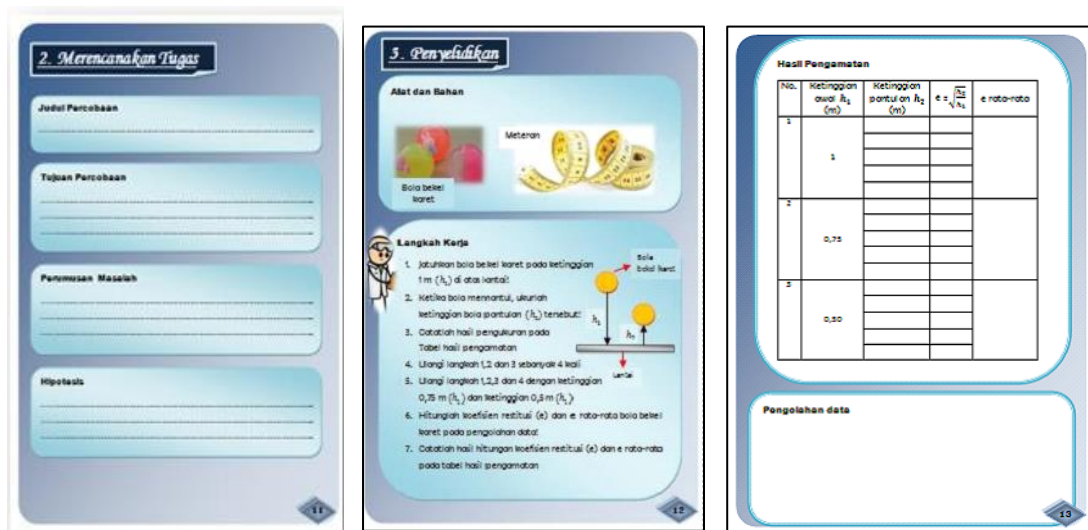


Figure 4. The initial design of 3,4, and 5 page

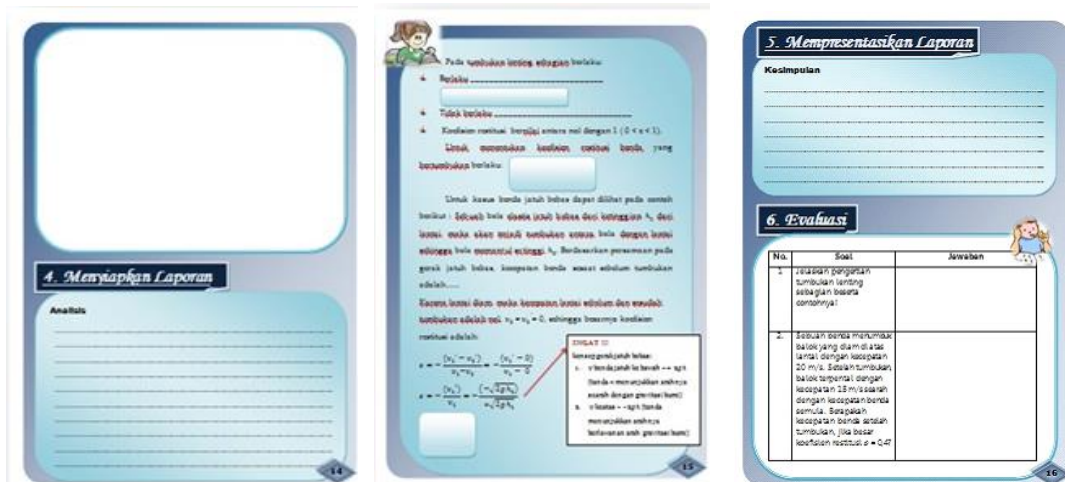


Figure 5. The initial design of 6,7, and 8 Page

Development Stage

The third stage is the development of LKPD, as a follow-up to the designs that have been carried out at the design stage. This development stage aims to produce LKPD that can be given to students during the implementation stage. At this stage the researcher is assisted by a team of experts consisting of 1 lecturer and 1 teacher to assess the developed LKPD. Before the LKPD based on the scientific approach using the group investigation model on the collision material was validated by a team of experts, the expert team first assessed and provided suggestions so as to produce LKPD that could be used in learning.

a. Cover

The initial and final designs of the LKPD cover based on a scientific approach using the Group investigation model on the collision material can be seen in Figure 6.



