AUGMENTED REALITY-ENHANCED DIGITAL LEARNING PLATFORM FOR ENHANCING LEARNING: A CASE STUDY OF INFORMATION SCIENCE AT SUAN SUNANDHA RAJABHAT UNIVERSITY

Jarumon Nookhong[1], Phachaya Chaiwchan[2], Nutthapat Kaewrattanapat[3], Natcha Wattanaprapa[4], Wichuda Kunnu[5], Sujitra Aomwongprem[6]

[1,2,3,4,5,6]Suan Sunandha Rajabhat University, Thailand

Email: *jarumon.no@ssru.ac.th[1]; phachaya.ch@ssru.ac.th[2]; nutthapat.ka@ssru.ac.th[3]; natcha.wa@ssru.ac.th[4]; wichuda.ku@ssru.ac.th[5]; s60123468064@ssru.ac.th[6]*

ABSTRACT

This research aimed to achieve three primary objectives: 1) design and develop a digital learning platform enhanced with Augmented Reality (AR) technology to enhance student learning, 2) assess the effectiveness of the AR-enhanced digital learning platform through expert evaluations, and 3) evaluate student satisfaction with the AR-enhanced digital learning platform. The study employed the ADDIE Model and focused on undergraduate students majoring in Information Science. The research involved a sample of 41 first to fourth-year Information Science students. The evaluation methods included statistical analysis using mean, standard deviation, interquartile range (IR), and quartile deviation (QD). The results indicated high effectiveness of the digital learning platform, as assessed by experts (Mean = 4.64, S.D. = 0.02, IR<=1, and QD<=0.0), and high satisfaction among students (Mean = 4.62, S.D. = 0.78, IR<=1, and QD<=0.0).

Keywords: Digital Learning Platforms, Augmented Reality, Electronic Book, Augmented reality electronic book

INTRODUCTION

Currently, Thai education is transitioning into the Education 4.0 era, aiming to foster national innovation and self-reliance. This transformation involves adjusting teaching methodologies to align with the country's innovation goals. STEM education, incorporating Science, Technology, Engineering, and Mathematics, has been introduced to play a pivotal role in reshaping the educational landscape (Techakosit and Nilsook, 2018; Skliarova et al., 2022). STEM education principles have been applied to the field of Information Science, emphasizing a digital learning system (Suthasinobon, 2019). This digital learning approach aligns with Constructivist theory, emphasizing learner-centric education, allowing students to construct knowledge through active engagement with others and their environment (Nguyen et al., 2022; Songkram et al., 2023).

In the current educational context, Augmented Reality (AR) technology has been integrated to create an Augmented Reality Electronic Book (AR-eBook), enhancing the learning experience by merging the real and virtual worlds. This technology has proven beneficial in various fields, including education, providing interactive and immersive learning experiences (Gómez Chova et al., 2019; P. jirapong, 2010; Yuen et al., 2011; Chutosri et al., 2021; Lucas et al., n.d.; Sırakaya and Alsancak Sırakaya, 2022).

The present research aligns with these concepts, aiming to develop a Digital Learning Platform enriched with Augmented Reality and eBooks. This platform is designed to support

STEM education, encouraging self-directed learning and constructivist approaches. It adapts AR technology to create a dynamic and interactive learning environment, fostering student participation and preparing them for continuous self-directed learning.

RESEARCH OBJECTIVES

This research study was aimed to

1) To design and develop a digital learning platform enhanced with augmented reality technology to promote student learning.
2) To assess the effectiveness of the digital learning platform with augmented reality technology in enhancing student learning, with input from experts in the field.
3) To evaluate student satisfaction with the use of the digital learning platform with augmented reality technology to enhance their learning experience.

METHODOLOGY

The research employs the ADDIE Model, consisting of the following procedural steps:

1) Analysis: The researcher conducted an analysis by studying data from relevant documents, theories, and research related to the digital learning platform enhanced with augmented reality technology. Information was gathered and synthesized to understand the digital learning landscape. The analysis highlighted that contemporary learners can access education anytime, anywhere. Learners can revisit and reinforce understanding through available information sources. The researcher adapted this analysis for students majoring in Information Science, using it to stimulate learning through the presentation of instructional media.

