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ANALYSIS OF USE OF PHYPHOX APPLICATIONS FOR PHYSICS PRACTICUMS USING SMARTPHONES ON COLLISION MATERIAL

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Abstract

Smartphones are a physical learning medium that can support students to experiment with measurement devices. One of the smartphone apps that can be used is phyphox. The study aims to find out collision analysis lends several types of fall fields that include soil, ceramic floor areas and board fields so that it will generate data on the height, time, and energy generated when objects hit the surface. The method used is an experiment with a collision testing comparison approach with different drop fields using phyphox and stopwatch applications. The results of three experiments in the energy board field that apples produce are larger than ceramic and soil floor fields. While the results of experiments using stopwatches showed that the energy produced has a slightly greater value than using phyphox. Phyphox application can be used for practicum independently.

Keywords: *Phyphox, Physics Practicums, Collision*

INTRODUCTION

Physics is a subject that contains several elements including curiosity, scientific method, facts, theory, and application (Damayanti, Ngazizah, & Eko, 2012). Physics is built on empirical experience, where concepts are formulated based on facts and observational data on symptoms, both natural and conditioned symptoms (Bambang, 2002). Physics studies existing facts then packaged into physical concepts and developed into laws or theoretical physics through experiments (Hughes, 1986). To achieve meaningful learning especially for students, students must be actively involved in learning and students must be able to find and construct their yearly (Fajri, 2019).

Experiments in physics aim to get students actively involved and train students to find knowledge

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Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 2 (2022) h. 156-165

independently (Mutmainah, 2017). Experiments are the activities of students to develop skills but are still minimally done in some schools. Some schools have props used manually by teachers and students (Lestari, 2021). One of the materials that must be supported by experiments is collision material. Abstract material makes students experience the authorship in studying concepts (Kurniawan, 2014). Students still experience errors in solving abstract concepts (Farida, 2015). Thus, experimentation is the most important part of physics learning.

As time progresses and technology advances, experiments can be conducted by students using smartphones. Smartphones can be used in physics learning by supporting students to experiment using smartphone sensors as measurement devices (Gonzales, 2015). One of the E-practicum applications commonly used in physics is Phyphox. The app developed by Aachen University aims to help conduct science experiments with smartphones (Novitasari, 2021). The phyphox application provides many simulations that can be used for physics practicums (Kuhn, 2013). Phyphox can be downloaded on Google Playstore and Appstore for free (Staacks, 2018). The use of phyphox applications produces valid and reliable data, presentation of data in real-time so there is no need to analyze data files (Pierratos, 2020).

The learning media used by teachers greatly affects the quality of learning (Handika, 2012). According to Kristiyani, et al (2020) revealed that phyphox application plays an important role in improving the mastery of student concepts as well as practicum activities with phyphox applications, students use and utilize technology very well and actively. Phyphox in a smartphone, a teacher does not take long to complete the material (Gotze & Benjamin, 2017). One of the materials that needs to use experiments is collision. Collision is the event of meeting two moving objects or a moving object about another object that is still or moving in cyrcle. Setiawan (2018) based on the kelentingan or elasticity of the collision is divided into three types, namely perfect lenting collision, partial lenting collision, and collision is not perfect lenting (Lawson, 1987).

Phyphox applications used in physics practicums can improve students' ability to solve problems (Noordyana, 2018). Based on research that has been reviewed by Nurfadilah et al. (2019) some schools already have simple but still manual props, one of which is collision props. The implementation of the collision practicum is limited to the activity of dropping the ball to the floor, in addition to the limitations of measuring instruments. Students will better understand if doing their experiments, students will find knowledge about the concepts taught (Prima et al., 2018). So there needs to be an application that students can use for their physics practicum and is easy to use. Therefore, this study aims to describe the use of the Phyphox application for physics practicums in collision matter.

METHODS

This research is experiment research. The study was conducted by conducting simulations with Phyphox using a comparative approach that has

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 2 (2022) h. 156-165

comparing properties. The comparison that will be done in this simulation is with the practicum about collisions simply using apples of course aims to find the height of the object when dropped or thrown and look for energy on the object with a different field of fall then compared to the time the fruit hit the surface using the application of phyphox and stopwatch which is a practicum manually. The data from this practicum will be compared with the simulation data, then it will be concluded through a graph to see the differences and similarities clearly and in detail.

