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Creation of Digital LKPD Based Problem Based Learning Model on Harmonic Vibration in Physics Learning for SMA Class X

Dinda Aprilia[1], Amali Putra[2]
[1.2] Department of Physics, Universitas Negeri Padang
e-mail: dindapriiil05@gmail.com

Abstrak

Pendidikan pada abad 21 berkembang pesat, hal ini terlihat dari perkembangan Ilmu Pengetahuan dan Teknologi (IPTEK) di berbagai bidang kehidupan. Perubahan IPTEK di abad 21 dapat dihadapi dengan memiliki berbagai keterampilan, salah satunya keterampilan pemecahan masalah. Kurikulum 2013 merupakan upaya pemerintah untuk mendorong peserta didik memiliki keterampilan untuk memperbaiki permasalahan di abad ke-21. Fakta yang ditemukan di lapangan adalah guru selama ini menggunakan bahan ajar cetak, namun belum menggunakan bahan ajar elektronik seperti LKPD Digital karena keterbatasan waktu. Salah satu solusi untuk mengatasi permasalahan tersebut adalah dengan membuat bahan ajar berupa LKPD Digital Berbasis Model Problem Based Learning. Penelitian yang dilakukan merupakan jenis penelitian Research and Development (R&D) dengan menggunakan model ADDIE untuk pengembangannya. Penelitian ini mempunyai keterbatasan pada uji praktikalitas pada tahap uji kelompok kecil. Hasil uji validitas dengan skor mean 0,85 dengan kategori valid. Hasil uji praktikalitas guru diperoleh dengan nilai rata-rata 86,5% dan praktikalitas siswa dengan uji kelompok kecil diperoleh nilai rata-rata 86% dengan kategori sangat praktis. Jadi, kesimpulan penelitian bahwa LKPD Digital Berbasis PBL pada materi Getaran Harmonik untuk Pembelajaran Fisika Kelas X SMA valid dan praktis.

Kata Kunci: *LKPD Digital, Pembelajaran Berbasis Masalah, Getaran Harmonis*

Abstract

Education in the 21st century is developing rapidly, this shown from the Science and Technology (IPTEK) development in various fields of life. The change of IPTEK in the 21st century can be faced by having various skills, one of which is problem-solving skills. The 2013 Curriculum is a government effort to encourage students to have the skills to fix problems in the 21st century. The facts found in the field are that teachers have used printed teaching materials, but have not used electronic teaching materials such as Digital LKPD due to time constraints. One solution to fixed this problem is to create materials for teaching in the form of Digital LKPD Based on the Problem Based Learning Model. The research conducted is a type of Research and Development (R&D) research using the model ADDIE for development. This research is have limitation in the practicality test at the small group test stage. The validity test results with a mean score of 0.85 with a valid category. The results of the teacher's practicality test were obtained with a mean score of 86.5% and the practicality of students with small group trials was obtained with an average value of 86% with a very practical category. So, the research conclusion that the Digital LKPD Based on PBL on the Harmonic Vibration material for Physics Learning for Class X of Senior High School is valid and practical.

Keywords: *Digital LKPD, Problem Based Learning, Harmonious Vibration*

INTRODUCTION

The significant change in Science and Technology (IPTEK) in the 21st century has developed very rapidly, as can be seen from the increasing number of various types of sophisticated technology that can help activities in human life. The development of IPTEK is also inseparable from science and education. The world of education must also adapt to technological developments so that it is not fixated on less active learning. This is in accordance with

Permendikbud No. 22 of 2016 concerning the Standards for Elementary and Secondary Education Processes. The sample of them is the IPTEK used to making learning become efficient and effective. The use of technology and capabilities in the digital field is a challenge for the world of education, one of which is physics learning. Learning physics is a means or vehicle for mastering knowledge, understanding concepts and principles in physics. Apart from that, in the 2013 curriculum, teachers are not the only source of learning but rather learn using many sources. Teaching and learning activities that only use teacher and student handbooks result in less interesting learning for students (Sukardi, 2017). Therefore, teachers are expected to develop interesting, creative and innovative teaching materials (Zuriah, 2016).

