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Development of Student Worksheet Assisted by Phyphox Application on Harmonic Vibration Material

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ABSTRACT

This study aims to develop student worksheets assisted by the Phyphox application on the material of Harmonic Oscillations in Springs. This study uses a 4D model consisting of 4 main stages: define, design, develop, and disseminate. The results of the designed worksheets have been reviewed by 2 physics education experts, and are considered suitable for use to support classroom learning. The trial was conducted in one class consisting of 31 students. The results of the trial showed an increase in learning outcomes after students participated in learning with the worksheets assisted by Phyphox that was developed. In addition, students also gave a good response to the use of worksheets assisted by Phyphox. Thus, the worksheets that were developed have the potential to be used in physics learning widely.

Keywords: *Phyphox; Harmonic oscillation; Student worksheet*

ABSTRAK

Tujuan penelitian ini adalah mengembangkan lembar kerja peserta didik (LKPD) berbantuan aplikasi Phyphox pada materi Getaran Harmonis pada Pegas. Penelitian ini menggunakan model pengembangan 4D yang terdiri dari 4 tahap utama : define, design, develop, dan disseminate. Hasil LKPD yang didesain telah di-review oleh 2 ahli pendidikan fisika, dan dinilai layak untuk digunakan untuk mendukung pembelajaran di kelas. Uji coba dilakukan pada satu kelas yang terdiri dari 31 peserta didik. Hasil ujicoba menunjukkan adanya peningkatan hasil belajar setelah peserta didik mengikuti pembelajaran dengan LKPD Berbantuan Phyphox yang dikembangkan. Selain itu, peserta didik juga memberikan respon yang baik terhadap penggunaan LKPD Berbantuan Phyphox. Dengan demikian, LKPD yang dikembangkan memiliki potensi untuk digunakan dalam pembelajaran fisika secara luas.

Kata kunci: Phyphox, Osilasi harmonik, Lembar kerja peserta didik

1. INTRODUCTION

Physics is a scientific discipline that studies the theories and concepts of all phenomena in the universe. Learning physics at school also develops scientific explanation skills (*scientific explanation)* of natural phenomena that occur. Scientific explanation leads to understanding how or why a phenomenon occurs (Supeno et al., 2017). In studying physics, students should master the process (how to find products and apply them in everyday life) and physics products (theories, principles and laws).

For physics subjects, practical work in the laboratory is very important (Hofstein, 2017). Laboratory work stimulates students to think critically, question scientific concepts independently, and practice collecting scientific information (Moeed, 2015; Orhan & Şahin, 2018). Laboratory work also plays a role in attracting students' attitudes towards science (Toma & Greca, 2018).

Technological developments can be used to support innovation in learning. One form of technological development is *smartphone*, whose presence certainly provides an opportunity for teachers or educators to be able to innovate learning media. *Smatphone* has several sensors that can be applied in physics experiments. Physics learning that utilizes technology has the potential to help hone students' cognitive thinking skills and make students creative. A free application called Phyphox is available on Android phones and iPhones (Staacks et al., 2022). This application provides features for conducting physics experiments using sensors *smartphone* (Coramik & Ürek, 2021; Pusch et al., 2021). Phyphox can be used to support experiments on topics such as magnetism (Lincoln, 2024), kinematics (Pierratos & Polatoglou, 2020), and force dynamics (Kousloglou et al., 2022). Figure 1 shows the menus in the Phyphox application.

Experimental learning using Phyphox can be carried out guided by worksheets for students (LKPD). LKPD is a tool that can be used to increase student participation, generally containing experimental instructions, questions and discussions (Norprinda & Soleh, 2019). LKPD needs to be prepared following a learning flow that is designed so that it can be used to optimize student learning outcomes. This research aims to develop a LKPD prepared using Phyphox-based experiments on harmonic vibrations in springs. It is hoped that this LKPD can make students participate actively in learning so that their learning outcomes can be optimal.