Figure 6. Development of (a) initial design and (b) final design of LKPD cover

Figure 6 is a cover image of the LKPD based on a scientific approach using the group investigation model on the collision material. After being examined by a team of experts, the LKPD cover experienced a change in one of the images on the cover. Before it is validated on the cover of the LKPD using an example of a collision that occurs between a train and a car, the validator suggests using a simpler image.

b. Page 1

The initial and final designs of the 1st page of the LKPD based on a scientific approach using the Group investigation model on the collision material can be seen in Figure 7. Figure 7 is the first part of the partially resilient impact LKPD. This section has several changes after being assessed by a team of experts, the validator adds a collision to the title to make it clearer. Another change is that the date and names of group members from the second part of the LKPD are moved to the first part of the LKPD under the title, and the indicators and learning objectives are removed. The validator suggested that the experimental objectives contained in the LKPD.

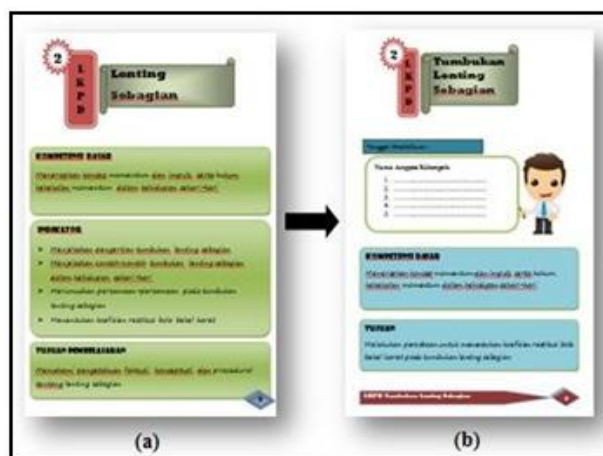


Figure 7. Development of (a) initial design and (b) final design of page 1 LKPD

c. Page 2

The initial and final designs of the 2nd page of the LKPD based on a scientific approach using the Group investigation model on the collision material can be seen in Figure 8.

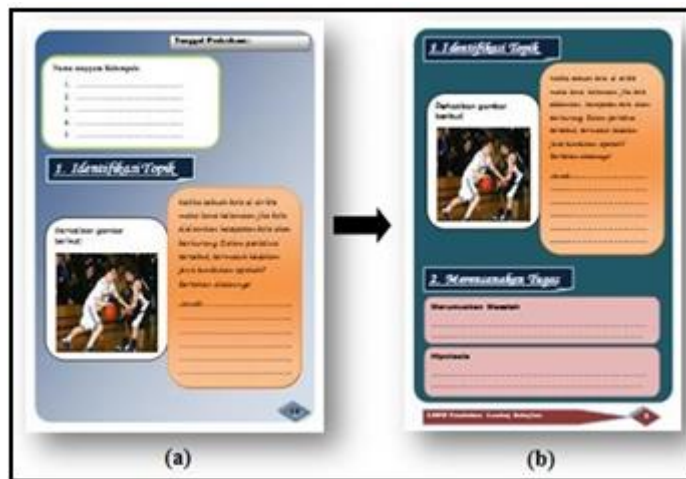


Figure 8. Development of (a) initial design and (b) final design of 2nd page LKPD

Figure 8 is the second part of the partially resilient collision LKPD. After being assessed by a team of experts, the second part experienced a change, which initially contained the date, the name of the group members and the topic identification step became the topic identification step and the task planning step consisted of formulating problems and hypotheses.

d. Page 3

The initial and final designs of the 3rd page of the LKPD based on a scientific approach using the Group investigation model on the collision material can be seen in Figure 9.

