

Improving Conceptual Understanding of Physics by Experiential Learning with The Aid of Apps

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Abstract: *Physics is always a challenging subject for students. One method used in improving the conceptual understanding of Physics by experiential learning with the aid of apps as a part of mobile learning. This paper will discuss the experience in CFS regarding the method use and the effect to the understanding of Physics. The researcher had developed two apps, one for calculating angular momentum and the other for calculating the frequency of sound in musical instruments. The effect of using experiential learning with the aid of apps is describe and elaborated. The researcher also carried out a survey on the student's experience using Likert scale of 1-5. From the response, 18% gave a score of 4 and 81% gave a score of 5. This indicates that most of them found that experience learning with the aid of apps really aids in their understanding of Physics concepts.*

Keywords: Experiential Learning, Apps, Physics Concepts, Mobile Learning

1. Introduction

Improving conceptual understanding of Physics has long been a huge concern in Science, Technology, Engineering and Math (STEM). (MacLeod, 2015) While traditional teaching approaches often emphasize on memorization, a growing body of research suggests that experiential learning, facilitated by educational technology, can significantly enhance students' grasp of physical principles. (Fromm et al., 2021)

One promising approach is the incorporation of real-world experiences into the physics curriculum. By engaging students in hands-on activities that demonstrate the real-world applications of physics concepts, this strategy provides an authentic, contextual framework for understanding foundational laws and theories. Furthermore, the engaging and interactive nature of this learning environment can foster heightened motivation and enthusiasm for the subject matter. (Becker et al., 2020)

The objective of the research is to find the effective way to teach Physics by using the experiential learning methods with the aid of apps developed to support the subject matter. The results suggest that the students like the method and they mentioned that they found the method engaging and beneficial to their understanding in Physics.

2. Literature Review

Alongside in-situ experiential learning opportunities, advances in educational technology offer additional avenues for enhancing conceptual physics understanding. Interactive simulations and remote-controlled experiments, delivered via mobile apps and web-based platforms, can provide distance-learning students with accessible, interactive experiences akin to those of their campus-based peers. By seamlessly integrating these digital tools into the learning process, instructors can guide students toward a deeper, more intuitive grasp of physical phenomena. (World et al., 2020) (Ferri et al., 2020)

Importantly, the efficacy of such approaches is contingent upon effective pedagogical strategies. As some studies have shown, simply providing students with hands-on experiences or technological resources is insufficient; instructors must also cultivate metacognitive skills. (Patwardharr et al., 2020) By thoughtfully integrating experiential learning activities and technological aids within a broader framework of socio-constructivist teaching, educators can harness the synergistic potential of these approaches to foster robust, meaningful physics understanding.

Ultimately, the judicious adoption of experiential learning and app-assisted instruction holds substantial promise for improving students' conceptual grasp of physics. By immersing learners in authentic, interactive environments that bridge theory and practice, educators can nurture a deeper, more enduring appreciation for the physical principles that govern our world. (Jo & Jo, 2020)

Physics is a branch of science that studies the behaviour of matter and energy, and how they interact with each other in the fields of mechanics, such as heat, light, electricity, sound, and so on. In a nutshell, it's basically the study of how everything works around us at its fundamental level, from simple things like kicking a soccer ball, heating up water, until to the interaction of atoms, space and time. (Ding et al., 2023)

The topic at hand here, is a running issue that a lot of students tend to consider physics to be a challenging subject in general. Filled with laden of concepts, principles, and mathematical formulae that can be very difficult to memorize, Physics can get absurdly tedious to learn, often leading to frustration and apprehension among learners, hampering their ability to engage deeply with the subject matter. (Schlesselman & Psych, 2020)(Aisyah Zulkifli et al., 2021)

Hence arises the question; does the problem root from the fact that physics is a subject of visualizing? Do students find it hard because they couldn't picture its theories and computations? Of course, Physics is a subject mostly comprising of calculation, but it can also be visualized, as it is a study of things around us. Hopefully with the approach that we have carve, it will create a more sustainable way to study Physics.

3. Methodology

The research starts with identifying the concept that we are going to teach in class. The researcher chooses two concepts for this research. One under the chapter of Rotational Physics in calculating the moment of inertia of a rotating object. Another one is under the chapter of wave, calculating the frequency of a tube from its length. The concept if first taught in the theory class. Next, we set up a suitable experiment to be conducted during class time or laboratory session so that the students can experience themselves the application of the Physics

concept. We are using PASCO 750 interface with sensor to conduct the experiment. The data can easily be displayed at the computer to have a fast visualization of the experiment that had been conducted.

The apps were develop using Power Apps form Microsoft. It is use because the apps are readily available with Microsoft package, and it can easily be share using Microsoft Team.

