THE DEVELOPMENT AND USABILITY OF WEB-BASED   LEARNING "HEATMINDS" FOR HEAT TOPICS AMONG PHYSICS STUDENTS IN PUCHONG

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SULTAN IDRIS EDUCATION UNIVERSITY

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DECLARATION OF ORIGINAL WORK

I, Visalliny A/P Muneesesparan, bearing student ID number D20202096492 and enrolled in the Faculty of Science and Mathematics, solemnly affirm that the thesis submitted for the completion of my Bachelor of Education in Physics with Honors, entitled "The Development and Usability of Web-Based Learning 'Heatminds' for Heat Topics Among Physics Students in Puchong" is an original piece of work. It has not been plagiarized from any other scholar's work or any other relevant copyrighted sources. I have taken great care to ensure that all citations, quotations, excerpts, and references from copyrighted works have been properly attributed and cited in accordance with academic and ethical standards.

Date: 24 June 2024

(VISALLINY A/P MUNEESESPARAN)

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ABSTRACT

This study aims to design and develop an educational website "HeatMinds" for the topic of heat and determine its usability among Form 4 physics students in Puchong. This developmental research design study was developed based on the ADDIE instructional design model. HeatMinds was validated through Face and Content validity by three experts. The research sample was chosen through cluster random sampling where one class was chosen. This research is categorised under the quantitative method with qualitative data since a questionnaire and interview were carried out to determine HeatMinds' validity. Moreover, the Technology Acceptance Model (TAM) was adapted as an instrument to determine the acceptance of HeatMinds through the survey. Then, the data was analysed using descriptive statistics of mean and standard deviation. The data from three experts showed that HeatMinds had a good face and content validity of 96.7% and 89.4%. Heatminds has received a high level of approval for perceived usefulness for mean and website attitudes for the lowest standard deviation of 0.50 among all four constructs. The Mann-Whitney U test value of 27.5 (p = .022) shows that the null hypothesis is not accepted because p < .05. This means there is a gender significant among male and female students. In conclusion, teachers should go through training to create their website and apply hybrid teaching methods in their teaching and learning process via the help of HeatMinds. Hence, HeatMinds proves to be a useful educational website that greatly benefits students by leveraging technology.

ABSTRAK

Kajian ini bertujuan untuk mereka bentuk dan membangunkan laman web pendidikan *"HeatMinds"* bagi topik haba dan menentukan kebolehgunaannya dalam kalangan pelajar fizik Tingkatan 4 di Puchong. Kajian reka bentuk penyelidikan ini dibangunkan berdasarkan model reka bentuk pengajaran ADDIE. Selepas itu, *HeatMinds* telah disahkan oleh tiga pakar melalui kesahan muka dan kesahan kandungan. Seterusnya, sampel kajian dipilih melalui persampelan rawak berkelompok (Kluster) di mana satu kelas telah dipilih. Penyelidikan ini dikategorikan di bawah kaedah kuantitatif dengan data kualitatif kerana soal selidik dan temu bual telah dikemukakan untuk menentukan kebolehgunaan *HeatMinds*. Selain itu, soal selidik Model Penerimaan Teknologi (TAM) telah adaptasi sebagai instrumen kajian untuk menentukan penerimaan *HeatMinds* melalui tinjauan. Kemudian, data dianalisis menggunakan statistik deskriptif melalui min dan sisihan piawai dan statistic inferensi melalui ujian *Mann-Whitney U*. Data daripada tiga orang pakar menunjukkan bahawa *HeatMinds* mempunyai kesahan muka dan kesahan kandungan yang baik iaitu 96.7% dan 89.4%. Selain itu*, Heatminds* telah menerima tahap kelulusan yang tinggi bagi *perceived usefulness* dan *website attitude* untuk min iaitu 3.45 manaka sisihan piawai terendah ialah 0.50 daripada keempat-empat konstruk tersebut. Nilai ujian Mann-Whitney U sebanyak 27.5 (p = .022) menunjukkan hipotesis nol tidak diterima kerana p <.05. Kesimpulannya, dari segi implikasi, guru harus melatih diri mereka untuk belajar mencipta laman web masing-masing dan harus mengaplikasikan kaedah pengajaran hibrid dalam proses pengajaran dan pembelajaran mereka dengan bantuan *HeatMinds*. Bukan itu sahaja, pelajar juga boleh mengambil inisiatif untuk membangungkan laman web sendiri agar dapat memenuhi keperluan student masing-masing. Oleh itu, *HeatMinds* terbukti sebagai laman web pendidikan yang berguna dan ia memberikan manfaat besar kepada pelajar.

