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Use of Tracker Application on Kinetic Orbital Art (KOA) and Magic Gyroscope as Physics learning Media

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Abstract:
This article aims to explain the use of tracker applications on Kinetic Orbital Art (KOA) and magic gyroscope in physics learning. The analysis method uses descriptive analysis whereby the value of the earth's gravitational acceleration in the kinetic circular motion of orbital art and magic gyroscope assisted by a tracker application and the Microsoft Excel program will be compared to obtain a graph of the position relationship to time. From research conducted on the motion of KOA and magic gyroscope assisted tracker application obtained acceleration value is 9.44 m/s^2 and 9.56 m/s^2. The graph obtained from both objects is not referred to as parabolic motion, on the KOA chart resembles a parabolic motion while the motion of magic gyroscope is referred to as circular motion. Thus the use of tracker application on KOA and magic gyroscope can be recommended as a learning medium of Physics in schools.

Keywords: Tracker app, KOA, magic gyroscope.

Citation:

Introduction

Physics is one of the subjects that explains the phenomena that occur in the universe in the form of facts, concepts, principles and laws (Supardi et al, 2012). Therefore, physics learning in schools should emphasize more on the process of extracting concepts so as to provide attractiveness for students (Amaliah et al, 2020). In fact, physics learning in the classroom emphasizes more on formulas and theories than the handbook used. As a result, the basic ability of physics decreased drastically (Pinxten et al, 2017), students tended to memorize the concept of physics and had a low understanding of the concept of physics (Viajayani et al, 2013). This can be seen from the number of students who explain the concept of kinematics by mistakenly and the low average score of students during the exam (Taqwa & Pilendia, 2018). Students tend to experience misconceptions of kinematics concepts in circular motion and parabolic motion (Tarisalia et al, 2020). The misconception of learners on the concept of circular motion is that learners consider that all rotational motion must be circular (Mashood & Singh, 2012) when the sense of rotation is the movement of objects on a flat plane whose trajectory is circular (Tarisalia et al, 2020). While the misconception of learners on parabolic motion is that learners tend to find it difficult to understand why the speed on the y-axis at the top of a projectile (parabola) is zero, although the acceleration is not zero (Kamaluddin & Fihrin, 2016; Yuwono et al, 2014).

Related to that, physics learning activities will be more meaningful and interesting if done with experimental activities (Anissofira et al, 2017). Experimental activities can help learners understand the basic concepts of physics in real time (Chiriacescu, 2020). The use of technology in learning is an effort to make it easier for students to learn (Semerci & Aydin, 2018; Astra et al, 2015). The use of media in learning can arouse the desire and interest of learning, arouse motivation and stimulation of learning activities, and bring psychological influences to learners (Handhika, 2012). In addition, the use of media can stimulate students' attention, interest, thoughts, and feelings in teaching and learning activities to achieve learning goals (Daryanto, 2013). Thus educators need media that

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can help obtain more accurate data when conducting experiments (Subali et al, 2021).

One learning medium that helps learners understand the concept of kinematics to experiment is tracker (Subali et al, 2021; Hockicko, 2020). Tracker is an app created by Open Source Physics (OSP) using java (Wee et al, 2015). Tracker provides an alternative solution for the limited laboratory equipment in schools so that students no longer need to go to the laboratory, prepare, and operate a variety of practicum equipment that spends too much time (Prasetyo, 2012). Tracker displays real and representative physics symptoms, both in data and graph form (Sartika et al, 2019). By using the tracker application to experiment the parameters of the concept of kinematics will be more accurate (Prima et al, 2016) and the process of analyzing the data is done in an uncomplicated way because it can get the results of representation directly (Khairunnisa, 2019). Interpret from tracker app can review the relationship between position, speed, and time (Kinchin, 2012).

The use of tracker application is done by video analysis method on certain objects (Hockiko, 2015), two of which are Kinetic Orbital Art (KOA) and magic gyroscope. KOA is a table display that aims as decoration and education. Koa's working system is similar to the orbit of the Milky Way consisting of various planets that circle the sun as the center of the galaxy and move in three dimensions, like an orbit on a planet that does not only rotate one way. KOA has the principle of "kinetic sculptures" which is a combination of physics and art that allows the object to move (Witabora, 2014). While the magic gyroscope is a gasing that if rotated on top of the container then it will not stop spinning. Magic gyroscope can be used as a prop in learning, one of which is perpetual motion that can be used as a very interesting demonstration of science in front of the class. The advantage of magic gyroscope is that the gasing is able to continue spinning for a long time. This is due to the magnetic force that provides energy for the gasing to continue rotating, the magnetic field is generated from the copper coil that is flowed by the battery's electric current. Thus KOA and magic gyroscope can support physics learning.

Based on the above exposure tracker application can be used as a learning medium physics on the concept of kinematics. This article aims to explain the use of tracker application on KOA and magic gyroscope in physics learning.