2) Design: Following a suitable analysis, the researcher proceeded with the design phase, which involved:

2.1) Utilizing Visual Studio Code to design the digital learning platform. Tools were employed to model the system, as illustrated in Figure 1.

2.2) Creating an assessment model for the digital learning platform with augmented reality technology. This involved experts (7 in total) who evaluated the platform's effectiveness using a 5-point Likert scale, based on predetermined metrics.

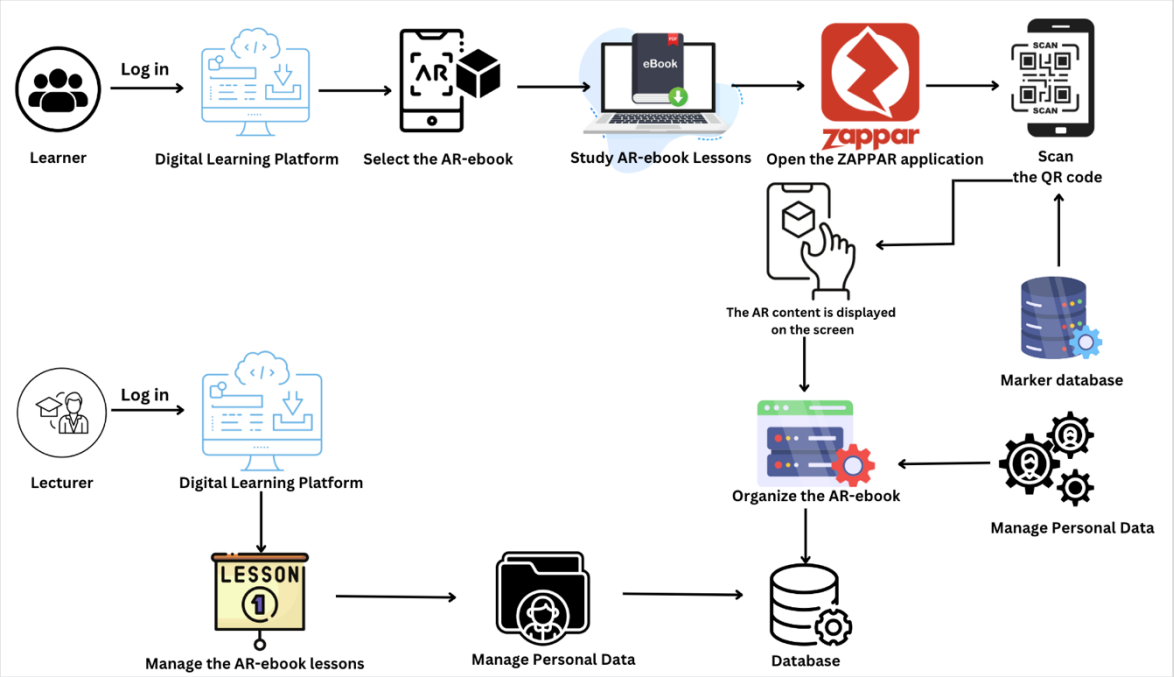

Figure 1. System Flow Diagram of a Digital Learning Platform with Augmented Reality

This system flow diagram depicts the flow of information and activities involved in a digital learning platform with augmented reality (AR). The diagram begins with a learner logging into the platform. Once logged in, the learner can select an AR-eBook to study. The AR-eBook is a digital book that includes AR content, such as 3D models, animations, and interactive simulations.

To access the AR content, the learner opens the Zappar application and scans the QR code on the AR-eBook page. The AR content is then displayed on the screen. The learner can interact with the AR content by moving the device around or by touching the screen.

The lecturer can also use the platform to organize the AR-eBook lessons and manage personal data. The lecturer can use the marker database to create and manage QR codes for the AR content. The lecturer can also use the data management system to manage personal data, such as learner names, email addresses, and progress.

3) Development: The development phase utilized various tools for content creation: HTML, CSS, JavaScript, PHP, phpMyAdmin, and Visual Studio Code for platform development. ZAPPAR WORK, Canva, and Pub HTML5 for designing e-Learning materials.