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LIST OF ABBREVIATIONS

HOTS	High Order Thinking Skills
OER	Open Educational Resources
SPM	Sijil Pelajaran Malaysia
ADDIE	Analyse, Design, Develop, Implement, Evaluate
TAM	Technology Acceptance Model
WBL	Web-based learning
PhET	Physics Education Technology
PU	Perceived Usefulness
PEU	Perceived Ease of Use
BI	Behavioural Intention
WA	Website Attitudes
eRAS	Educational Research Application System
WBLRs	Web-Based Learning Resources
SMDM	Sidek Module Development Model
SUS	System Usability Scale
DSKP	Dokumen Standard Kurikulum dan Prestasi
JPN	Jabatan Pendidikan Negeri

CHAPTER 1

INTRODUCTION

1.1 Research Background

Websites became a comprehensive platform for managing and delivering educational content for teachers and students. It helps teachers to keep track of their student's progress and works as an educational platform to educate their students regarding any topic. However, there are very few websites for the topic heat. Teachers often find delivering information difficult for students as they prefer engaging learning materials. Hence, websites function as engaging material to provide essential resources that students need. Here, teachers get to adopt a facilitator role as the current generation widely recognises educators as facilitators, companions, or mentors in developing skills and knowledge (Hadar & Brody, 2021; Irfansyah et al., 2023). The Public Malaysian Certificate of Education, SPM (*Sijil Pelajaran Malaysia*), several topics are chosen for the Higher-Order Thinking Skills (HOTS) question. Form 4 and Form 5 students in Malaysia must answer questions from the topic (Kementerian Pendidikan Malaysia (KPM), 2019).

Proper learning sources are needed to promote critical thinking and problem-solving skills among students to answer HOTS questions. Although this website can't

completely master students' skills it can help them answer similar HOTS questions to enhance their skills. The digitalised education system lacks standardisation of resources online. The traditional educational system had learning materials that were copyrighted in libraries in the form of digital and printed. However, the sudden shift in the educational system puts teachers and students in tough spots as they must rely on unreliable blogs and websites (Idrus et al., 2021). Hence, this research aims to develop an educational website that can guide students and teachers to understand and enhance their knowledge of heat topics.

1.2 Rationale of the Study

The rationale of this study is to address the limitations of traditional classrooms and increase students' interest and motivation in studying physics. The implementation of e-learning during the COVID-19 pandemic has shown that students prefer face-to-face teaching methods as they can't adapt to the new norm of e-learning. Students are unable to grasp the flexibility or comfort the online education carries since it presents challenges like distractions and technical issues. Moreover, studies have shown that students have positive perceptions of online learning as it promotes satisfaction, interaction, and individual features of online learning (Sulaiman, 2013). The use of web-enhanced course media in a hybrid learning model has also increased student motivation and interest in physics (Yani & Dahlan, 2021). Hence, this study aims to develop and determine the usability of web-based learning "HeatMinds" for the subtopic heat from the Form 4 Physics syllabus. This website has focused on Form 4 and Form 5 students' ability to learn efficiently through online platforms in Malaysia.

1.3 Problem Statements

Self-learning systems are often affected by limited valid Internet resources for educational purposes (ReSkills, 2022). Even in the current digitalized generation, there

is still a lack of learning platforms (Idrus et al., 2021; Woo & Reeves, 2007). This is due to the e-learning system in developing countries not being entirely or even partially adopted and its utilization has not been completed. Hence, current existing educational websites are considered less satisfactory and acceptance level. However, a little improvement can cause a huge change in web-based learning as it's accepted and used by both students and teachers (Cook, 2007). In addition, as heat topics need further understanding detailed learning materials are needed at the moment. During my practicum, I faced struggles in embedding the heat topics knowledge visually in learning materials as they were lack of resources. Hence, a new initiative is needed to create more learning materials under the heat topics.