Methode

The study used a direct experimental approach using trackers on KOA and magic gyroscopes. The measurement results with the tracker application is a comparison of the value of earth's gravitational acceleration in KOA and magic gyroscope assisted tracker application as well as graphs of positional relationship to time.

The experimental procedure is as follows, 1) Put KOA on a plain background, 2) Play and record the motion of KOA with the mobile phone camera, 3) Next use a tracker to analyze the data, 4) Repeat steps 1 to 3 using a magic gyroscope.

Analysis using tracker application is to first insert the video that has been recorded with the import menu, then the fan motion video in the frame set that is the initial and final frame that will be analyzed with the tracker. Next calibrated the stick by clicking the track menu >> new >> calibration tools >>calibration stick. Lastly determine the mass point of the object to be analyzed. The analysis method uses descriptive analysis which will be compared to the value of earth's gravitational acceleration in kinetic orbital art circular motion and magic gyroscope assisted tracker application with Microsoft Excel program to obtain a graph of positional relationship to time.

Result and Discussion

Motion kinematics in physics lessons discuss the magnitude of kinematics that affect the motion of objects, which includes trajectory, speed and acceleration (Wijayanto & Susilawati, 2015).

The tracker app uses video analysis that can help learners to shape conceptual thinking and at the same time eliminate misunderstandings to develop students' skills and intellectual abilities and improve learners' understanding (Hockicko et al, 2014; Hockicko et al, 2016). The appearance of KOA motion and magic gyroscope by using the tracker application is shown in Figure 1 and Figure 2.

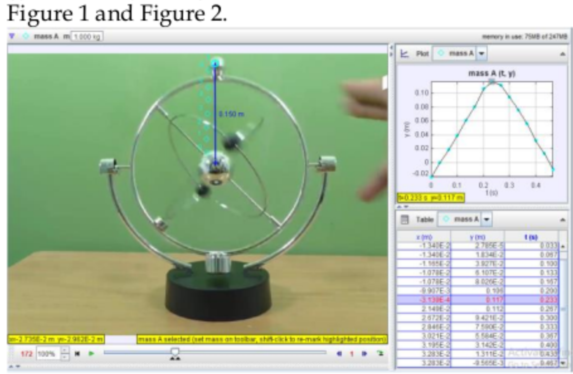

Figure 1. KOA Motion Display in Tracker App

Motion magic gyroscope inputted with tracker application shown in Figure 2 below.

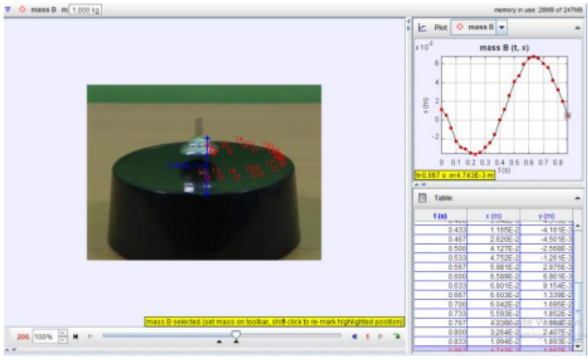

Figure 2. Motion Display Magic Gyroscope in Tracker App

The data analysis results using tracker application on KOA and magic gyroscope shown in Table 1.
Table 1.

Table 1. Data Analysis Results Using Tracker Application on KOA and magic gyroscope

No	Objek	t (s)	y (m)
1	**KOA**	0	-0.0209
2		0.033	2.79E-05
3		0.067	0.01834
4		0.1	0.03927
5		0.133	0.06107
6		0.167	0.08026
7		0.2	0.106
8		0.233	0.117
9		0.267	0.112
10		0.3	0.09421
11		0.333	0.0759
12		0.367	0.05584
13		0.4	0.03142
14		0.433	0.01311
15		0.467	-0.00957
16	***Magic Gyroscope***	0	0.02153
17		0.033	0.02258
18		0.067	0.02353
19		0.1	0.0226
20		0.133	0.02151
21		0.167	0.01832
22		0.2	0.01474
23		0.233	0.01249
24		0.267	0.00778
25		0.3	0.003012
26		0.333	0.001035
27		0.367	-0.00256
28		0.4	-0.00452
29		0.433	-0.00416
30		0.467	-0.0045
31		0.5	-0.00257
32		0.533	-0.00126
33		0.567	0.002975
34		0.6	0.006901
35		0.633	0.009154
36		0.667	0.01339
37		0.7	0.01695
38		0.733	0.01852
39		0.767	0.01984

Comparison of gravitational acceleration value on KOA circular motion and magic gyroscope obtained from tracker application in Table 2 below.