Figure 1. Phyphox Application Menu Display

2. METHOD

The LKPD was developed using a 4D model which consists of 4 main stages, namely *define, design, develop,* and *disseminate*. Level *define* includes needs analysis, user analysis, curriculum analysis, and technology analysis. Results of the stage *define* became the basis for designing the LKPD in this research. At stage *design*, determine the media used and design the LKPD. The LKPD is designed with a modeling-based learning flow and utilizes Phyphox at the exploration stage. Final stage results *design* form *prototype* then goes through the stages *develop* (development). On stage *develop, prototype* LKPD through a series *review*, testing, and revision. First, the LKPD is *review* by 2 physics education experts. Results *review* became the basis for the first revision stage. LKPD was also tested in real classes. The trial involved one class at one of the state high schools in the city of Surabaya. There were 31 students who participated in the trial. In this field trial, the effectiveness of using LKPD was evaluated. Trial design using *one-group pre-test and post-test design*. Students' responses to the use of LKPD in class were also explored using a questionnaire. The results of the field trials are then taken into consideration in the final revision. Dissemination is the stage where LKPD is widely used. In this research, dissemination was still very limited, namely it was used in one school.

The instruments used to collect data were: (1) Learning tool review sheet to determine the suitability of the LKPD, using a scale of 1-4; (2) Question items *pre-test* and *post-test* to determine students' initial and final knowledge of the learning material presented; (3) Student response questionnaire to determine responses to the use of LKPD, using a scale of 1-4.

3. RESULT AND DISCUSSION

PD is designed to follow a modeling-based learning flow consisting of syntax: orientation, exploration, modeling, model evaluation and revision, application, and reflection (Pratidhina, Rosana & Kuswanto, 2024). Orientation is the stage where students are introduced to the physics system that will be studied in learning. Exploration is a phase where students actively investigate the physical system being studied, in this case the harmonious vibrations of springs. Experiments using Phyphox are part of the exploration. The modeling phase is the stage where students develop a model based on the results of exploration. The temporary model designed is then evaluated and revised if necessary. After evaluating and revising the model, there is an application stage where the model obtained is applied to several related physics problems. The end of the modeling-based learning flow is reflection. Figure 2-8 shows an example of each part of the LKPD which is prepared using a modeling-based learning flow.

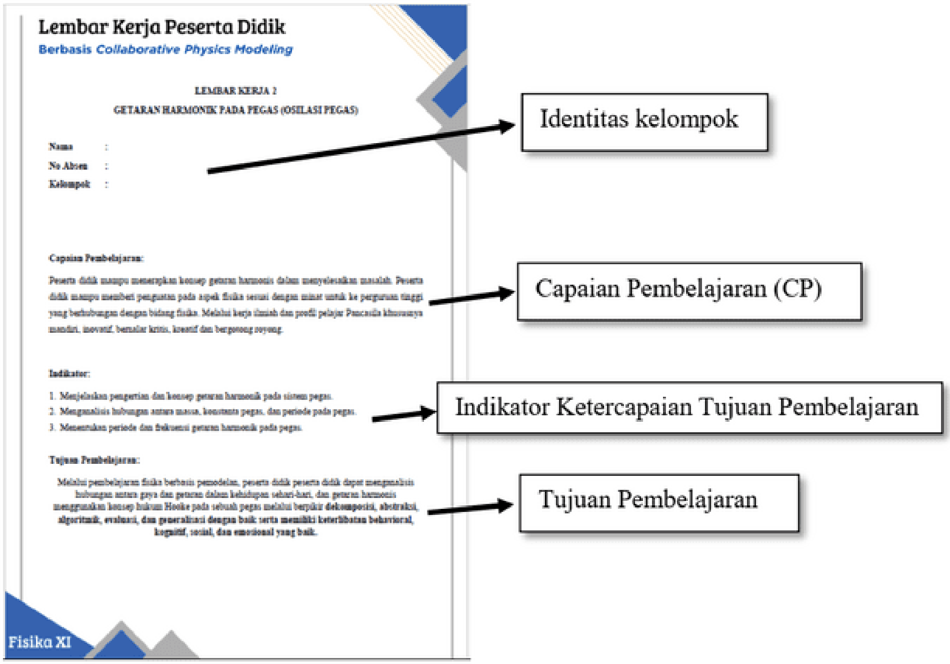

Figure 2. The introductory part of the LKPD contains title, identity, learning outcomes, indicators and objectives.