For the angular momentum, the formula used is as follows:

$$I = mr^2 \quad (1)$$

Where I is also known as moment of inertia, where m is the mass and r is the radius. The moment of inertia depends on the shape of the object as shown in FIGURE 1. Since the formula depends on the shape of the object, so it is convenience if we can have an apps to calculate it.

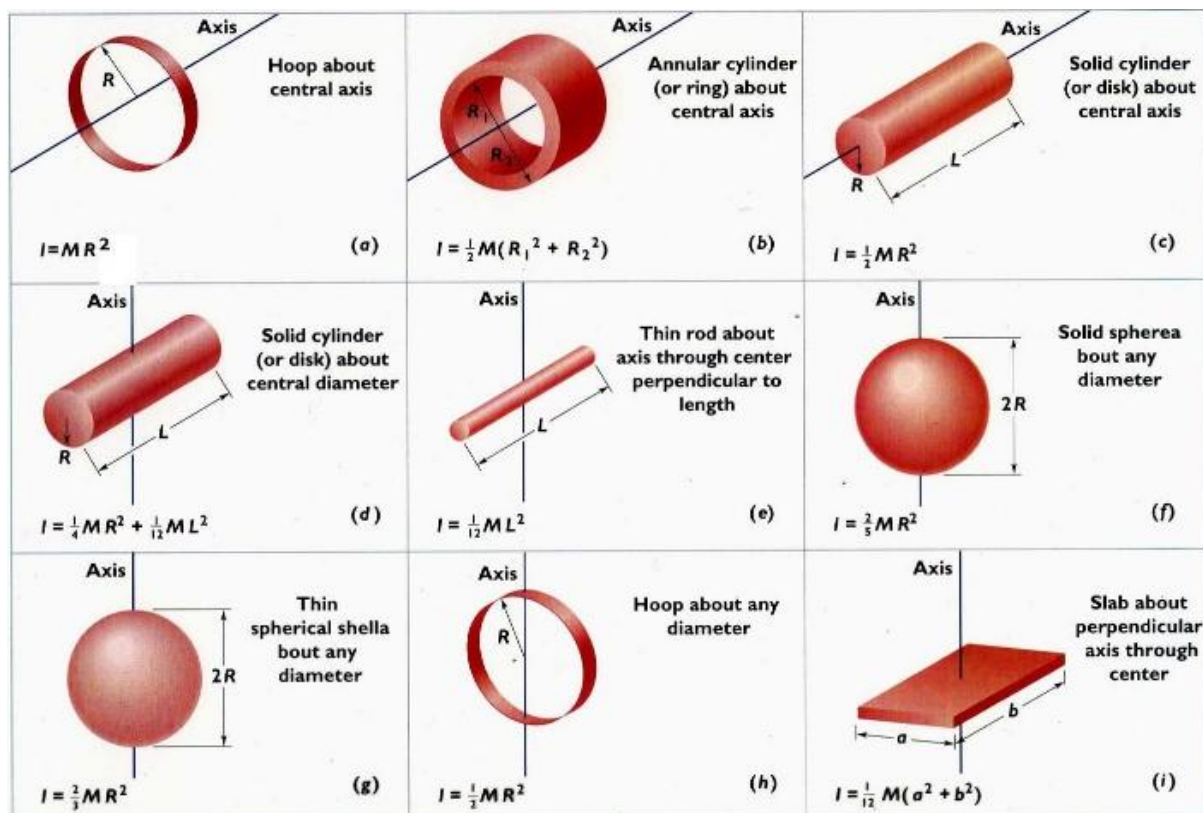


Figure 1: Student Conduction Angular Momentum Experiment in The Laboratory

For the wave in the tube, the frequency of the tube can be calculated using this formula

$$f = \left(\frac{v}{\lambda}\right) \quad (2)$$

The full formula is shown in Figure 2.