In this measurement, the first step to do is to prepare apples of the same mass of 0.25 kg and also prepare gadgets that have the Phyphox application installed. The next step is to determine the initial height at which the object will be dropped. Furthermore, storing the gadget on a surface close to the object at the time it is dropped (the gadget is already in the state of the phyphox system), then the object is dropped at a predetermined initial height, so that it will generate data on altitude, time, and energy in the experiment.

The practicum is not much different from the simulation using Elastic Collision but what distinguishes it from practicum is to determine the height of the ball and energy using mathematical analysis or manually with equations (1) to find the height of the ball and (2) to determine its energy (Fruleux et al., 2012).

$$h = \frac{1}{2}\, g\, (\frac{\Delta t}{2})^{\mathbf{2}} \quad \ldots\ldots\ldots\ldots (1)$$

That way, when the ball is dropped just by knowing the exact time the fruit touches the floor will be obtained the height of the fruit using the equation (1). If the height of the fruit is known, it can determine the kinetic energy at the height of the fruit by using equations (2) (Singh & Rosengrant, 2003).

$$\frac{E_2}{h_2} = \frac{E_1}{h_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

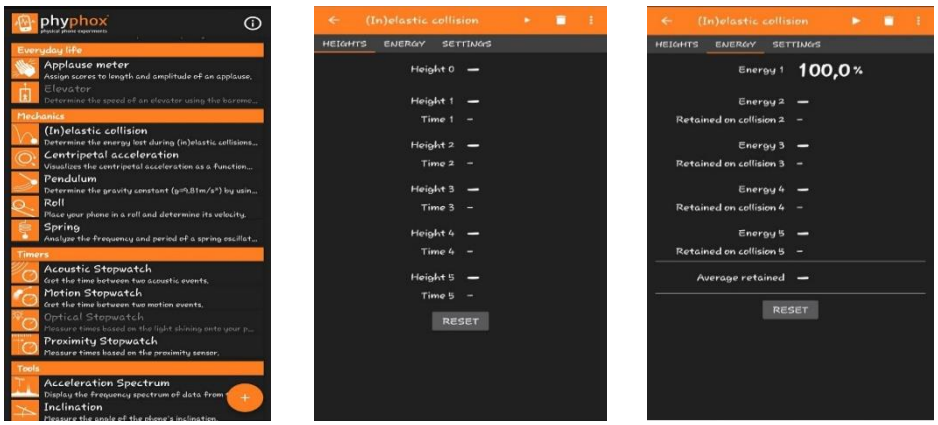

Figure 1. Application of phyphox on collision material.

RESULTS AND DISCUSSION

Impulse momentum material includes the submatery of impulse momentum relationships, changes in impulse momentum, the law of conservation of momentum, as well as collisions (Serway & Jewett, 2010).

Based on the results of practicum that has been done using

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 2 (2022) h. 156-165

phyphox application and practicum manually using stopwatch. Practicum conducted 3 tests using phyphox application with different fall media, namely boards, ceramic floors, and soil. The test result data is presented in tables 1,2, and 3.

Table 1. Use of board field phyphox application.

High (cm)	Energy (J)
100	-
1,69	100
1,73	249,5
1,29	185,9
0,75	107,8

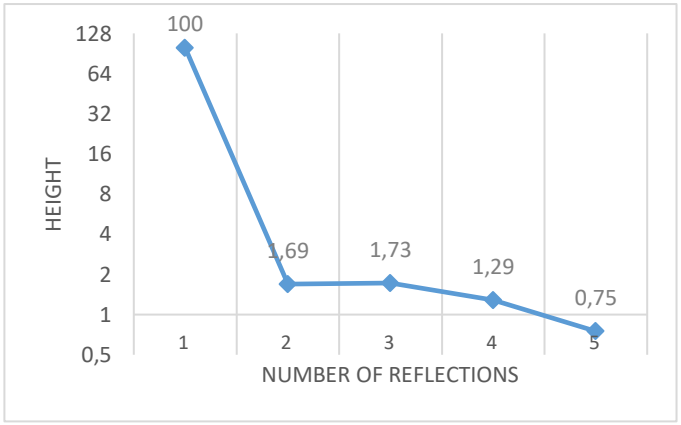

Figure 2. Collision graph using phyphox application of board plane

Tabel 2. The use of phyphox application of ceramic floor field.