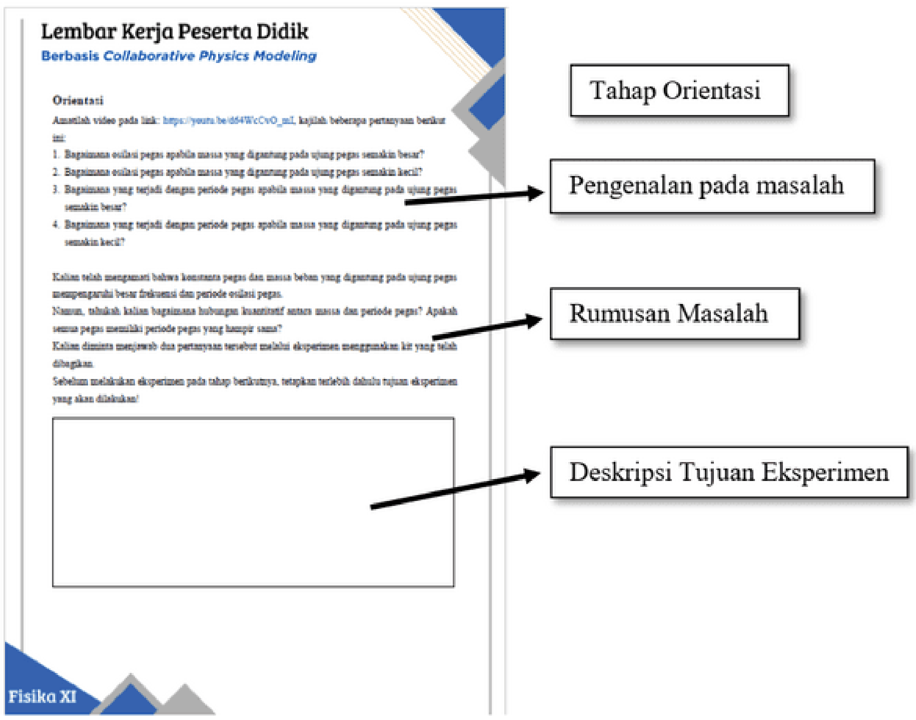

Figure 3. Orientation section on the LKPD.

