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Dialogical, Interactive and Contextual Analysis Of Physics Worksheets Based On PBL On Parabolic Motion Material

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Abstract. *Learning media greatly determines the effectiveness and efficiency of achieving learning objectives. This development was carried out with the aim of making PBL-based physics worksheets on parabolic motion material and its application as an alternative medium for physics lessons. Parabolic motion is circular motion whose trajectory is a parabola. This study uses a research design methodologyResearch and Development or research and development. Based on the research results assessed by material experts and media experts that PBL-based physics worksheets on parabolic motion material and its implementation have a feasibility index of 80 and 87 which fall into the feasible category.*

Keywords: *LKPD, PBL, Parabolic Motion*

Abstrak. Media pembelajaran sangat menentukan efektivitas dan efisiensi pencapaian tujuan pembelajaran. Pengembangan ini dilakukan dengan tujuan untuk membuat LKS fisika berbasis PBL pada materi gerak parabola dan penerapannya sebagai alternatif media pembelajaran fisika. Gerak parabola adalah gerak melingkar yang lintasannya berbentuk parabola. Penelitian ini menggunakan metodologi desain penelitian Research and Development atau penelitian dan pengembangan. Berdasarkan hasil penelitian yang dinilai oleh ahli materi dan ahli media bahwa LKS Fisika berbasis PBL pada materi gerak parabola dan implementasinya memiliki indeks kelayakan 80 dan 87 yang masuk dalam kategori layak.

Kata kunci: LKPD, PBL, Gerak Parabola

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INTRODUCTION

In a study, of course, requires a learning component that is expected to achieve learning objectives. Glasses subject is part of learning related to science and has parts of material consisting of facts as well as basic concepts and laws of physics itself. Physics can also be interpreted as a science that studies matter and substances that can be used as a reference for properties, physics, as well as components and changes in energy. The existence of physical learning can also help the process of approaching the learning set by the teacher. The existence of physics lessons often makes students feel bored, but with effective learning methods that are not always embedded in the teacher, learning will take place systematically and not be boring (Wahyudi, 2021).

As technology develops, many methods are used to convey the learning process, and it is often heard that there is a word wall method where this method can be interpreted as a method of using games as education with varied game templates and of course can be used as an alternative media for the physics lesson itself, in physics learning also has quite a focus which can be said to be one of the references that can be seen from the process. the existence of glasses learning will certainly make students misunderstand because the lessons are considered difficult and seem boring and there are also many students who lack enthusiasm for this subject, but when viewed from the other side, students will also be excited if the lesson seems fun (Yarza, et al., 2020).

In a study of course there are concepts which can be mentioned as a reference for learning. the existence of media that is increasingly developing can also be seen from the default learning that has been widely used. It has been seen that Indonesia is one of the countries that has included globalization in the field of education and has developed accordingly, the internal education system of Indonesian schools has also followed the level of learning that follows technological developments. and it has been seen because many schools have started implementing learning that follows technological developments. Glasses learning itself can also be interpreted as a lesson that has a relationship with science which was originally determined by valid theories, but glasses learning is also often associated with subjects that are difficult and difficult to understand because of the teacher's lack of creativity in providing material so that students the students feel bored, physics is also one of the sciences. The existence of education is also very influential for the progress of a country in order to create a young

generation for Indonesia. the existence of PBL learning media also influences the spectacles learning process at various stages starting from the junior high school stage to the tertiary stage. this can also be seen from the description given mainly in the Problem Based Learning model which is also a learning model that meets valid criteria and has a positive impact on the continuity of learning related to student learning outcomes (Hikmawati, et al., 2021). The use of instructional media that is still inadequate for parabolic motion material causes lower student motivation to learn.

In relation to the word wall, there is also some material such as an example of parabolic motion. Parabolic motion itself can be interpreted as a form of motion that is influenced by the presence of gravitational forces which are also related to the earth's surface. Movement in parabolic motion moves along a curved path under the action of Earth's gravity alone. In physics learning, parabolic motion is a two-dimensional motion (Karim and Duden, 2016).

