DEVELOPMENT OF A SMARTPHONE BASED-LEARNING MODULE ON HARMONIC OSCILLATORS AND USABILITY AMONG PHYSICS TEACHER TRAINEES AT SULTAN IDRIS EDUCATION UNIVERSITY (UPSI)

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ABSTRACT

The purpose of this study is to develop the smartphone based-learning module on the harmonic oscillators and identify the perception among physics teacher trainee at Universiti Pendidikan Sultan Idris. The research design is the developmental research using the ADDIE model. Fifty participants are used among Bachelor of Physics Education Students at UPSI using the purposive sampling technique. Usefulness, Satisfaction and Ease of Use (USE) questionnaire is used in this study to determine the usability and perception in the development and implementation of the module. Content validity index (CVI) from three experts is used to analyse the face validity and content validity. The descriptive analysis is used to analyse the usability of smartphone based-learning module on harmonic oscillators. The data were analyzed descriptively using Statistical Package for the Social Sciences (SPSS) software. The study findings of their mean values for usefulness, ease of use, ease of learning and satisfaction constructs respectively are 3.78, 3.72, 3.72 and 3.81. The results imply that the module is suitable to be implemented in university as it incorporating interactive simulations, real-time data displays, and hands-on activities enhances student engagement and facilitates deeper exploration of concepts compared to the traditional learning time. In conclusion, the research has developed a learning module based on the Mobile Learning approach for the topic of Harmonic Oscillation and can be effectively used by both students and educators to explore what other materials can be utilized as harmonic oscillators, aiding their understanding of the topic of harmonic oscillation.

Keywords: smartphone based-learning module, harmonic oscillator, usability

ABSTRAK

Tujuan kajian ini adalah untuk membangunkan modul pembelajaran berasaskan telefon pintar mengenai pengayun harmonik dan mengenal pasti persepsi dalam kalangan guru pelatih fizik di Universiti Pendidikan Sultan Idris. Reka bentuk kajian adalah penyelidikan pembangunan menggunakan model ADDIE. Seramai 50 peserta digunakan dalam kalangan Pelajar Sarjana Muda Pendidikan Fizik di UPSI menggunakan teknik persampelan bertujuan. Soal selidik Usefulness, Satisfaction and Ease of Use (USE) digunakan dalam kajian ini untuk menentukan kebolehgunaan dan persepsi dalam pembangunan dan pelaksanaan modul. Indeks kesahan kandungan (CVI) daripada tiga orang pakar digunakan untuk menganalisis kesahan muka dan kesahan kandungan. Analisis deskriptif digunakan untuk menganalisis kebolehgunaan modul pembelajaran berasaskan telefon pintar pada pengayun harmonik. Data dianalisis secara deskriptif menggunakan perisian Statistical Package for the Social Sciences (SPSS). Dapatan kajian nilai min bagi kebergunaan, kemudahan penggunaan, kemudahan pembelajaran dan konstruk kepuasan masing-masing ialah 3.78, 3.72, 3.72 dan 3.81. Hasilnya membayangkan bahawa modul itu sesuai untuk dilaksanakan di universiti kerana ia menggabungkan simulasi interaktif, paparan data masa nyata, dan aktiviti hands-on meningkatkan penglibatan pelajar dan memudahkan penerokaan konsep yang lebih mendalam berbanding dengan masa pembelajaran tradisional. Kesimpulannya, penyelidikan telah membangunkan modul pembelajaran berdasarkan pendekatan Pembelajaran Mudah Alih untuk topik Ayunan Harmonik dan boleh digunakan dengan berkesan oleh kedua-dua pelajar dan pendidik untuk meneroka bahan lain yang boleh digunakan sebagai pengayun harmonik, membantu pemahaman mereka tentang topik tersebut. ayunan harmonik.

Kata kunci: modul pembelajaran berasaskan telefon pintar, pengayun harmonik, kebolehgunaan

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LIST OF ABBREVIATIONS

SHM	Simple Harmonic Motion
SPSS	Statistical Package for the Social Sciences
CVI	Content Validity Index
I-CVI	Item Content Validity Index
S-CVI	Sum Content Validity Index
UPSI	Sultan Idris Education University
KMSw	Sarawak Matriculation College

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CHAPTER 1

INTRODUCTION

1.0 Introduction

When learning physics, students must understand the concepts, principles, and laws in order to explain them in their own words, suit to their maturity and intellectual level (Agusti, 2023). For instance, younger students might understand gravity through everyday experiences like observing an object fall, while older students could explore gravitational forces by studying the interactions between planets and stars.