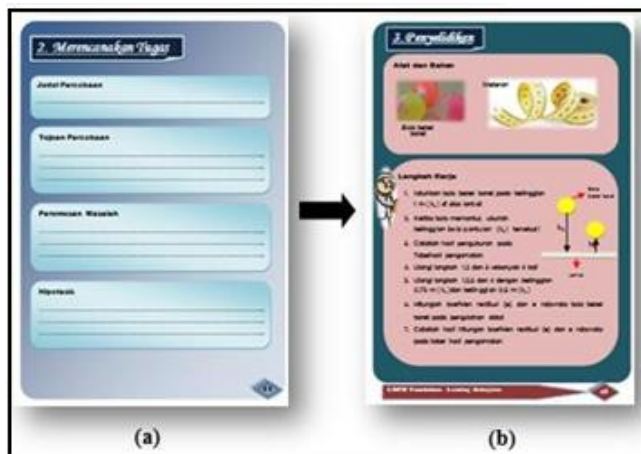


Figure 9. Development of (a) initial design and (b) final design of 3rd page LKPD

Figure 9 is the third part of the partially resilient collision LKPD. After being assessed by a team of experts, this section underwent a change, which initially contained a second step, namely planning a task consisting of the title of the experiment and the objectives of the experiment. The validator suggested that the title of the experiment be removed because it was

already contained in the first part of the LKPD and for the purpose of the experiment it was transferred to the first part of the LKPD and the goal was written so that students were more torn. For the step of planning the task which consists of formulating problems and hypotheses, it has been transferred to the second part of the LKPD so that in the third part the LKPD continues to the third step, namely the investigation.

e. Page 4

The initial and final designs of the 4th page of the LKPD based on a scientific approach using the Group investigation model on the collision material can be seen in Figure 10.

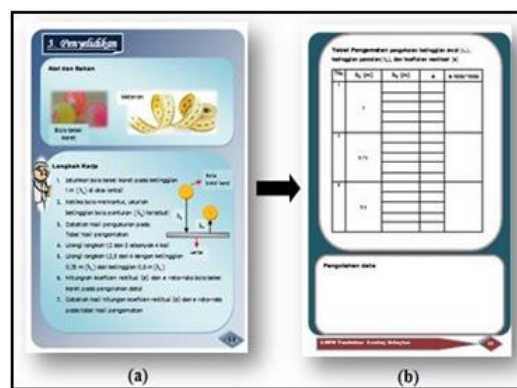


Figure 10. Development of (a) initial design and (b) final design page 4 of LKPD

Figure 10 is the fourth part of the partially resilient collision LKPD. After being assessed by a team of experts, this section contains investigative steps for the observation table and data processing.

f. Page 8

The initial and final designs of the 8th page of the LKPD based on a scientific approach using the Group investigation model on the impact material can be seen in Figure 11.

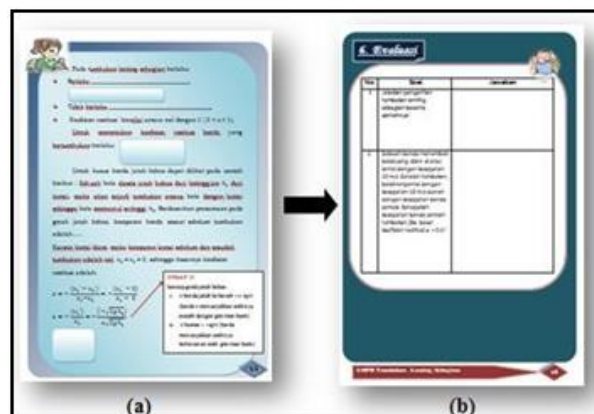


Figure 11. Development of (a) initial design and (b) final design on page 8 of LKPD

Figure 11 is the seventh part of the partially resilient collision LKPD, after being assessed by a team of experts, this section underwent a change, which initially contained the material, the validator suggested that it be removed so that students could find out for themselves the material to be studied. Based on the validator's suggestion, the seventh part of this LKPD contained the next step of the group investigation model, namely the evaluation step.