High (cm)	Energy (J)
100	-
2,12	100
2,57	120,9
1,13	53,1
0,16	7,7

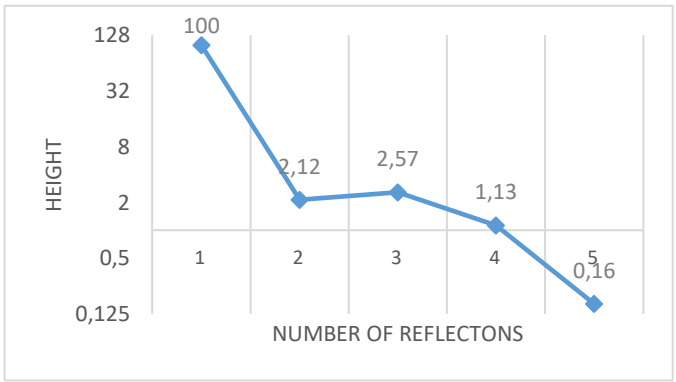

Figure 3**.** Collision graph using phyphox application of ceramic floor plane.

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 2 (2022) h. 156-165

Table 4. Use of soil field phyphox application

High(cm)	Energy (J)
100	-
2,33	100
2,31	99,4
0,14	5,9

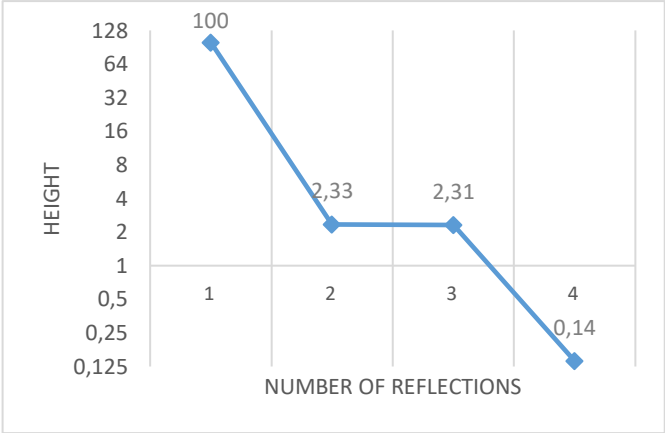

Figure 4. Collision graph using ground plane phyphox application.

The three experiments were shown data differences between the falling fields of the board, floor and ground. Of the three experiments the field of apple blasting boards produced larger than the field of ceramic and soil floors. While in the field of land banging occurs has a smaller value than the value of the bang on the field of boards and ceramic floors. This is because the ground has a rougher surface so that it has a large friction force and results in the ball bouncing no higher than the surface of the floor or board that has a slippery surface area.

Other factors that affect the magnitude of the resulting bang can also be influenced by several factors such as the distance of the gadget at the time the ball is dropped and the position of the apple when dropped. The distance of the gadget is influential because if the fruit is not close to the sound sensor it will affect the data results, because in the elastic collision experiment using the sound sensor contained in the gadget. While the position of the apple when dropped affects the reflection that will be produced because the shape of the apple is not perfectly round.

Table 5. Use a stopwatch on the board field.

High (cm)	Energy (J)
100	-
3,45	100
3,01	25,28
1,60	13,43
0,67	5,6

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 2 (2022) h. 156-165

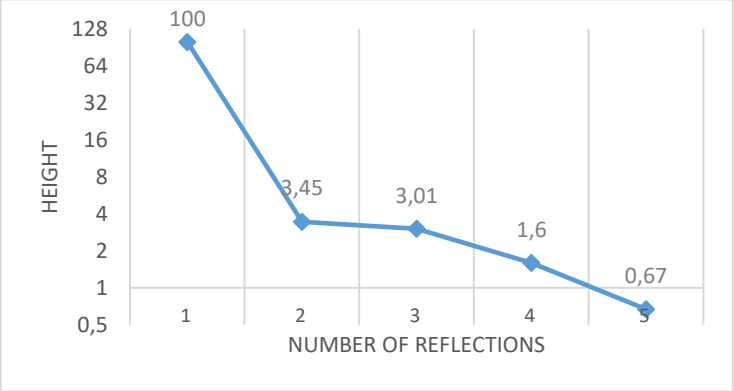

Figure 5. Collision graph using board plane Stopwatch

Practical activities and second observations to compare between using the application and not using applicadi ie by using Stopwatch. Collision testing was conducted using apples of the same weight and the same plane at the time of using the phyphox application. The results of practicum can be manually seen in tables 4, 5, and 6.