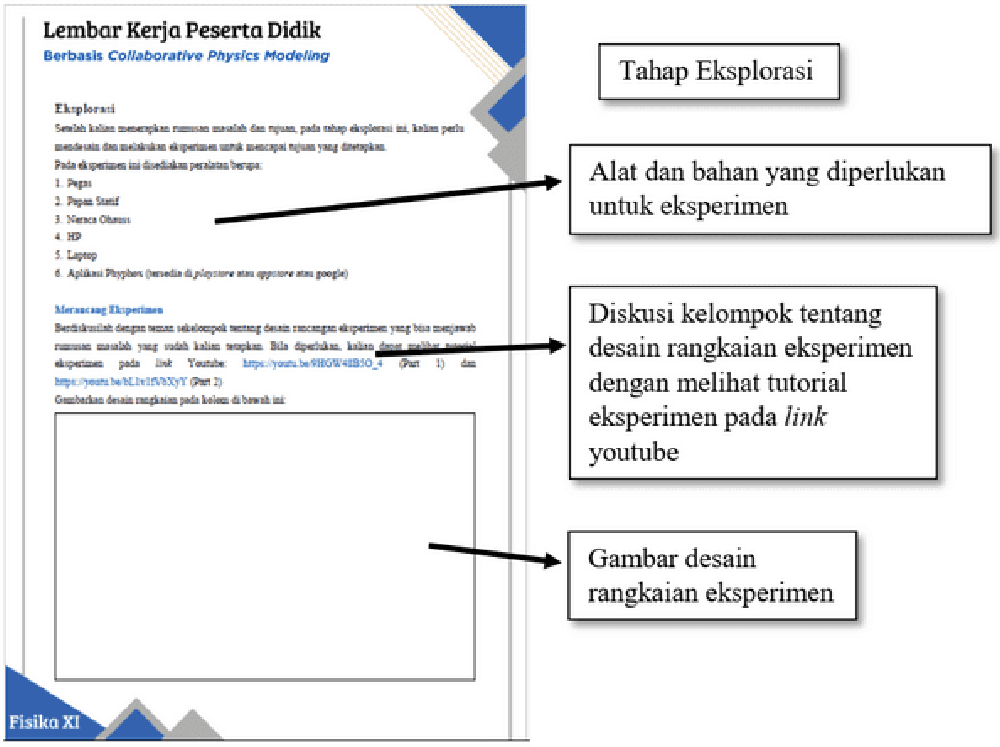

Figure 4. Example of the exploration section of the LKPD.

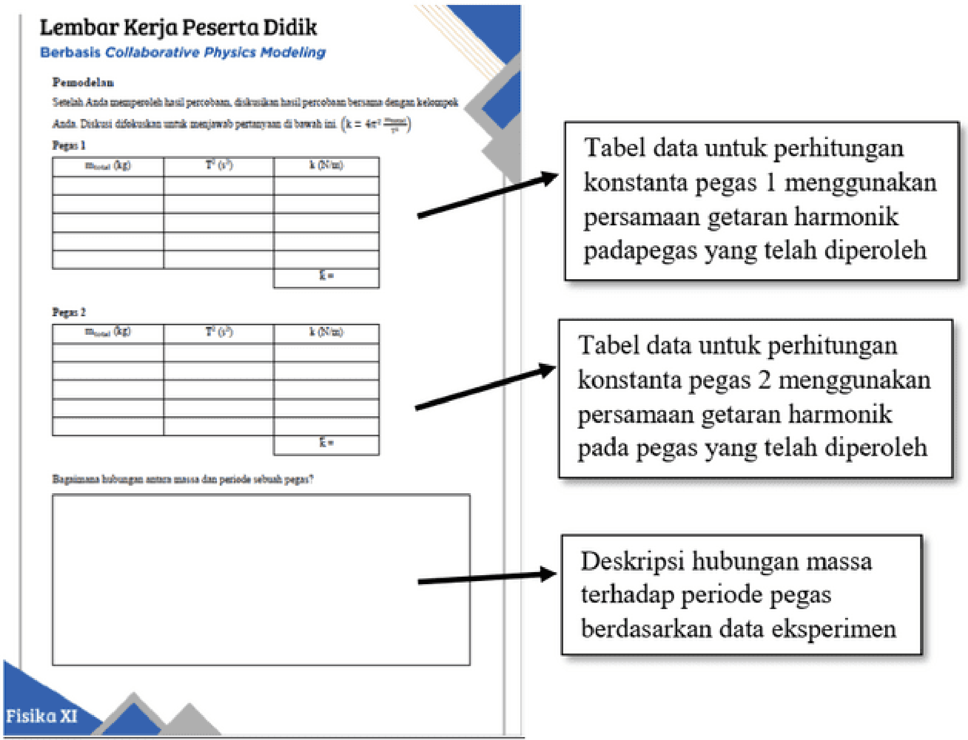

Figure 5. Example of the modeling section in the LKPD.