The materials for teaching are a crucial part in learning. The materials for teaching is the sample of the learning tools that impact the process of learning. The materials for teaching can improve the learning quality in schools. This materials are all shape of materials in the consist of systematically arranged material devices that are used to help educator in conduct activities in learning and enable students to learn (Rahmadani 2018). There are various types of materials for teaching used by educators, one of which is LKPD (Student Worksheets). According to Prastowo (2014:204) that LKPD is a material of teaching that is printed in the form of sheets of paper which contain material, the material summary, work instructions on questions that can be done by students based on basic competencies so that learning objectives can be achieved.

One of the materials for learning that is so hard for students to get understanding is the harmonic vibration material. Research conducted by Riasti, (2016), in the harmonic vibration material there are many physics concepts that are applied in everyday life. Although the concept of harmonic vibration exists in everyday life, this material has abstract characteristics and has a fairly high level of complexity and complexity. This is supported by Novriani's research (2021) which concluded that most students find it difficult to understand the harmonic vibration material that occurs in everyday life phenomena, but tends to be abstract because it occurs during a very fast and short time interval. The resson is students to have less mastery of learning.

The Problem Based Learning (PBL) model is a way in learning that can train students' ability to solve a problem. PBL is a method of instruction that can assist students in developing the abilities required in the contemporary globalized world (Hotimah, 2020). The PBL model application in classroom learning requires the right media. The use of printed books in schools tends to provide less physics problems in real life. This is not in accordance with the 2013 curriculum which requires every classroom learning to utilized a approach by scientific which involves observing, asking, trying, reasoning, and communicating. This approach of scientific is intended so that students' understanding of the concept of the material presented is better. Therefore, learning in the 2013 curriculum is expected to provide direct experience to students.

This Problem Based Learning (PBL) model aims to encourage students to learn through various real-life problems that are linked to the knowledge they have or will learn. This goal can be achieved if the PBL model is integrated into good learning media. One variation of this media in learning can be in the shape of digital LKPD (student worksheets). Digital LKPD is a student exercise sheet that is done digitally and carried out systematically and continuously within a certain period of time (Sari, 2017). Digital LKPD is a teaching material that is packaged in order to ensure students can explore the content on their own and get more involved in resolving current issues by completing activities that address issues pertaining to daily life (Aini, 2019). The availability of interesting materials for teaching is a crucial point for teachers and students in the process of learning. Therefore, teachers must provide complete teaching materials and attract students' interest in learning.

Many efforts have been made by the government to fulfill the demands of 21st century skills, efforts made by the government specifically in the field of education such as curriculum renewal, improvement of educational facilities and infrastructure, development and procurement of teaching materials, training and increasing the educators quality, and management of Higher Education quality (Yanti, 2013). The curriculum currently used is the 2013 curriculum where the 2013 Curriculum is based on the shape and work of learning in the classroom (Festiyed, 2015).

However, the reality in the field is not in accordance with the expected conditions. Physics learning conducted in three schools in Padang City still tends to be lecture methods and still rarely

uses Digital LKPD. According of interviews results with physics teachers in the three schools, the information that teachers have used teaching materials but the materials for teaching used are still in printed form, one of which is LKPD. The Digital LKPD used is still limited to images. In addition, according on the needs analysis from student for questionnaire about LKPD, it is known that some students still consider physics difficult, the LKPD presented is less interesting and the LKPD used does not fully meet the criteria for good LKPD.

The ideal LKPD according to Sari (2020) is an LKPD that is made according to the learning model used during learning so that this LKPD will be effective, successful and meaningful. Making LKPD can involve the latest technology so that LKPD is interesting and practical to use. One of the software that can be used to make more interesting LKPD is Flip PDF Professional. The flip PDF professional program provides the following benefits: 1) interactive publishing, which looks good by including links, images, and videos; 2) The LKPD can be adjusted using a variety of templates, themes, and backgrounds; and 3) supported by text and audio (Khairinal, 2021).

The difference between Digital LKPD and printed LKPD that is commonly used is that Digital LKPD is presented in an interactive form that allows direct feedback and its appearance is attractive because it contains video, audio and animation. While printed LKPD cannot provide this, the unattractive appearance makes students bored, it is easily torn and damaged if carried and there is no reciprocal response for students (Sumardani, 2020). The previously available Digital LKPD only contained materials, images and practice questions, did not include steps in the PBL model and there was also no interaction between students.