Table 5. Use the stopwatch on the board plane.

High (cm)	Energy (J)
100	-
3,17	100
1,73	17,21
1,17	11,63
0,94	9,34

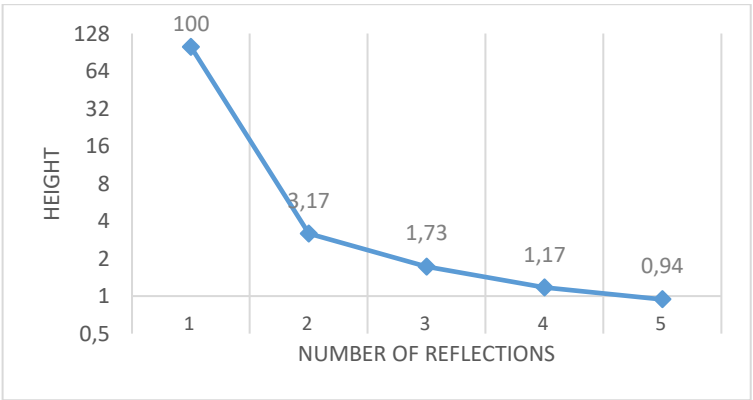

Figure 6. Collision graph using floor plane Stopwatch

Table 6. Use of a stopwatch on the ground.

High (cm)	Energy (J)
100	-
1,91	100
1,56	42,77
0,74	8,33

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 2 (2022) h. 156-165

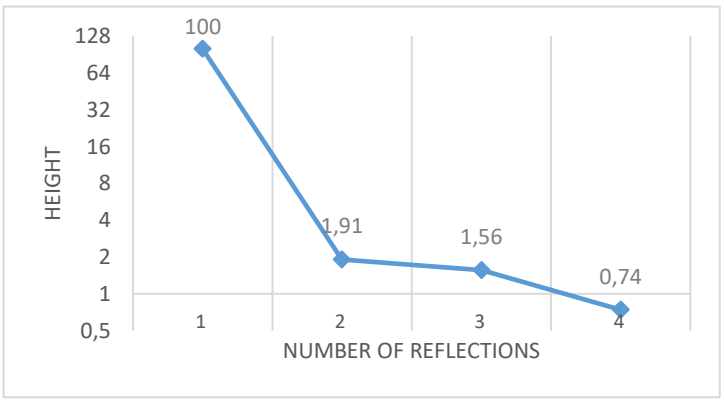

Figure 7. Collision graph using ground plane stopwatch.

The results obtained from the three experiments that have been conducted using stopwatches in various fall areas such as the fall fields of the board, floor and soil show that there is a slight difference in energy produced which is greater than using phyphox. These results are strongly influenced by the level of thoroughness of researchers in using stopwatches. The more thorough the use of the stopwatch, the value that will be obtained will not differ too much from the phyphox application.

Momentum and kinetic energy in a collision can be eternal if one ball has to move when one is movin the ball is released, two balls must move when two balls are released, and so on. If only one ball is released two balls can also move, but on the condition that both the balls are linked to each other. In this case when ball 1 is released ball 6, 7 that are mutual the associated can move simultaneously and ball 1 will bounce back after the occurrence collision (Ricardo & Lee, 2015).

The utilization of this Phyphox application can increase independence, motivation, and 21st-century skills for students. Students can practice on their own at home or school. This is according to Wahyuni (2020) which states that experiments with Phyphox are very practical so that teachers and students can carry it out in the classroom without the need for a laboratory. According to Saprudin (2019) who stated that the application of phyphox as an application of physics experiments is considered to solve problems in physics learning.

CONCLUSION

The results of three experiments in the field of apple energy boards produced were larger than ceramic and soil floors. While the field of land has the least energy value among other fields caused by a rougher surface so it has a large friction force. While the results of experiments using stopwatches showed that the energy produced has a slightly greater value than using phyphox. Researchers' level of rigor in using stopwatches and phyphox applications should be further improved to produce more accurate data, as well as more variation in the testing field to further generate varied data. phyphox can make it easier for students to practice independently.

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 2 (2022) h. 156-165

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Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 2 (2022) h. 156-165

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