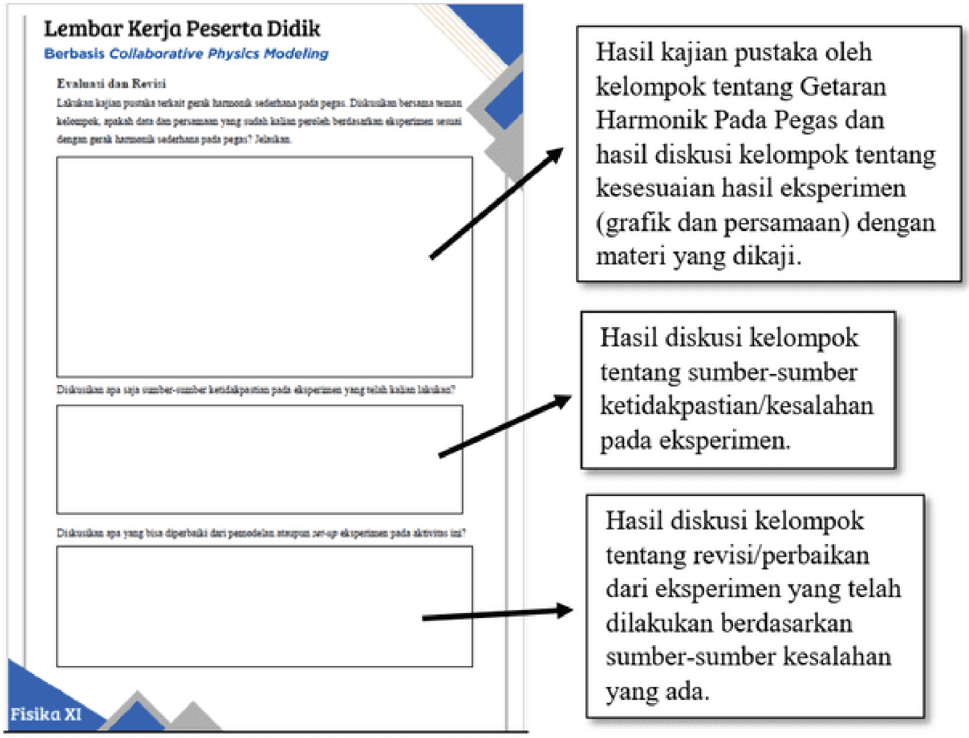

Figure 6. Example of the model evaluation section in the LKPD.

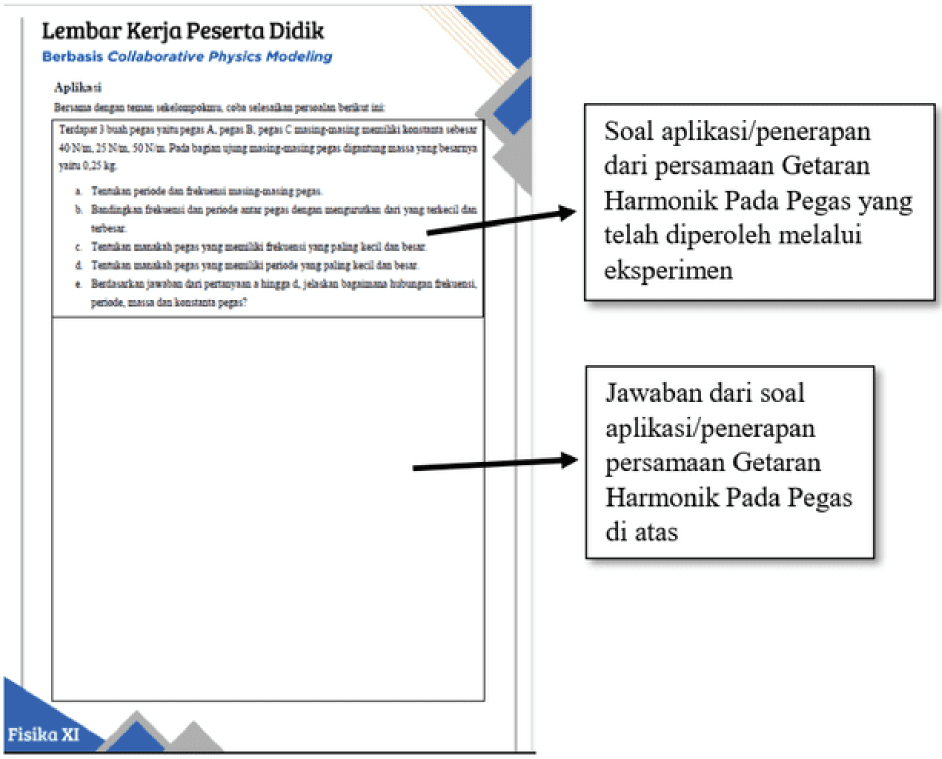

Figure 7. Example of the model application section in the LKPD.