Besides that, Current educational platforms are below satisfactory. The creation of an educational platform is intended to overcome the shortcomings of existing platforms as research suggests that it has only partially met student's needs (Liu et al., 2020, Wong, 2023). Moodle, Open edX, and NEO LMS are famous online learning platforms recognised for their benefits like unrestricted access, affordable education prices, and flexible learning (Liu et al., 2020; Lin & Yeh, 2022). However, general search experience in numerous Open Educational Resources (OER) repositories is disappointing as it's below satisfactory (de Oliveira et al., 2018). Students are normally required to browse many websites, YouTube pages, or notes to understand selected topics. Thus, having all educational resources including notes, slides, and worksheets in one place allows students to develop a further understanding of this chapter with less effort.

By having access to this website teachers can also use it as a learning material and reinforce their understanding of this topic for an effective teaching experience. Since students have a high ability and comfort to use computers and mobile devices this approach was more conventional as the education system must adapt to meet the current generation's demands (Ally & Prieto-Blzquez, 2014; Basar et al., 2021). This study aims to develop a web-based learning "HeatMinds" for heat topics to enhance students' academic performance.

1.4 Research Purpose

The study aims to develop and determine the usability of the "HeatMinds" website via web-based learning material that focuses on heat topics to enhance and simplify the learning process for physics subjects by using the Wix website in Puchong, Malaysia.

1.5 Research Objectives

1. To design and develop the "HeatMinds" website that promotes online learning for the heat topic.
2. To determine the usability of the "HeatMinds" website via a web-based learning system in facilitating learning among students in Puchong.
3. To determine the gender difference in learning and teaching among students via "HeatMinds".

1.6 Research Questions

1. Is the "HeatMinds" website that promotes online learning for the heat topic valid?
2. What is the usability level of the "HeatMinds" website via a web-based learning system in facilitating learning among students in Puchong?
3. Is there any gender difference in learning and teaching via "Heatminds" website?

1.7 Research Hypothesis

1. There is no significant difference of usability level between male and female students was found after using the HeatMinds website.

1.8 Research Scope and Significance

The research scope focuses on the learning and teaching methods among secondary school students in physics education. This study involves designing and developing an educational website for physics educational purposes in Malaysia on the topic of heat. This website was developed by using the Wix website platform and it's known as "HeatMinds". Wix was chosen because the platform is user-friendly, and it mostly has all the free features compared to other websites. The Wix platform is extremely useful as well as cheap as it doesn't require any membership subscriptions. This website benefits students, teachers, and the Ministry of Education.

1.8.1 Students

This website aims to serve as a proper educational space for secondary school students by providing important learning materials such as notes, videos, and worksheets to improve student's understanding. Students found this website useful as it allows them to access educational materials flexibly with the help of an internet connection since it was developed by using the Wix website. As the pandemic forced students to adapt to online learning, students found it more convenient to use websites as a tool to enrich their knowledge. Additionally, web-based learning improves students' independence, and problem-solving skills and serves as a motivation in learning activities (Aryani, 2019; Sina et al., 2023).

1.8.2 Teachers

The benefit of HeatMinds isn't limited to only students but also to teachers. This website helps teachers work as facilitators to provide knowledge to students. As it serves as a platform for teachers to convey material and interact with students, teachers get to enhance students' motivation and involvement in learning activities. This is because they get to give their feedback on their work in the following classes. They can get a bigger picture of students liking and can use this technique for another topic. Overall, this website is an eye-opener for teachers to understand student's learning standards at their own pace. HeatMinds also works as a tool to enhance the learning experience and facilitate effective teaching methods with their students.

1.8.3 Ministry of Education (MoE)

The Ministry of Education (MoE) may find this website useful as it covers the topic from the Public Malaysian Certificate of Education, SPM (*Sijil Pelajaran Malaysia*). Students were able to relate to the given materials and teachers found it easier to guide their students to enrich their knowledge. HeatMinds can promote further usages of web-based learning and it can allow the education system to be aligned with modern trends. This website was one of the useful developments and practical approaches to improving our education system via the usage of technology.