Learning media is no stranger to lecturers, teachers or students. Learning media is usually used by an educator as an intermediary to convey information. The word 'media' comes from a Latin language viz*medius*. *Medius* the meaning is 'middle', 'intermediate', or 'introductory'. In Arabic, the media is defined as an intermediary from a message sender to the recipient. In 1971, Gerlach and Ely believed that media, when understood deeply, is human, material, or events that build conditions so that recipients acquire knowledge, skills, and attitudes. So, in detail it can be concluded that the media are tools that can be graphic, photographic or electronic to capture and process visual and verbal information. As already explained, this media can often be called any tool that is used as a channel of information. While learning is an activity or process to achieve a goal. Therefore, learning media is media that is used in the learning process as a channel for messages between educators and students so that teaching objectives are achieved (Mariand*aet al.,* 2014:114).

THEORETICAL STUDY

Learning media greatly determines the effectiveness and efficiency of achieving learning objectives. As technology develops, many types of media have been formed and created by humans. Starting from media that upholds creativity to media that prioritizes its content. Therefore, as a teacher or educator, one must be familiar with

various media and their characteristics. And use media according to the level of student characteristics. LKPD is one of the learning media that has been around for a long time. Usually LKPD begins to be used by students at the middle or high school level, SMK, MA and so on. LKPD contains sheets that support the activities of students who carry out activities in the form of objects and issues being studied (Arif*et al.,* 2019:330).

In learning, educators, namely teachers, lecturers or others hope that learning objectives can be achieved effectively. Because of the material that has been delivered, it is hoped that the outcome of the delivery will be good learning outcomes (Saeupuzaman, and Saeful K., 2016: 2). One of the learning materials in physics is parabolic motion. Parabolic motion is the basic material in knowing physics. Parabolic motion is circular motion whose trajectory is a parabola. This parabolic motion is a two-dimensional motion that combines two axes, namely the horizontal axis is called the (x) axis, and the vertical axis is called the (y) axis. On the horizontal axis is Uniform Straight Motion and the vertical axis is Uniformly Changing Straight Motion (GLBB). In parabolic motion, air friction is neglected. Air friction in this case plays a very important role in reducing the energy of the object's motion which in turn reduces the size of the projectile trajectory. But in this concept, many ignore air friction. The principle of parabolic motion applies to motion if: the earth is in a homogeneous state, the height of the object is constant, the air pressure is small, the object is moving slowly, and it occurs at the north and south poles (Rajagukguk, and Chayani S., 2018: 1).

According to Rajagukguk and Chayani S (2018), parabolic motion is also called bullet motion. Parabolic motion always has an initial velocity. However, not all movements that have an initial velocity can be called parabolic motion. This bullet motion is a motion where the object is given an initial velocity and then moves as far as the trajectory. This does not forget also influenced by the force of gravity of the earth. The components of parabolic motion are the distance and height of the object. An object experiencing parabolic motion will have an initial velocity (v_0) as well as a very large acceleration then the direction is the same as the acceleration of gravity (g). In everyday life, the application of parabolic motion is playing golf balls (when playing the ball will fly up like the concept of parabolic motion), throwing basketballs and others (Wibowo, and Titin S., 2020: 259).

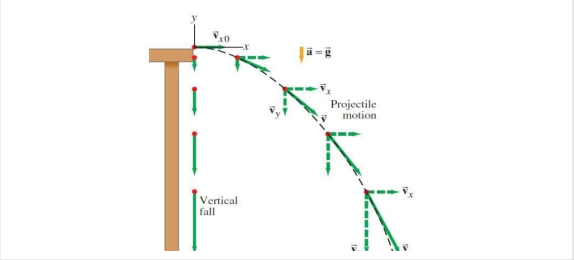

Fig 1. Illustration of a bullet falling horizontally (Source: Giancoli, 2014)

In the picture above, we can examine the vertical component (y). By the time it leaves the table, this ball has a velocity x component (t=0). Then the ball leaving the table experiences a downward vertical acceleration (g). So that the initial (v_{and}= 0) then increases in size as the ball hits the ground. The value (y) is positive upward. The acceleration due to gravity (g) is in the (-y) direction, so (a_{and} = -g). With y replacing x then: $v_{and} = v_{y0} + a_{and}t = -gt$. Since the speed of y is 0 (v_{and}= 0), the vertical displacement can be calculated by:

and = $and_0 + v_{y0} + ½\ a_{and}t^2$

With $y_0 = 0$; $in_{y0} = 0$; and $a_{and} = -g$. Make $y = -\ 1⁄2\ gt^2$

On the other hand, there is no acceleration in the horizontal direction (neglecting air resistance). with $a_x = 0$, the horizontal component of the velocity v_x remains constant equal to v_{x0} . Horizontal displacement with $a_x = 0$ can be calculated by $x = v_{x0}t + ½\ a_xt^2 = v_{x0}t$ (Giancoli, 2014:71-72).