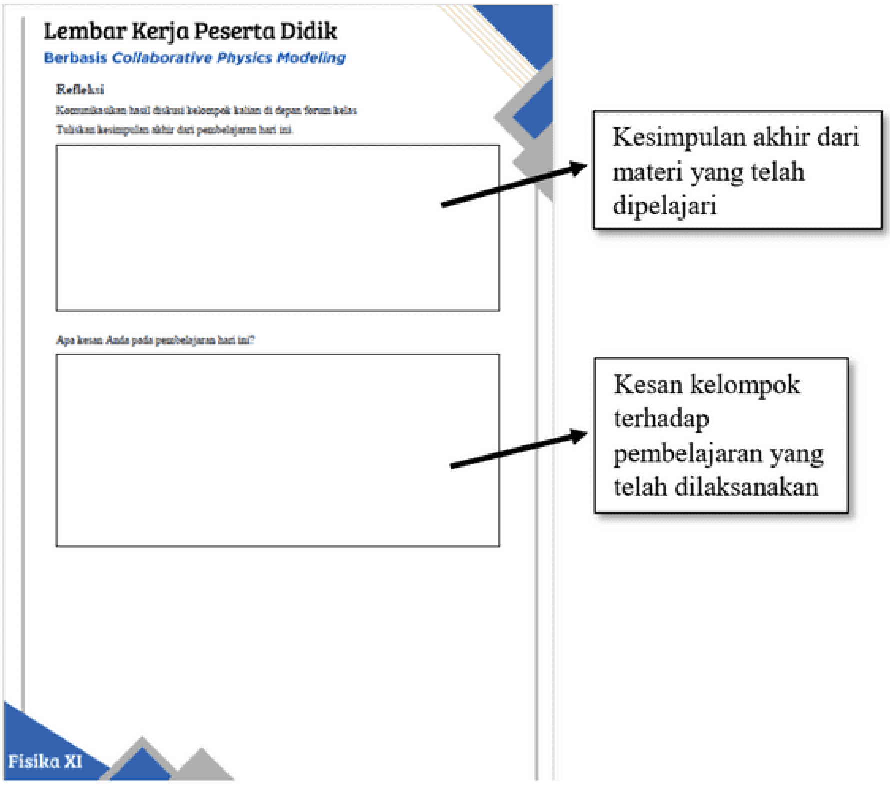

Figure 8. Example of the reflection section on the LKPD.

The LKPD design was assessed by 2 physics education experts based on aspects of format, content, language and appearance. The results of the assessment for each aspect can be seen in Table 1. Based on expert assessment, the LKPD has been assessed as good in the linguistic aspect. LKPD is considered very good in terms of format, content and appearance. There were several improvements made after *review* by experts, including improvements to the sentences of practical instructions to make them easier to understand, as well as additions *link* video tutorial on using Phyphox in experiments on LKPD.

Table 1. Results of Expert Review of LKPD

No.	Assessment Aspects	Reviewer		Rat rat	Information
		R1	R2		
1	Format	4,00	4,00	4,00	Very good
2	Head	3,36	3,45	3,41	Very good
3	Appearance	3,38	3,63	3,50	Very good
4	Language	3,00	3,25	3,13	Good

The field test was carried out in one class at a public high school in the city of Surabaya. There were 31 students involved in the trial. In the trial, students followed the modeling-based learning flow on the LKPD. Exploration of harmonic vibration phenomena was carried out directly using Phyphox in groups, as documented in Figure 9. An example of an LKPD completed by students is presented in Figure 10.

Figure 9. Documentation of experiments carried out by students.