1.9 Theoretical frameworks

This website focuses on students' interests in study and emphasises the need to build a strong foundation in terms of gaining knowledge. Hence, a robust approach is needed to develop an educational website. Constructivist learning theory, E-learning theory, web-based learning, and mobile learning play a vital role in the development of this

website. Constructivist learning theory focuses on allowing individuals to progress on their own by having teachers as their instructors (Kong & Song, 2013; Wu et al., 2022). It works solely as a student-centered learning method but it encourages peer interaction and collaboration. Moreover, the website can also be used as a learning material in face-to-face classes. Hence, it further promotes a blended learning approach in upcoming generations. HeatMinds consists of quizzes, simulations, exercises, and games that allow students to explore heat concepts on various devices with the help of an internet connection. Students are recommended to work independently and explore the website in their phase. No time limit is fixed on this learning method. Furthermore, the website allows learners to exchange their ideas and knowledge with peers. Thus, these four theories allow HeatMinds to leverage technology engagingly and effectively to empower learners to expand their knowledge on heat topics.
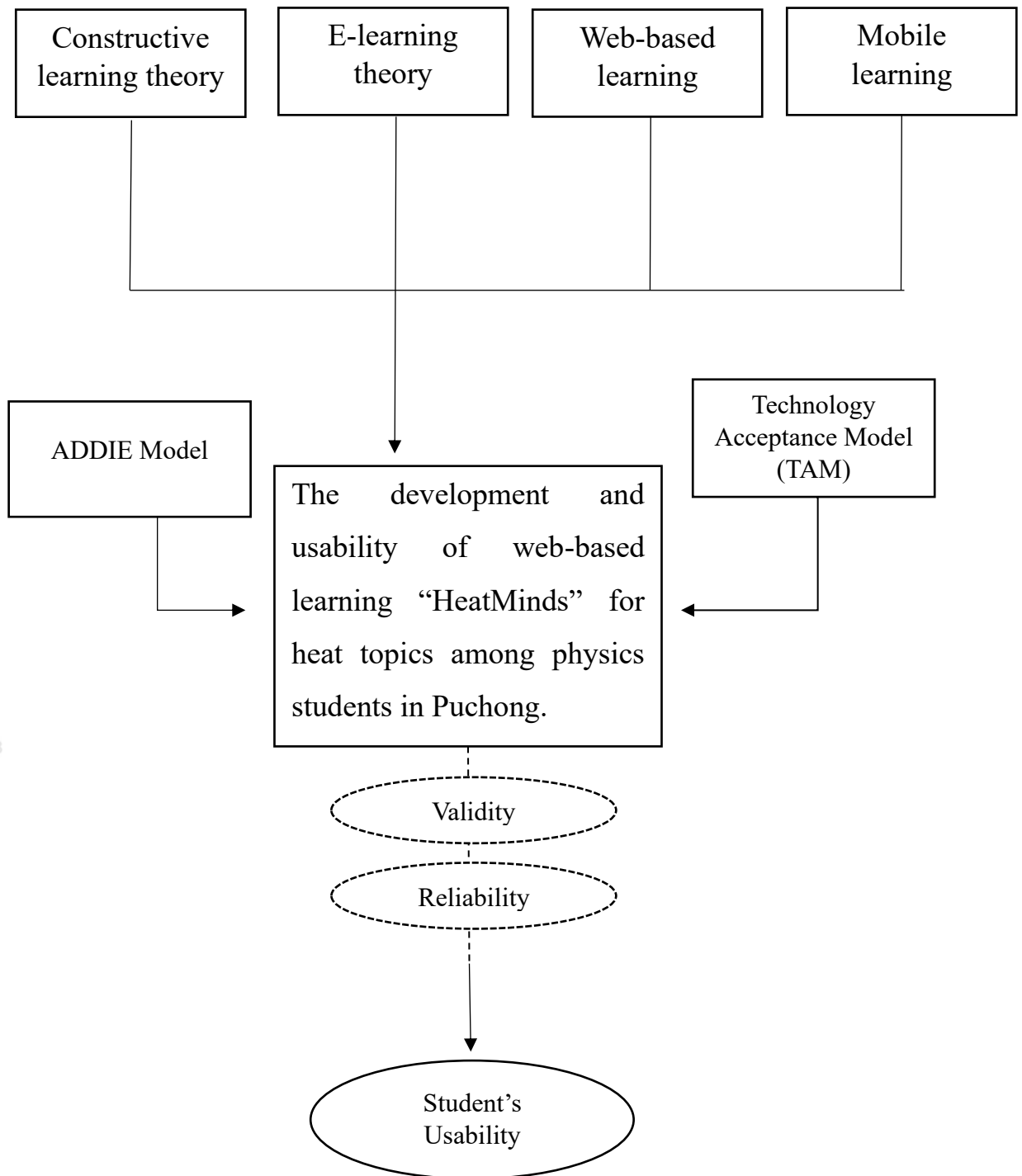
Figure 1.1 Theoretical Framework of HeatMinds