Then the kinematic equation in two dimensions for constant acceleration is as follows:

a) X-axis components (horizontal)

$in_x = v_{x0} + a_xt$ (1)

$x = x_0 + v_{x0} + ½\ a_xt^2$ (2)

$in_x^2 = v^2_{x0} + 2a_x(x-x_0)$ (3)

b) Y-axis component (vertical)

$in_{and} = v_{y0} + a_{and}t$ (1)

and = $and_0 + v_{y0} + ½\ a_{and}t^2$ (2)

$in_{and}^2 = v^2_{y0} + 2a_{and}(y-y_0)$ (3)

With description :

in_x = speed on the x-axis (m/s)

in_{x0} = initial speed on the x-axis (m/s)

a_x = acceleration on the x-axis (m/s^2)

x = total displacement on the x-axis (m)

x_0 = initial position on the x-axis (m)

in_{and} = speed on the y-axis (m/s)

in_{y0} = initial velocity on the y-axis (m/s)

a_{and} = acceleration on the y-axis (m/s^2)

and = total displacement on the y axis (m)

and_0 = initial position on the y-axis (m)

t = object time at each path position (s)

Above is the equation of the two components that exist in parabolic motion (Wibowo, and Titin S., 2020: 260). The relationship between angle and distance is directly proportional which is proven by the equation $x = v_0 \cos t$. In theory, the relationship between distance and time is also directly proportional, that is, the greater the distance, the longer the time required. In addition, the elevation angle is also the elevation angle and maximum height which affects the maximum distance of the parabolic motion where: $x_{max} = v_0 \sin 2\vartheta / g$ and $y_{max} = v_0^2 \sin^2 2\vartheta / 2g$ (Nurmasyitah*et al.,*2022:250-254).

Apart from using LKPD, the concept of this article is also assisted with wordwall-based online media. Wordwall is one of the games which is useful and engages students by learning and playing. Wordwall is very effective when used for evaluation at the end of student learning. Wordwalls are very effective for both online and offline learning. Students become more enthusiastic when working on questions given by the teacher (Hidayah., 2022: 4-5). Many supporting learning processes in education. One of them is the PBL (Problem Based Learning) learning model.

Wiyono (2015) said that PBL has now been developed into interactive multimedia that meets valid, practical criteria and has a positive impact on student learning outcomes. Model *Problem Based Learning* is a learning model that is based on problems that exist around students as the beginning of the learning process. Then in this model later students in groups think critically and have the skills to solve problems

so that students have no difficulty understanding the subject matter given (Rohman *et al.,*2021:232-233).

METHOD

In this research, we used the Research and Development research design methodology or research and development. According to (Sugiyono, 2009), R&D research is research used to make certain products and then tested the effectiveness of the product. This is also said by Nana Syaodih Sukmadinata (Sukmadinata, 2005) that the research conducted with this method is the process of production and developing or improving existing products or product learning environments. Based on the opinions of the two experts above, a conclusion can be drawn that the R&D research method is a research method that produces educational products or media that are tested on students, both new products and processed old products. This R&D research method is also widely used in the world of education because the product is made through research and development which is expected to increase the productivity and efficiency of education, one of which is through the training of qualified prospective educators. (Elfina & Sylvia, 2020).

This research adopted the modified ADDIE (analysis, design, development, implementation and evaluation) model, with no implementation and evaluation stages carried out. According to the ADDIE model (analysis, design, development, implementation and evaluation) it is very suitable for making learning media based on LKPD (Student Worksheets).

Then the technique for collecting data used in this research is the validation sheet for the validator. The LKPD assessment consists of 4 components/criteria or rating scale, namely (1) Very poor (invalid) (2) Poor (quite valid) (3) Good (valid) and Very Good (very valid). To obtain data that is a valid LKPD, an assessment instrument is used with analysis using established analytical techniques and calculation methods. For the formula to calculate the average score of each component, you can use equation 1.