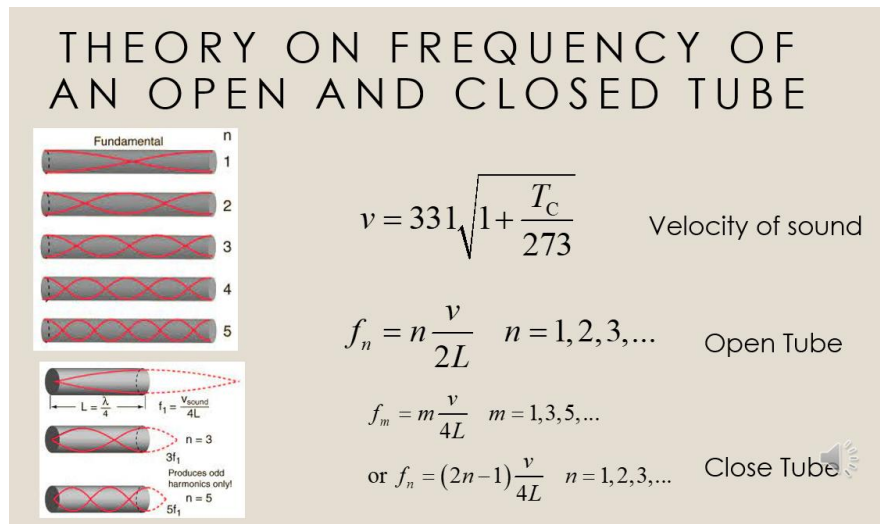


Figure 2: The full formula for calculating the frequency of the tune

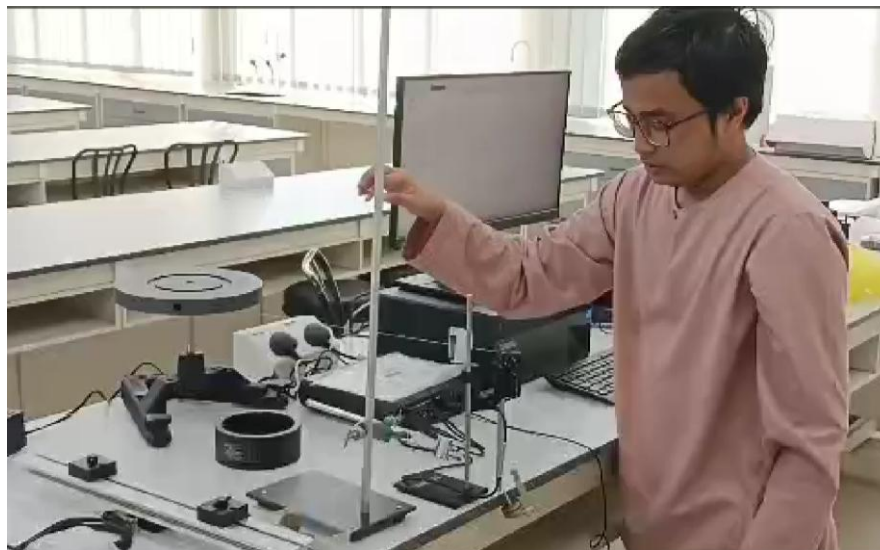


Figure 3: Student conduction angular momentum experiment in the laboratory



Figure 4: Lecturers demonstrating various frequency of tube experiment in the laboratory

The concept was demonstrated to the student and then the students are allowed to do the experiment with the help of the Apps. For data collection, Microsoft Form was chosen as platform to gather the feedback from the students. 100 response participated in the survey. The research model is shown in FIGURE 5 outlining the various steps in this research.

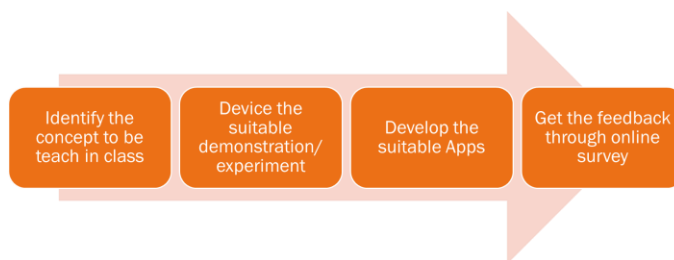


Figure 5: Research Model

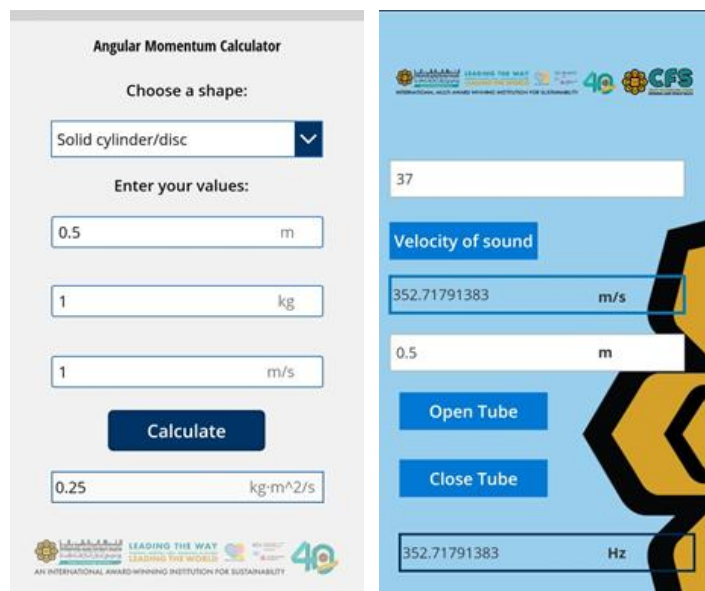


Figure 6: The apps developed.