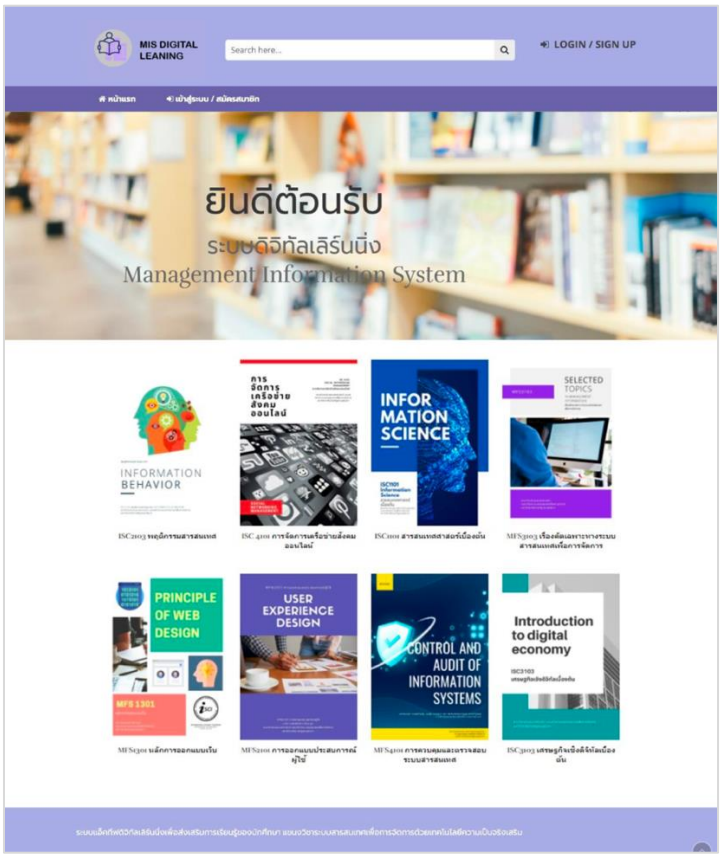

Figure 2. Digital Learning Platform Interface

The platform comprised eight core courses for Information Science Management, including subjects like Information Science Fundamentals, Web Design Principles, Information Behavior, User Experience Design, Digital Economics, Information Systems Management, Online Social Network Management, and Information System Control and Audit.

4) Implementation: Implementation involved user interaction with the platform:

4. 1) Students accessed AR content by downloading the ZAPPAR app and scanning markers.

Figure 3. Online Lesson Management Page

4.2) Users accessed the digital learning platform through advertising posters, downloading the ZAPPAR app for interaction.

5) Evaluation: Evaluation utilized feedback from two main groups:

5.1) Experts (7 individuals) assessed the platform's effectiveness.

5.2) Students majoring in Information Science (41 individuals) evaluated user satisfaction with the platform.

RESULT

1. Evaluation of the Effectiveness of Digital Learning Platforms with Augmented Reality Technology:

Table 1. Evaluation of the Performance of the Augmented Reality Digital Learning Platform

Evaluation Items	Mean	S.D.	Quartiles			Interquartile	Quartile Deviation
			Q1	Q2	Q3		
Performance Test							
Platform Processing Performance	4.43	0.53	4	4	5	1	0.50
Processing in Displaying Registration Results	4.57	0.53	4	5	5	1	0.50
Processing in Displaying Login Results	4.57	0.53	4	5	5	1	0.50
Processing in Displaying Online Lesson Management	4.71	0.49	5	5	5	1	0.30
Processing in Displaying User Account Editing	4.71	0.49	5	5	5	1	0.30
Processing in Displaying Adding Online Lessons	4.57	0.53	4	5	5	1	0.50
Processing in Displaying Bookshelf	4.71	0.49	5	5	5	1	0.30
Processing in Displaying Lesson Learning	4.57	0.53	4	5	5	1	0.50
Function Test							
Platform Data Storage Accuracy	4.57	0.53	4	5	5	1	0.50
Platform Data Retrieval Accuracy	4.71	0.49	5	5	5	1	0.30
Platform Media Display Accuracy with Augmented Reality	4.71	0.49	5	5	5	1	0.30
Platform Display Accuracy of Online Lesson Media	4.71	0.49	5	5	5	1	0.30
Overall Platform Accuracy	4.71	0.49	5	5	5	1	0.30
Summary	**4.64**	**0.02**	**4**	**5**	**5**	**1**	**0.00**