$$\bar{X} = \frac{\Sigma x}{N} \quad (1)$$

Where $\bar{x}$ is the average score of the assessment by experts, $\sum x$ is the number of scores obtained by experts and N is the amount of data (Damayanti et al., 2013). However, this process has not been completed, it is necessary to convert the average score obtained into a value with criteria. This was done because to find out how feasible the LKPD resulted from the development, which was originally in the form of a score, was converted into qualitative data. with the feasibility index formula as follows:

$$feasibiltiy\ index = \frac{average\ of\ all\ aspects}{the\ highest\ rating\ scale} \quad (2)$$

Table 1. Feasibility category is obtained in the PBL-based physics worksheet

Feasibility index	Category	Decision
X > 88	Very worthy	If all the items in the element are considered very appropriate and there are no deficiencies with this product, then it can be used as a student worksheet
50 > X > 88	worthy	If all the items in the elements are assessed as appropriate even though there are few and there needs to be justification in the student worksheet product, it can still be used as a student worksheet
X >50	Not feasible	If each item in the element is considered inappropriate and there are deficiencies with this product, then justification is needed so that it can be used as a student worksheet

RESULTS AND DISCUSSION

The results of this research are interactive multimedia learning tools in the form of PBL-based physics worksheets. LKPD is prepared for development which contains an assessment of problems regarding parabolic motion in everyday life given to students, time allocation and learning resources. The feasibility of this LKPD is done by validating the product to one material expert and one media expert.

Material Expert Judgment

The results of data analysis obtained from material experts with an overall average analysis per aspect value of 0.71 with a feasibility index of 80 are classified as feasible. When viewed from the components developed, the dialogic and interactive components are worth 4 with a very good category, and the contextual essence component is worth 3 with a good category. The validation index values of all aspects and types of components developed by material experts for LKPD can be seen in the graphical image below.

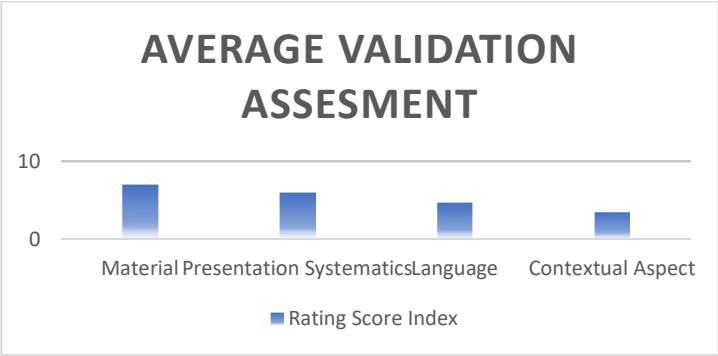

Fig 2. Graph of average validation assessment

Based on the graph above, it can be explained that the value of the material validation aspect which consists of the completeness of the material, the accuracy of the material, as well as the currentness and contextuality has an average score of 7; on the systematic aspect of the presentation which consists of presentation technique which has an average score of 6; in the aspect of language which consists of communicative, dialogic & interactive components, as well as suitability with the development of students has an average value of 4.6; while for the last component, namely the contextual aspect which consists of contextual nature and contextual components, it has an average value of 3.5. The values of these validation components are obtained from validation sheets that have been tested by material experts so that it can be found that this physics worksheet is most prominent in the dialogic & interactive components and contextual nature. The value of these validation components can be seen in the graph below.

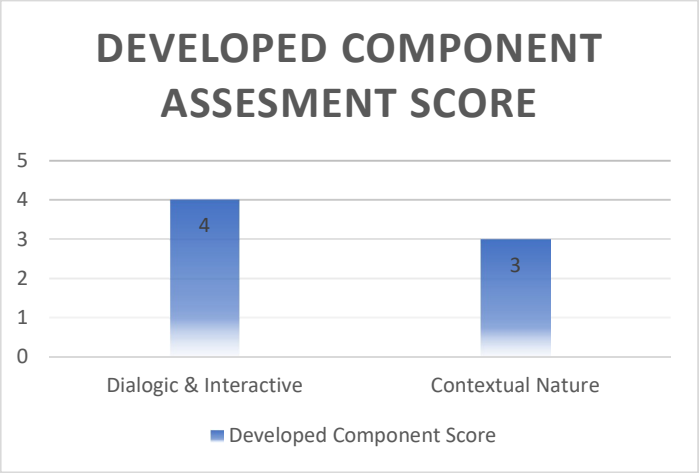

Fig 3. Graph of developed component assesment score

This LKPD is more prominent in the dialogic and interactive validation components as well as the contextual nature component. This is because this LKPD was developed using PhET media to facilitate solving existing problems, which was then assisted by using Wordwall media as the developer of this LKPD. The development of PBL-based worksheets using PhET and Wordwall media is considered to increase the interactive level of students in Parabolic Motion material. This media is said to be interactive and practical because it is easy to use and then the contents of the material are complemented by interesting writing, pictures, simulations, even animations so that they can motivate student learning and help in solving problems given by the teacher in learning. This is in accordance with research from Usman (2002) that the use of learning media cannot be separated from the function of the learning media.