Based on the problems that have been presented description, the researcher is interested in making a product in the form of a Digital LKPD based on the Problem PBL Model for Harmonic Vibration material for Class X of Senior High School. Therefore, the researcher proposes a research title, namely "Creating a Digital LKPD Based on the Problem Based Learning (PBL) Model on Harmonic Vibration Material for Physics Learning for Class X of Senior High School."

METHOD

This research used a method by research and development (Research and Development). This study making product in the shape of a Digital LKPD Based on the PBL Model on the Harmonic Vibration material for Physics Learning for Grade X of Senior High School which is valid and practical to be used by students in the process of learning. The model utilized in this research is ADDIE (Analysis, Design, Development, Implementation and Evaluation). The ADDIE model is a research model that provides an opportunity to conduct continuous evaluation and revision so that the resulting Digital LKPD will be a valid Digital LKPD.

This research was conducted at the Department of Physics, Padang State University to conduct a validity test by 5 experts. After that, the research was continued in 3 schools, namely SMAS Adabiah Padang, SMA Negeri 6 Padang and SMA Negeri 12 Padang. This research purposes is to assess the practicality of the Digital LKPD that has been created. The practicality test was conducted by 3 teachers and 9 students with a small group test. The research phase based on the development of the ADDIE model are as follows.

Analysis Stage

1. Needs Analysis: The first stage of needs analysis is defining the problem that needs to be developed in Digital LKPD. Problem analysis is carried out to obtain a picture of facts and alternative solutions as well as student characteristics.
2. Curriculum Analysis: Finding abilities or skills that students need to acquire, such as KI, KD, resources, assessment tools, and assessment indicators, is the goal of curriculum analysis (Endriani et al., 2018.)
3. Material Analysis: Material analysis aims to identify the main material that needs to be included in the Digital LKPD, have relevant material and re-arrange it systematically.

Design Stage

At the design stage of this Digital LKPD, it already contains a good and correct structure of teaching materials. The Digital LKPD that will be created is designed as attractive as possible so that there is no boring and uninteresting impression during learning. The structure of the Digital LKPD is in related with the National Education Ministry 2008. The Digital LKPD is designed in such

a way that it is hoped to be easy to support students in activities of learning. The following is the design structure of the Digital LKPD that has been created by researchers, including: 1) Cover, which displays the front page of the Digital LKPD containing the author's identity, title of the material and images that are relevant to the content, 2) Introduction containing: Foreword and Table of Contents, 3) Digital LKPD consists of: title, subject identity, instructions for use, includes learning objectives, core competencies, basic competencies, indications of competence accomplishment, and a handbook for studying the Digital LKPD. 4) The learning phases for problem-based learning include introducing students to problems, setting up learning activities, directing research, presenting work, and assessing and analyzing. 5) Sample question, 6) Assignments.

Development Stage

The development phase is the process of realizing the design into a Digital LKPD Based on Problem Based Learning in related with the material and KD to be achieved in learning. After the initial design of the Digital LKPD Based on PBL is complete, the next stage is the validation test. At this phase, an evaluation is conducted, namely by analyzing data on the product assessment obtained results from the validator. This is done to obtain the validity value and the Digital LKPD Based on Problem Based Learning. If the product being developed obtains an invalid value, then the Digital LKPD that is developed is revised and re-validated until the Digital LKPD is valid for use.

Implementation Stage

The implementation stage is the product trial stage. The product implementation is intended to getting data that can be used as a basis for revealing the practicality of the Digital LKPD Based on the PBL Model. The product practicality test was done in a small group trial, namely by assessing 3 physics teachers and 9 students. This practicality test was conducted at SMAS Adabiah Padang, SMAN 6 Padang and SMAN 12 Padang majoring in science who had studied Harmonic Vibration material. The researcher explained to students how to fill out the questionnaire and explain the Digital LKPD Based on Problem Based Learning. Students were asked to see the product produced, then students were asked to provide an assessment related to the E-LKPD product Based on the Problem Based Learning Model. At this stage, an evaluation is conducted, namely by analyzing data on the findings of product assessments obtained from practitioners. This is done to obtain the practical value of the Digital LKPD Based on the PBL Model. If the product created gets a practical value, then the creation of the Digital LKPD has been completed.