From Table 1, the evaluation results indicate that the overall performance of the augmented reality digital learning platform is at the highest level (Mean = 4.64, S.D. = 0.02, IR<=1 and QD<= 0. 0). The platform is designed with user- friendly Graphical User Interface (GUI) principles, ensuring ease of use and flexibility. The testing methodology employed, Black-Box Testing, effectively identified and rectified system errors, resulting in a highly functional and well-rounded platform.

2. Evaluation of User Satisfaction in Using the Platform by Information Management Students:

Table 2. Evaluation of User Satisfaction in Using the Platform by Information Management Students

Evaluation Items	Mean	S.D.	Quatiles			Interquartile Range	Quatile Deviation
			Q1	Q2	Q3		
User Interface							
Modern Aesthetics	4.61	0.49	4	5	5	1	0.50
Easy-to-Use Design	4.59	0.50	4	5	5	1	0.50
Appropriate Use of Colors	4.66	0.48	4	5	5	1	0.50
Readable Fonts and Typography	4.59	0.50	4	5	5	1	0.50
Suitability of Symbols	4.59	0.50	4	5	5	1	0.50
Usability Test							
Platform Ease of Use	4.61	0.49	4	5	5	1	0.50
Design Suitability for Various Uses	4.66	0.48	4	5	5	1	0.50
Suitability of Design in Creating Augmented Reality Lesson Media	4.63	0.49	4	5	5	1	0.50
Suitability of Design in Creating Infographic Lesson Media	4.63	0.49	4	5	5	1	0.50
Use of Easily Understandable and Correct Terminology	4.66	0.48	4	5	5	1	0.50
Summary	4.62	0.78	4	5	5	1	0.00

Table 2 reveals that user satisfaction with the platform among Information Management students is at the highest level (Mean = 4.62, S.D. = 0.78, IR<=1 and QD<=0.0). The developed digital learning platform with augmented reality significantly aligns with the information literacy and skills of the students, creating an engaging and enjoyable learning atmosphere. The integration of AR-eBooks stimulates knowledge acquisition and understanding, fostering active participation in the learning process.

CONCLUSION

The design and development of a digital learning platform with augmented reality technology to enhance the learning experience of Information Management students in the field of Information Management Science is of paramount importance. The platform, developed following the principles of the ADDIE Model, is widely accepted and preferred in the development of educational platforms and instructional media. This approach aligns with contemporary teaching and learning methodologies, ensuring the integration of modern technology into curriculum development and learning management.

Incorporating Augmented Reality (AR) technology into Electronic Books (eBooks) has been applied to create an Augmented Reality Electronic Book (AR-eBook). This innovative approach aims to promote digital learning, blending cutting-edge technology with curriculum development and learning management processes. The utilization of AR-eBooks seeks to address the challenge of engaging students in learning, as noted by Janjira and Katareeya. The fusion of Augmented Reality with eBooks creates an interactive and captivating learning experience, stimulating learning beyond traditional book reading methods (Vate-U-Lan 2013) (Jain et al. 2017).

The development is in line with Thailand's education in the Industry 4.0 era (Gerdruang 2017) (Wannapiroon et al. 2021), advocating for a shift in teaching methods. The proposed instructional model introduces new teaching approaches to educators. Additionally, students can easily grasp lessons through Infographics, readable texts, and user-friendly terminologies.

The approach supports the Thai education reform by integrating technology to facilitate learning, offering convenience for both educators and students.

Furthermore, the platform's adaptability to Smart Devices (Jdaitawi et al. 2023) fosters an innovative learning environment where educators can upload learning materials, and students can access and understand lessons anytime and anywhere. This approach aligns with the digital curriculum and learning model advocated by Suthasinobon (2019) and Oliva and Gordon (2013) (Uiphanit et al. 2020), breaking the barriers of traditional learning locations and promoting digital literacy among students.

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