Smartphone based-learning module can serve as one of the Physics educational tools. These modules often include features like interactive simulations, videos, quizzes, and other multimedia tools, which help simplify and enliven complex topics. For instance, an app may use a simulation to explain the principles of harmonic oscillation, showing how factors like mass and spring constant impact the movement. The learning process by using educational apps enable timely emotional exchange and communication between students and lecturers. Instantaneous doubt clarification is made possible by features like real-time feedback, messaging, and discussion forums, which also promote a positive learning atmosphere. Students' attention and enthusiasm can be sustained with this ongoing connection.

Besides, it enhances student’s engagement in learning harmonic oscillation and also to foster higher-order thinking skills in experimental projects in order to become a high quality young generations in education. Interactive applications on smartphone help students to have better visualization about abstract concepts and see their practical applications. For example, Students can apply theoretical knowledge in real-world situations by creating their own experiments, analyzing data, and drawing conclusions using apps. This kind of learning fosters students' capacity for creativity, critical thinking, and problem-solving.

In these modern days, the usage of smartphone can present either challenges or opportunities, particularly within the realm of education (Bani & Masruddin, 2021). An interactive and technology-enhanced learning approaches have proven to enhance the students engagement and understanding of complex scientific concepts like harmonic oscillation in physics education. Through the integration of smartphone based-learning modules, educators can exploit on the students familiarity with smartphone to enrich their learning experiences.

Nowadays, in physics education, many educators have started to focus on addressing challenges in teaching and learning fundamental concept of harmonic oscillation for the secondary students especially among foundation students. Harmonic oscillation is one of the application apply in simple harmonic motion. Simple harmonic motion (SHM) is a type of periodic movement that follows a sinusoidal pattern over time, where a force is directly related to the displacement (Tho, 2018). Harmonic oscillation refers to the deviations of equilibrium points under a stationary stochastic force, follow back and forth motion seen in many kinds of natural phenomena. The simplest example of oscillatory element is an object with mass hanging on a spring (Torcal & Francisco, 2023). Imagine, we have an object suspended from a fixed point by a string. When the object is pulled to one side and released, it is alternating backwards and forwards in a regular form. At the same time as it swings, it moves through its equilibrium position which is the midpoint and reaching its maximum displacement on each side before return back towards other opposite direction. The motion of the pendulum fulfill the sinusoidal law pattern.

However, students might find studying harmonic oscillations physically in class is challenging due to the abstract nature of the phenomena and the difficulty in visualizing the motion. Students in today's world are expecting variety of interactive mediums in education (Wong et al., 2023). Many studies have proven that by using demonstration on the smartphones and applications, students tend to more actively engage in the learning process (Khasawneh et al., 2023) In this case, smartphone applications in physics education can enhance learning about harmonic oscillation by providing interactive simulations and visualizations, enabling hands-on exploration of parameters for the students better understanding.

1.1 Rationale of the study

Undertaking research on the creation and effectiveness of a smartphone based-learning module on harmonic oscillators is essential for various reasons. Mobile technology-powered education supports the development of smartphone based-learning modules that improve their understanding about complex topics such as harmonic oscillators in a flexible and accessible manner. Nowadays, mobile technology has become more useful and convenient as it can be conducted everywhere compared to the traditional learning (Zhou, 2023). Furthermore, understanding the usability of smartphone-based learning modules is essential for optimizing their effectiveness in educational settings. Thus, this study examines the

potential of smartphone as a technological device in university to aid teaching-learning-evaluation processes. Using smartphones when teaching and learning, the focus is on how the students knowledge is acquired and applied. of the smartphone in the academic environment (Salcines et al., 2020). Hence, this study contributes to the ongoing efforts to harness technology for more diversing, accessible, and effective learning experiences especially in the university.

1.2 Problem Statements

Materials such as springs and pendulums involve complicated ideas about motion and energy. Understanding harmonic oscillators can be tough for students (Hauko et al., 2018). In traditional teaching, lecturer will only explain all of the concepts verbally and equations. However, students might not fully get it without seeing it in action (Syuhendri, 2022). Besides, conducting experiments with harmonic oscillators in university labs can be difficult due to limited apparatus and time. So, students struggle to understand how harmonic oscillators work and how they could relate to this matter in other physics ideas.

Lack of teaching aids for harmonic oscillation in university has also become one of the barriers for lecturers to teach. Students find it difficult to visualize the real-world situation of oscillation. Therefore, teaching aids using apps can make

learning about harmonic oscillators much easier for students (Bani & Masruddin, 2021). These applications can show simulations and animations that explain how harmonic oscillators behave in different situations. Students will be able to explore concepts about harmonic oscillators in a fun and an interactive way. Using educational apps for mobile learning allows learners to efficiently complete personalized, fragmented learning processes, significantly enhancing their higher-order thinking skills (Zhang & Zhang, 2023). Applications such as Quizzes and exercises can be included to test the student's knowledge level. By using these applications, lecturers are able to assist students understand harmonic oscillators better and make the learning process to become more engaging which sets them up for success in physics and beyond.