The development of this LKPD is also devoted to contextual aspects in the form of contextual nature components, where the material contained in LKPD has a good relationship with everyday life so that students can easily connect the material being taught with everyday life.

Media Expert Judgment

The results of the analysis of data obtained from media experts with an overall average value of analysis per aspect is 0.94 with a feasibility index of 87 which is classified as feasible. When viewed from the completeness of the material, communication and display quality, as well as the overall function of the media, it is

concluded that these LKPD have different validation values. The validation index value of all aspects by media experts on LKPD can be seen in the graphical image below.

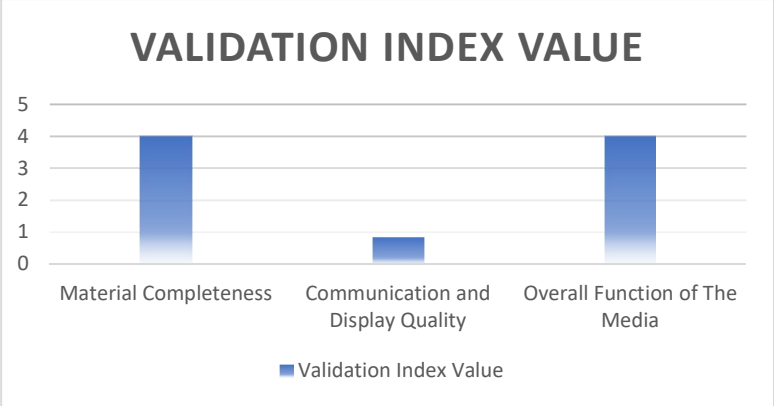

Fig 4. Graph of validation index value

Based on the graph above, it can be seen that the media in this LKPD is very interactive and easy to understand so that it can motivate students' learning without any difficulties in learning, especially in Parabolic Motion material.

Based on the results of validation above, the development of lanyon-based physics can increase the level of students' activation when learning takes place. William, Rice and Rogers (Severin & Tankard, 2009, p. 448) define that interactivity as the level of participants in the communication process and participants have control and can switch roles in mutual mutual. One level of mutual benefit concept, exchange, control and participants is interactivity acquired in the information system that does not allow user intervention to change content. This harmonizes with the purpose of research in creating a learning atmosphere which influences students' learning motivation, resulting from the involvement of color as one of the components of space. Cognitive interaction involves psychological, emotional and intellectual participation between humans and systems (Julianto et al., n.d.).

The difference in this study with previous research is the development of the ITO is more interactive and more motivating students in learning. The development of lon-based PBL will increase students' motivation so that students can be more interactive toward parabola motion materials, have critical thinking ability, and be able to address the problem of parabola motion very well. The media used in lon

development makes it easier for students to formulate problems, understand concepts, and the ability to solve problems in dish motion materials.

In addition to the development of the student interactive attitudes, students can also easily understand the concepts of parabola motion and relate them to everyday life. For example, when students experience events that refer to the parabolic motion, students can sum it up and can discern the concept that relates to the material of physics that has been taught. So from this existence, the development of this LKPD is also included in the development of contextual nature in Parabolic Motion.

CONCLUSIONS

After validating the LKPD that has been made with the development of a PBL-based interactive multimedia learning tool in the form of a physics LKPD. This LKPD is designed to help students understand parabolic motion in the context of everyday life. Assessment is carried out on aspects of time allocation, learning resources, and the suitability of LKPD with the desired development. To determine the feasibility of this LKPD, product validation was carried out by a material expert and a media expert. The results of data analysis from material experts show an average value of analysis per aspect of 0.71 with a feasibility index of 80, which indicates that this LKPD is included in the feasible category. Meanwhile, the results of data analysis from media experts showed an average analysis value per aspect of 0.94 with a feasibility index of 87, also included in the feasible category. So, these LKPDs are considered to have different validations in terms of completeness of the material, communication and display quality, as well as the overall function of the media.

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