Evaluation Stage

This stage is carried out at every step in the ADDIE model, to see the results and minimize errors in the designed product, an evaluation of the product process for development is conducted, in order to see the shortcomings and weaknesses of the product development process and it is hoped that the evaluation findings can increase the product again according to needs and become a good learning resource.

RESULTS AND DISCUSSION

The first stage in this study was to conduct a needs analysis of Digital LKPD through interviews with teachers in three schools in Padang City and giving questionnaires to students. According on the interview results, we can look that students still consider physics learning difficult. So that teachers more often present the material in front of the class and discuss questions that are related to the material being studied. The findings of the student questionnaire from 20 students showed that students were still less interested in learning physics, because physics is difficult to understand. However, relevan to the implementation of the 2013 curriculum where the process of learning is centered on students. So that the need for resources of learning that can trigger student activity, one of which is Digital LKPD Based on the PBL Model. Based on the questionnaire that has been filled out by students, students need technology-based worksheets, which can motivate activities of learning and increase understanding of students' of the material to be studied. Students like Digital LKPD which contains videos, animations and audio.

The second stage is product design with the aim of designing Digital LKPD Based on PBL Model on Harmonic Vibration material for Physics Learning that can be used by students as additional references in learning. This stage is obtained in accordance with the analysis results that

has been done. The Digital LKPD that was created refers to the Ministry of National Education in 2008 with components including, title/identity, instructions for use, KI/KD, summary of material, tasks or work steps and assessment in the form of evaluation

The third stage is product validation. The purpose of this validity test stage is so that the Digital LKPD given and used by students has a valid value. Digital LKPD based on the PBL model was validated by five validators from UNP physics lecturer experts. The results of the validity of the Digital LKPD were obtained from the validator's assessment of the product through the validity assessment sheet instrument. The Digital LKPD assessment instrument consists of 3 aspects, namely the aspect of content feasibility, the aspect of the characteristics of the Digital LKPD and the steps of the Problem Based Learning model. The assessment on the validation sheet ranges from 1 to 5 for each validator. The value of a component is obtained from the average of the validator's assessment for each aspect in the component. The first assessment aspect is the feasibility of the content. The feasibility aspect of the content contains four indicators. The four indicators are the relevance of the material to KI and KD, language, presentation and graphics. The Validity findings of Digital LKPD for the aspect of content feasibility assessment shown in table 1.

Table 1. Validation Results for Content Feasibility Aspects

No	Indicator	Aiken's V Value	Category
1	Suitability of material with KI and KD	0.80	Valid
2	Linguistics	0.85	Valid
3	Presentation	0.81	Valid
4	Graphics	0.88	Valid
	Average	**0.84**	**Valid**

The second assessment aspect is the characteristics of the Digital LKPD. The characteristics aspect of the Digital LKPD contains three indicators. The three indicators are the truth of the content, language and suitability. The validation results for the assessment aspect of the characteristics of the Digital LKPD shown in Table 2.

Table 2. Validity Results for the Characteristics Assessment Aspects of Digital LKPD

No	Indicator	Aiken's V Value	Criteria
1	Truth of Content	0.83	Valid
2	Language	0.93	Valid
3	Compliance	0.82	Valid
	Average	**0.86**	**Valid**

The third assessment aspect is the PBL model phase. This assessment aspect contains five indicators. The five indicators are introducing students to the issue, arranging them, directing their research, creating and presenting their work, and assessing and analyzing their problem-solving skills. The results of the Digital LKPD validation for the assessment aspect of the People Based Learning Steps shown in Table 3.

Table 3. Validation Results for PBL Steps Assessment Aspects

No	Indicator	Aiken's V Value	Criteria
1	Student Orientation to Problems	0.8	Invalid
2	Organizing Students	0.93	Valid
3	Guiding the Investigation	0.8	Valid
4	Developing and Presenting Work Findings	0.83	Valid
5	Analyzing and Evaluating Problem Solving	0.85	Valid
	Average	**0.84**	**Valid**

The average value obtained from each aspect of the Digital LKPD assessment based on the PBL Model for Harmonic Vibration material can be determined from the average of the three aspects of the validity assessment of the Digital LKPD by UNP physics lecturers that have been analyzed, which shown in the following table 4.