Student's motivation and attitude towards learning, especially in terms of education awareness, involve multiple factors that affect the way students could interact with educational content, overcome obstacles, and achieve academic success, especially in learning harmonic oscillation as it considered one the most important part. The abrupt change in the traditional format of education has led to difficulties in motivating students to acquire new knowledge (Costa et al., 2018). Lecturers highly wanting their students to do assignments without providing a proper educational material to help them understand better (Qodr et al., 2021). Students' attitudes towards a subject can significantly impact their performance, leading to either high or low achievement (Assem et al., 2023).Smartphone technology has inevitably changed every individual's behaviours with its variety of features. As apps on the smartphones

offer interactive learning, these tools are able to make students more collaborative and interested in learning harmonic oscillations.

As a conclusion, the advent of a smartphone based-learning module has the potential to revolutionize teaching and learning methods. Harmonic oscillation play a huge part in physics education. Students and lecturers can easily collaborate and communicate also interact as smartphone promote features like discussion forums and knowledge sharing especially for the harmonic oscillators topic

1.3 Research Objectives:

i. To develop the smartphone based-learning module on the harmonic oscillators among Physics teacher trainees .

ii. To identify the students perception in the development and usability implementation of the smartphone based-learning modules on harmonic oscillators.

1.4 Research Question

i. How can a smartphone based-learning module be developed to effectively enhance the understanding of harmonic oscillators among Physics teacher trainees ?

ii.What are the students perception in the development and usability implementation of a smartphone-based learning module on harmonic oscillators?

1.5 Research scope

This study seeks to develop and assess the usability of a smartphone based-learning module on harmonic oscillators among Physics teacher trainees at Sultan Idris Education University (UPSI).

1.6 Research Significance

This study hopes to make the following contributions :

i. Improve Physics learning : By developing a smartphone based-learning module on harmonic oscillators among Physics teacher trainees at UPSI as it offers an immersive and interactive platform for grasping intricate scientific principles for the students.

ii. Teaching aids : Lecturers are allowed to create a customized learning module of harmonic oscillators that aligns with curriculum requirements and learning preferences of university students.

iii. Promoting technology advancements: By developing smartphone as educational tools, it encourages student's motivation and develop skills using digital resources as their medium to learn more about harmonic oscillators and offer accessibility to educational materials.

1.7 Theoretical framework

The ADDIE model has been chosen for developing and assessing the usability of a smartphone based-learning module on harmonic oscillators.The ADDIE model implements educational tools and other learning resources, including multimedia technology (Gamal, 2023). The ADDIE model follow needs of students with its 5 stages which are analysis, design, develop, implement, and evaluation as equipped with revision activities first (Martatiyana et al., 2023).

Meanwhile, the main learning theory used in this research is Constructivism. Constructivism learning theory exhibits, instructional design and technology

integration. The constructivist theory state that knowledge is created through experiences, no matter whether it is in a virtual environment with the help of technology (Yakar et al., 2020). Constructivism learning theory can make sure students to understand the concepts of harmonic oscillators when they participate with the learning material in hands-on activities.