1.10 Operational Definitions

"HeatMinds" Development

Development comes with a broad term of meaning and in this study, development is specified under website development. Website development is the creation and maintenance of websites that can be accessed through the Internet, and it uses different programming languages, tools, and frameworks (Pastore, 2012). The development of technology has led to rapid advancements in web design and development, particularly in the education sector. Web development programs enable students to acquire the technical competencies required to plan, develop, and implement appealing and useful websites. Hence, HeatMinds is designed and developed for secondary school students in Malaysia. This website solely emphasises the topic of heat. Creating a website requires a systematic approach to ensure functionality and appealing features for the user's daily engagement. The website "HeatMinds" was developed by using wix.com. This website was developed by choosing a domain that reflects the nature of education. A proper template with aesthetic design or colorful design was chosen depending on the topic. HeatMinds consist of notes, learning videos, worksheets, PhET simulations, and games. Every content was divided to make it easier for users. Regular updates and testing were made to identify any issues on that platform. Performance was checked via laptop and mobile to ensure the compatibility of the website. Once testing was successful, HeatMinds was launched to the public to serve as an educational space for providing important learning materials. This instructional design model is adapted from ADDIE which stands for Analyse, Design, Develop, Implement, Evaluate. ADDIE is used for the development of websites as this method is student-centered, innovative, and authentic. This model is designed to assist students in shifting their knowledge patterns from traditional classrooms to online learning validity was conducted by a group of experts.

HeatMinds Usability

Usability refers to the quality of the user experience when interacting with it and it's important to ensure that end-users can achieve the best possible outcomes from a given educational resource (Keenan et al., 2022). Usability is relevant in software products, where it determines the capability of the product to be understood, learned, used, and attractive to the user (Garcia, 2012). The usability can be measured by the frequency of student usage on this website and the initiative taken to complete the given learning materials. Hence, the HeatMinds website should be able to leave a good impression on users and it should be easy to use as well. Hence, the Technology Acceptance Model (TAM) survey is adapted and used to determine the degree of usability of tasks (Cheah et al., 2022). The TAM model provides valuable insights into the determinants of user acceptance and offers practical guidance for constructing a website for educational purposes. Furthermore, this adapted TAM questionnaire with a total of four constructs is used to build this website such as perceived usefulness, perceived ease of use, behavioural intention, and website attitudes. To get more insightful data, a short interview was conducted to confirm the usability of the teacher and selected students. It's further explained under methodology.

1.11 Limitations

While internet access has improved in recent years, there are still areas, particularly in rural and remote regions, that have limited bandwidth and poor internet connectivity. Several challenges were faced in the implementation of this website. First, limited internet infrastructure and connectivity. Internet access remains undeveloped in rural areas as several areas are unable to get proper Internet access even today. This was an obstacle as students wouldn't be able to access the platform efficiently due to the uneven distribution of internet access services in mountain areas. Not only that but this website also wasn't made specifically for students. Some may find it hard to engage. Online resources that are provided on this web are limited to users. Students may find

it hard to understand the lessons due to limited learning materials and teachers may find it hard to use it as a teaching tool.

Moreover, this poses challenges for students and educators in accessing online learning materials and participating in real-time interactive activities (Krishnamoorthy & Soh, 2021). Lack of digital literacy skills such as despite efforts to improve digital literacy in Malaysia, there is still a significant portion of the population, including students and educators, who lack the necessary skills to effectively use web-based learning platforms (Ismail et al., 2018). Furthermore, this website might not be able to satisfy every student's need as students are divided into three categories based on their performance such as excellent, intermediate, and poor. Excellent students might find this educational website as a standard approach and poor students might be overwhelmed with the Higher Order Thinking Skilled questions (HOTS). These restrictions imposed on users may impact the satisfaction of user needs on this educational website.

1.12 Conclusion

This study aims to focus on creating a well-developed website HeatMinds to enhance students' learning materials. After a brief understanding of this research purpose, the chapter can enlighten the issues that can be faced during the implementation of this website together with the way to overcome the issues. This chapter concludes the necessity of this approach and also aims to serve as a new beginning for the comprehensive online learning platform.