Table 2. Comparison of gravity acceleration values in KOA and magic gyroscope

g (m/s²)	
KOA	Magic Gyroscope
9,44	9,56

From Table 2, it is obtained that the value of koa gravitational acceleration and magic gyroscope respectively is 9.44 m/s^2 and 9.56 m/s^2. Thus the acceleration value approaching the value of gravitational acceleration is KOA and magic gyroscope as conveyed by Newton that the value of gravitational acceleration on earth is 9.8 m/s^2 (Tiplar, 2001). However, the value of gravitational acceleration in several different places may not be exactly equal to 9.8 m/s^2 (Tipler, 1998). The acceleration value performed by Chusni (2017) in Yogyakarta area with a single measurement method of 9,689 ± 0.009 m/s^2. Thus, the value of magic gyroscope acceleration conducted in Yogyakarta is equivalent to research conducted by Chusni (2017) compared to the acceleration value in KOA.

The graph of position relationship to time y=f (t) on KOA is shown in Figure 3.

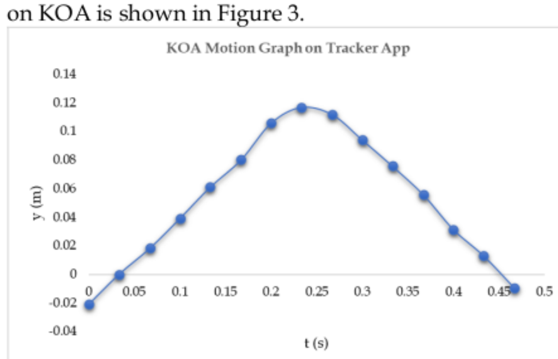

Figure 3. KOA Motion Graph Tracker App

The graph of position relationship to time y=f (t) on magic gyroscope is shown in Figure 4.

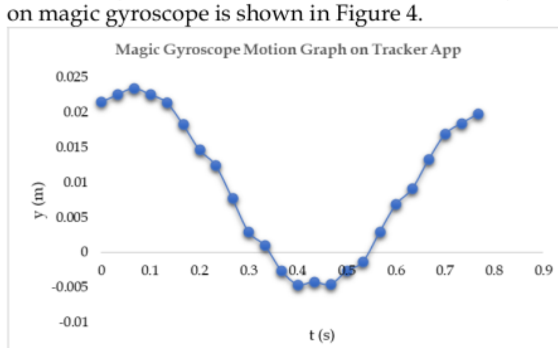

Figure 4. Magic Gyroscope Motion Graph Tracker App

Parabolic motion is a combination of regular straight motion (GLB) analyzed from the decomposition of the x-axis (horizontal) and irregularly changed straight motion (GLBB) that can be analyzed from the decomposition of the y-axis (vertical), in which the air-servant force is ignored, so it will be different from the reality (Halliday et al, 2010). From Figures 3 and 4 it appears that the image is not intended to be a parabolic motion and showing the position relationship to the time in KOA and magic gyroscope has a value that changes irregularly then the speed value changes in a regular manner. Figure 3 is almost similar to the motion of a parabola, but the motion of KOA when viewed carefully the trajectory is not parabolic but rather forms like a mountain and the speed value due to a change in position to time on the y axis of the peak of a projectile (parabola) is not zero, although the acceleration is not zero (Kamaluddin &Fihrin, 2016; Yuwono et al, 2014). Thus, the use of tracker application makes it easier for students to understand the concept of kinematics clearly either by using data in the form of tables or graphs. This is in agreement with the research conducted by Afifah et al (2015) which states that this Tracker application can be used as one of the alternative media used in physics learning. Figure 4 magic gyroscope motion has a perfect circular graph that is shown with the tracks on the chart that almost form a circle. Thus the magic gyroscope is a Regular Circular Motion (GMB) because when moving circularly has a fixed speed but the linear speed of objects that move in a circular irregularly always changes direction at all times. This is because the centripetal acceleration that has a direction perpendicular to the trajectory of objects that move circularly and always has a direction towards the center of the circle (Tarisalia et al, 2020).

The use of tracker application can help students conduct experiments independently by obtaining results in the form of garfik, table, and value (Subale et al, 2021). In addition, students quickly determine the acceleration value of the moving object. The use of trackers on KOA and magic gyroscopes can help train learners to understand the concept of kinematics both parabolic motion and circular motion. In the end the students will get results and conclusions. This is relevant to research conducted by Trocaru (2020) where the use of tracker applications by analyzing experimental videos motivates learners to learn and discover physical events in real life, this is shown by learners to be more active and responsive while studying. At the time of learning, experimenting with the help of Tracker, the average student has shown aspects that do not depend on others (Bernard, 2019).

Conclusion

From research conducted on the motion of KOA and magic gyroscope assisted tracker application obtained acceleration value is 9.44 m/s^2 and 9.56 m/s^2. The graph obtained from both objects is not referred to as parabolic motion, on the KOA chart resembles a parabolic motion while the motion of magic gyroscope is referred to as circular motion. Magic gyroscope is referred to gmb because when moving circular has a fixed speed but the linear speed of objects moving in a circular irregularly always changes direction at all times caused by centripetal acceleration. Thus the use of tracker application on KOA and magic gyroscope can be recommended as a learning medium of Physics in schools.

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References

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