1.8 Conceptual framework

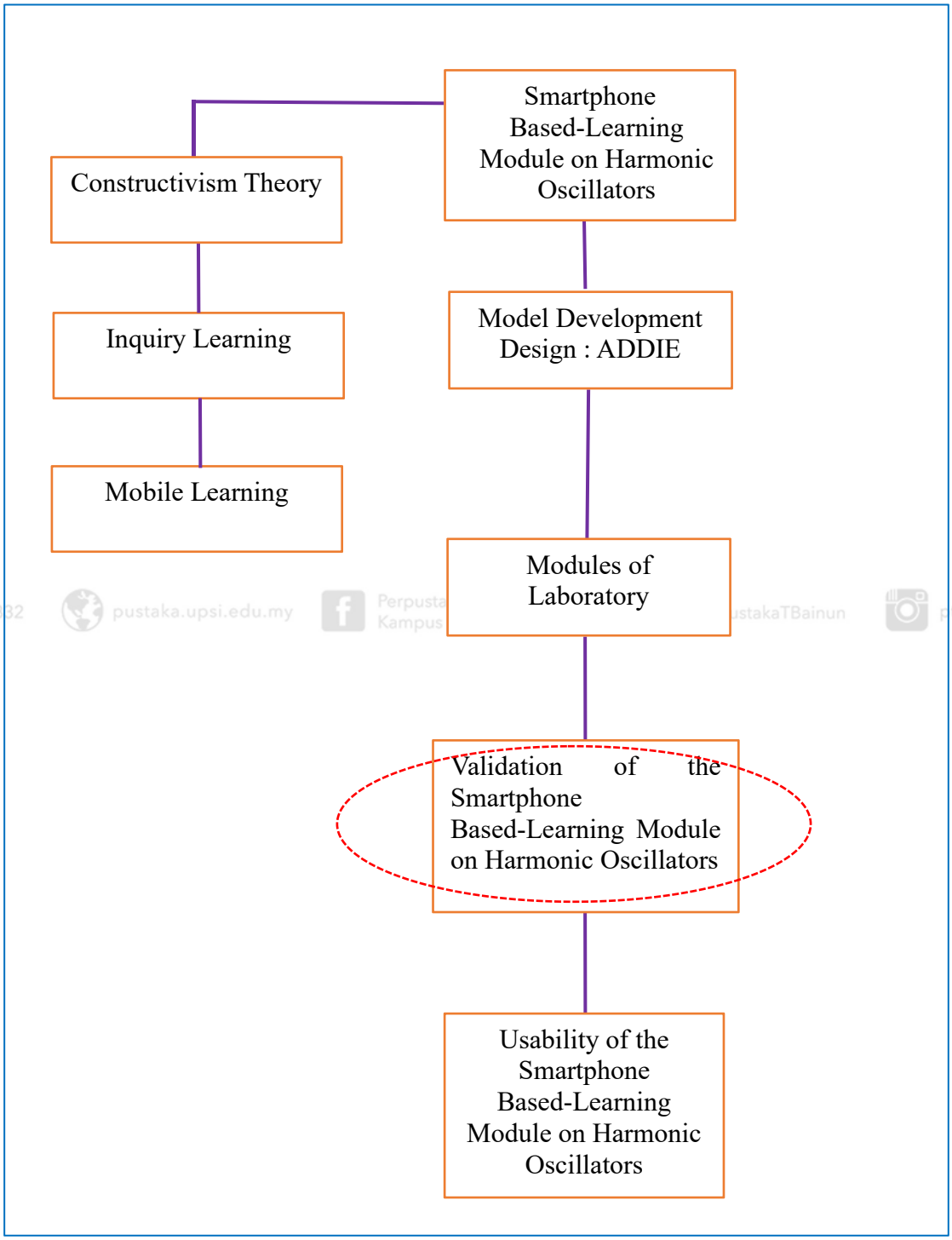

FIGURE 1 : Smartphone Based Learning Module on Harmonic Oscillators

Conceptual Framework

1.9 Operational Definitions

The operational definitions used in this research are as follows :

i. Development

Development is defined as creating modules, developing software, or constructing models (Ghazali & Sufean, 2016). In this study, the researcher created a smartphone based-learning module on harmonic oscillators for Physics students.

ii. Usability

Usability mean achieving goals efficiently within specific contexts in which emphasize ease of use and efficiency (Pirie, 2023). In this study, the usability of this module can be assessed using an evaluation form validated by three designated experts module and questionnaire distributed to the study participants.

iii. Perception

Perception involves the interpretation and understanding of information to form experiences about objects, events, or their relationships (Amalia, 2018). In this study, the perception to be examined is the user motivation. User motivation perception is assessed through a questionnaire item on motivation perception distributed to the study participants.

1.10 Limitations

Among the limitations presents in this study of smartphone based-learning module on harmonic oscillators are disparity in student access to smartphones and the variability in device capabilities. Moreover, each smartphone has different software performance, which can lead to unequal learning experiences among students. Next, the small screens and limited processing capabilities of smartphones can affect the interactive and visual components essential for understanding the concept of harmonic oscillators. Other than that, prolonged screen time may lead to eye strain and diminished attention spans, which can undermine the effectiveness of the learning module. These limitations give challenges to both students and lecturers on the implementation of smartphone based-learning module.

1.11 Delimitations

This study is limited to the topic of SHM which is focusing more on harmonic oscillation in Physics subject. This is done to reinforce students understanding about the concept of harmonic oscillation in that chapter. One of the delimitation concerns is the geographical location. Researchers might concentrate on universities in a specific region or district to streamline data collection and guarantee uniformity in educational standards. Delimitations may also pertain to the particular aspects of harmonic oscillations using smartphone applications under investigation among foundation

students. For instance, the study may focus on specific types of harmonic oscillators, such as simple pendulums or mass-spring systems while excluding more intricate systems to ensure clarity and focus (Brown & Smith, 2018). The researcher might plan to restrict the study to specific learning objectives related to the harmonic oscillations. By establishing this limitation it can help to make sure that the study stays manageable, feasible, and adequately addresses the research questions.

1.12 Conclusion

Overall, the details of this research implementation have been discussed starting from the research background, research problem, research objectives and questions, research theoretical and conceptual framework, limitations and delimitations, scope and the significance of the study, methods also the operational term definitions used in the development of a smartphone based-learning module on harmonic oscillators.