Table 4. Analysis of Average Validity Value of E-LKPD

No	Validity Aspects	Average Value	Criteria
1	Content Eligibility	0.84	Valid
2	Characteristics of Digital LKPD	0.86	Valid
3	PBL Model Steps	0.84	Valid
	Average	**0.85**	**Valid**

From Table 4, th conclusion that the average value of the validity value of the Digital LKPD given by the UNP physics lecturer, namely 0.85, is in category was valid. The value given by the validator on the validation test sheet instrument states that the Digital LKPD Harmonic Vibration Based on the PBL Model is valid.

During the validation process, the validator provides several comments and suggestions in the form of input so that the product created becomes better. The suggestions provided by the validator will be a guideline for researchers in revising the Digital LKPD so that the E-LKPD used becomes more effective and efficient.

The next stage is the implementation of the product in the form of a practicality test of the Digital LKPD Based on the PBL Model by teachers analyzed based on the practicality instrument created. The practicality test results of the Digital LKPD Based on the PBL Model consist of four assessment aspects. The four assessment aspects are ease of utilized of the Digital LKPD, attractiveness, efficiency of the Digital LKPD and availability of problem solving in the Digital LKPD. Each assessment aspect has several assessment indicators that get a score of 1 to 5.

The average value obtained from each aspect of the Digital LKPD assessment based on the PBL Model for Harmonic Vibration material can be determined from the average of the four aspects of the practicality assessment of the Digital LKPD by teachers that have been analyzed, which shown in Table 5 below.

Table 5. Analysis of Average Value of Teacher Practicality in Digital LKPD

No	Practicality Aspect	Average Value (%)	Category
1	Ease of Use of Digital LKPD	88.9	Very Practical
2	Attractiveness	86.1	Very Practical
3	Efficiency	84.2	Practical
4	Problem Based Learning Model	86.7	Very Practical
	Average	**86.5**	**Very Practical**

From Table 5, it can be concluded that the average value of the practicality of the Digital LKPD given by three physics teachers, namely 86.5%, is in category was very practical. The score given by physics teachers on the test of practicality sheet instrument states that the Digital LKPD Harmonic Vibration Based on the PBL Model is very practical to use in physics learning.

The next implementation stage is the practical test of Digital LKPD Based on PBL by students analyzed based on the E-LKPD instrument Based on Problem Based Learning that was created. The findings of the practicality test of Digital LKPD Based on PBL consist of three aspects of assessment, namely the ease of use of Digital LKPD, the attractiveness of Digital LKPD and the efficiency of Digital LKPD.

The average value obtained from each component of the Digital LKPD assessment based on Problem Based Learning for Harmonic Vibration material for Physics Learning for Grade X of Senior High School can be determined from the average of the three components of the E-LKPD practicality assessment by 9 students shown in table 6 below.

Table 6. Analysis of Average Value of Students' Practicality in Digital LKPD

No	Practicality Aspect	Average Value (%)	Category
1	Ease of Use of Digital LKPD	90.2	Very Practical
2	Attractiveness	83.7	Practical
3	Efficiency	84.2	Practical
	Average	**86**	**Very Practical**

From Table 6 above, the conclussion that the average score of students' practicality towards Digital LKPD Based on the PBL Model by 9 students, namely 86%, is in the very practical category.

CONCLUSION

Based on the findings of the research and discussion that have been conducted, the research conclussion that the feasibility of Digital LKPD Based on the PBL Model for Harmonic Vibration material for Physics Learning for Class X of Senior High School, which is reviewed from the validity test, is in the valid category with an average validation value from experts of 0.82 and reviewed from the practicality test by teachers, it is in category was very practical with an average score of 86.5% and practicality by students is in category was very practical with an average score of 86%. However, because this study is only limited to small-scale tests, it is advisable to conduct further research to assess its effectiveness more comprehensively. The researcher hopes that the development of this Digital LKPD will not only cover harmonic vibration material, but also cover all class X materials of the Merdeka Curriculum.

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