Validity Test

The LKPD validation is carried out by providing the LKPD that has been compiled to a team of experts to be validated. There are 3 aspects that are assessed in terms of validating the LKPD, namely the appearance of the LKPD, the material aspect in the LKPD, and the language aspect in the LKPD. The expert team will provide an assessment of the LKPD with a score range of 1-5 with certain conditions. The results of data processing validation by the expert team can be seen in table 4.1, table 4.2, and table 4.3.

a) Validation of Display Format in LKPD

The team of experts validated the display format aimed to see to what extent the display feasibility of the developed LKPD was. So if the display format in this LKPD is still not feasible, revisions are needed to get a display format that is suitable for use in learning. The results of the LKPD display format validation can be seen in table 5.

Table 5. Results of Average Validation Forms of LKPD Display Based on Scientific Approach Using Group Investigation Model on Collision Material

No.	Assessment Criteria	Score				Total	Aver age	Category
		1	2	3	4			
1.	Clarity of writing with the type of measure and a suitable size			1	9	4,5	Excellent	
2.	Image usage suitability with the material			1	9	4,5	Excellent	
3.	Appropriate image size and clarity			1	9	4,5	Excellent	
4.	Image presentation can attract attention			2	8	4.0	Good	
5.	Proportional paper size			1	1	7	3,5	Good
6.	The suitability of paper thickness			1	1	7	3,5	Good
7.	Suitability of the colors used in LKPD			1	9	4,5	Excellent	
8.	The right page design			1	9	4,5	Excellent	
9.	Selection of attractive cover			2	8	4.0	Good	
Average feasibility of LKPD display format					8.33	4	Good	

Based on the validation results of the LKPD display format, there are 9 assessment criteria. In the 9 assessment criteria, there are 5 assessment criteria with very good categories and 4 of them with good categories. However, if seen as a whole, the LKPD average assessment shows a score of 4 in the good category. This shows that the LKPD display format is suitable for use in learning.

b) Material Validation in LKPD

The team of experts validating the material in the LKPD aims to be able to see the feasibility of the material in the LKPD being developed. So if the material format in this LKPD is still not feasible, a revision is needed to get the LKPD material format that is suitable for use in learning. The results of the validation of the LKPD material format can be seen in table 6.

Table 6. Average Results of Material Validation in LKPD Based on a Scientific Approach Using the Group Investigation Model on Collision Materials

No	Assessment Criteria	Score					Total	Average	Category
		1	2	3	4	5			
1.	Clarity of KD, indicators, and learning objectives				2		8	4	Good
2.	The accuracy of questions with basic competency and learning indicators that have been formulated				2		8	4	Good
3.	Easy to digest concept presentation				2		8	4	Good
4.	The compatibility of the content of the components in the LKPD with the syntax of Group Investigation (identification of topics, planning tasks, preparing the final report, presenting the final report, and evaluation)				1	1	9	4,5	Excellent
5.	Suitability of LKPD content with the syntax of the Scientific Approach (observing, questioning, collecting data, processing data, and communicating)				1	1	9	4,5	Excellent
Average feasibility of material in LKPD							8,4	4	Good

Based on the results of the validation of the LKPD material, there are 5 assessment criteria. In the assessment criteria, there are 3 assessment criteria with good categories and 2 of them with very good categories. However, if viewed as a whole, the average LKPD assessment shows a score of 4 in the good category. This shows that the material in this LKPD is suitable for use in learning.

CONCLUSIONS

Based on the research that has been done, the researcher can conclude that the overall results of the LKPD validation show an average score of 4 is in the good category. After the implementation of LKPD learning outcomes have increased, namely the overall average of students is included in the medium category and the average result of the overall response of students shows a score of 4 which is included in the category agree. From the three measurement results of LKPD, it can be said that

LKPD based on a scientific approach using the group investigation model on collision material is feasible to be applied in learning.

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