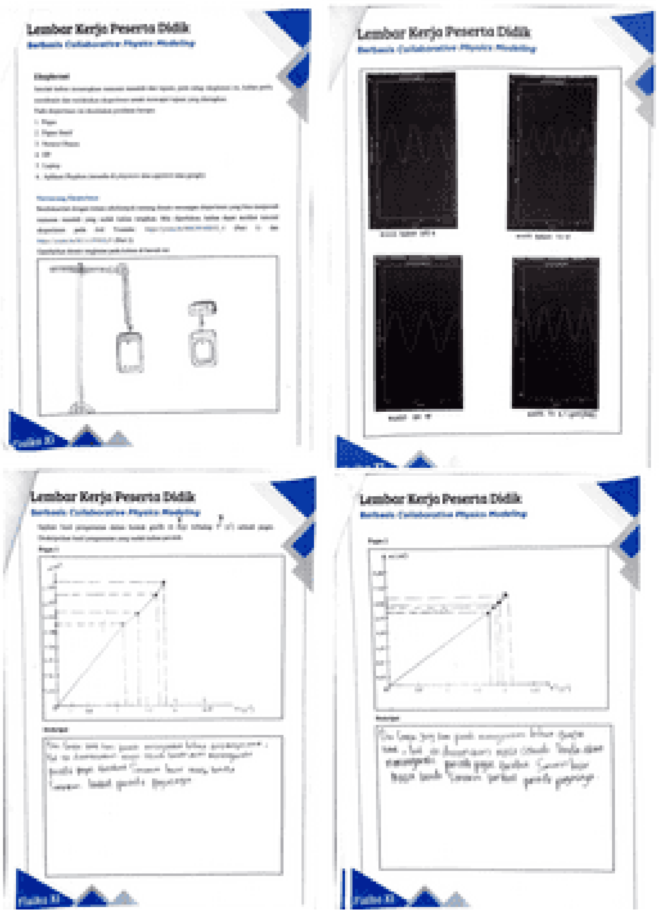

Figure 10. Example of the LKPD section filled in by students.

Before and after implementing the LKPD, students are asked to work on it pre- and post-test. Results pre- and post-test shown in Table 2. There is a significant increase in student learning outcomes after participating in learning activities guided by LKPD. Class average on post-test achieved a score of 85.21 and N-gain amounting to 0.74 which is included in the high category (Hake, 1998).

Table 2. Pre- and Post-Test Results

Installment-Instalment Pre-test	Rate-Rata Post-test	N-gain	Criteria
42,04	85,21	0,74	High

Table 3. Results of Student Responses to LKPD

No	Item	Score	Information
1	LKPD display design	2,95	Good
2	LKPD helps in the learning process	3,15	Good
3	Type and size of letters on LKPD	3,35	Good
4	Language used in LKPD	3,30	Good
5	The explanation of the exercises on the LKPD is easy to understand	3,10	Good

At the end of the lesson, students also fill out a questionnaire to assess the LKPD that has been tested. Student responses to the quality of LKPD are generally good. Students stated that the display design of the LKPD was good and helped the learning process. Detailed results can be seen in Table 3.

The results of this research are in line with previous research with student subjects showing that learning physics with an inquiry model using Phyphox also increases understanding of concepts on the topic of rolling motion (Suoth, Silangen & Rende, 2023). Phyphox is also effective in increasing understanding of the topic of friction (Ilmi et al., 2021). These positive trial results indicate that the introduction of Phyphox with active learning can stimulate students to be actively involved during learning so that their learning outcomes can achieve optimal results.

4. CONCLUSION AND RECOMMENDATION

In this research, LKPD assisted by the Phyphox application has been developed. The LKPD was developed in accordance with the modeling-based learning flow. LKPD is considered suitable for use in learning by experts. Based on trials, the implementation of learning with LKPD is effective in improving learning outcomes and getting good responses from students. Thus, it can be concluded that LKPD has the potential to optimize the use of technology in physics learning in the classroom.

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