4. Results and Discussions

The survey was given to the students after the experiential learning was completed. It consists of online form using a Likert scale of 1-5, 5 being the highest (most satisfy). 73.8% of the resonance is male and the rest is female as shown in FIGURE 7. A total of 107 students participated in the survey. SPSS version 25.0 was used to analyse the data.

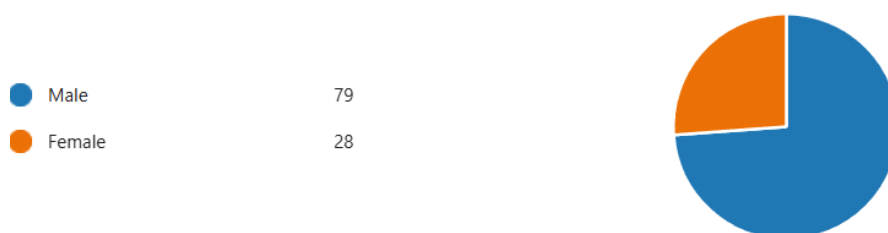


Figure 7: Gender ratio

Table 1: Descriptive statistics on the research.

	Descriptive Statistics											
	N Statistic	Range Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Error	Std. Deviation Statistic	Variance Statistic	Skewness Statistic	Std. Error	Kurtosis Statistic	Std. Error
Do the Physics Experiential Learning in the class improves your understanding in Physics?	100	1	4	5	4.82	.039	.386	.149	-1.691	.241	.878	.478
Do the Physics Apps improve your understanding in Physics?	99	3	2	5	4.65	.063	.628	.394	-2.090	.243	5.164	.481
Valid N (listwise)	99											

Table 1. shows the details analysis of the descriptive statistic of the survey. The students gave a mean score of 4.82 for experiential learning of Physics. The standard deviation of 0.386 and skewness of -.691, means that the graph is skewed to the right as shown in FIGURE 8. This indicates that the students really support the idea that experiential learning really helps them in understanding Physics.

Figure 9. shows the response of the students based on the apps used. They gave a mean score of 4.65, less than 0.2 from the previous one. The skewness is -2.090 again indicating the graph is skewed to the right. All these indicates that the student find that the apps really help the student in understanding Physics.

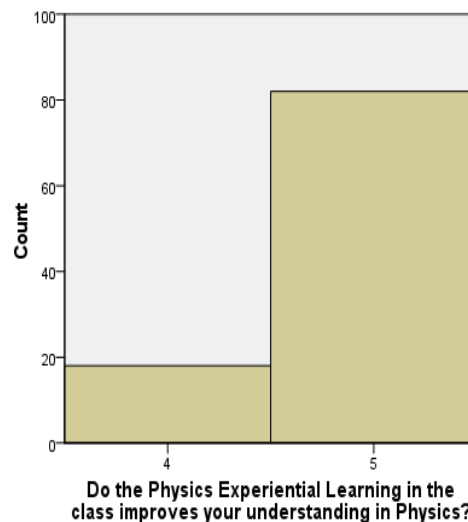


Figure 8: The response on Physics experiential learning in class improves in their understanding of Physics

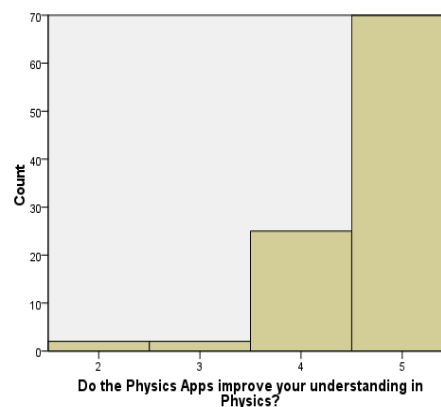


Figure 9: The response on improvement of understanding of Physics with the help of the apps.

5. Conclusion

In this work, the researcher presented the application of experiential learning as a tool in understanding Physics. The results also shows that the apps help the student to understand Physics. Since most students have handphone, the availability of apps is one easy method to help them. From the survey conducted, we can conclude that:

- Experiential study is one of the important methods in understanding Physics.
- The use of apps really helps the students to understand the physics applications.
- Mobile learning is the way forward especially with the advancement of Artificial Intelligence (AI).

Future works includes in extending the method in other subject and topics. The apps can also be integrated with Artificial Intelligence (AI) so that it will further assist the students in understanding Physics.

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