

IMPROVING STUDENT ACHIEVEMENT IN COMPUTER SYSTEM ARCHITECTURE COURSE THROUGH A SELF-LEARNING PLATFORM

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ABSTRACT. Computer System Architecture (DFC10223) course is a common core course for first-semester students of Diploma in Information Technology (Digital Technology) program offered at Politeknik Malaysia. It is a continuation of core knowledge in computer systems and technology that is essential in the field of Information Technology. However, there has been a decrease in student achievement in Session II: 2021/2022 compared to Session I: 2021/2022, according to the Course Outline Review Report (CORR). Out of 82 students who took the course, 26 failed the Final Examination in Session II: 2021/2022. Additionally, the results of student achievement in PLO for Session II 2021/2022 also showed a decrease (PLO001 = 65%, PL0004 = 77%) compared to Session I 2021/2022 (PLO001 = 75%, PL0004 = 84%). To address this issue, the course lecturer developed a self-learning platform called i-Learn CSA using the ADDIE Model concept to help students improve their understanding and interest learning this course. i-Learn CSA is a one-stop information center based on a web-based application using the Google Site platform. A survey was conducted on 69 students to assess their perception of i-Learn CSA, with the results showing an overall mean of \bar{x} = 4.36. This indicates that over 90% of students agreed that i-Learn CSA helped improve their understanding of the CSA course.

KEYWORDS: Computer System Architecture, Course Outline Review Report

1 INTRODUCTION

Computer System Architecture (CSA) is a crucial course for students pursuing the Information Technology Diploma Program (Digital Technology) at Politeknik Malaysia. The course equips students with knowledge of computer architecture and technology, which is essential in the field of Information Technology. However, according to the Course Outline Review Report (CORR), student achievement in Session II 2021/2022 has declined compared to Session I 2021/2022. The most common challenge faced by students in learning CSA is the inability to interpret sequential logic circuits and solve questions related to instruction set and assembly language programming (CORR, Session II 2021/2022). To address this challenge, the course lecturer developed a self-learning platform called i-Learn CSA. The traditional teaching and learning patterns of lecture and practical face-to-face in the classroom or computer lab were no longer effective in engaging student (Wu & Plakhtii, 2021).

This trend is in line with today's digital era, where teaching aids that are more creative and innovative can attract the students' interest during the teaching and learning process (T&L) (Muchlisin, 2019). This is due to rapidly growing technologies in the life of students nowadays. The presentation slides used by lecturers were static and one-way, causing students to lose interest in class and in studying independently using the notes from the presentation slide (Siraj & Maskari, 2018). Therefore, the purpose of this research is to design and develop a one-stop central platform for the Computer System Architecture course and evaluate the usability features of the developed platform. This paper aims to investigate the effectiveness of i-Learn CSA in improving student achievement and engagement in learning CSA.

2 LITERATURE REVIEW

The integration of information technology and communication has the potential to facilitate learning and help learners achieve their educational goals (Balakrishnan & Gan, 2016). However, the

effectiveness of this integration largely depends on the models, strategies, mechanisms, and approaches used in the learning process (Kamsin et al., 2022). Recent advancements in technology have revolutionised the way students learn and engage with course content (Hunaidah, 2022; Kamsin et al., 2022). Self-learning platforms are one such technological innovation that has been gaining popularity in recent years. These platforms provide students with access to learning resources, exercises, and quizzes, allowing them to learn at their own pace and time (Silverajah et al., 2022; Nurhayati et al., 2021). Several studies have shown that self-learning platforms can be effective in improving student learning outcomes and engagement in different academic disciplines (Silverajah et al., 2022)

A research study by Pubian & Herpratiwi (2022) discusses various research results related to the use of Google Site in learning. The study highlights that Google Site can be used as a media or learning method in the classroom, particularly in the 21st century, where technology has revolutionised the education sector, attracting students to engage in the learning process. Google Site is a service provided by Google that enables users to easily and freely create a website with various functions, such as adding images, videos, links, and other documents (Site et al., 2022; Djusar et al., 2021). The use of Google Site as a wiki and photo folio site will make it easier for the instructor to provide learning resources that students or learners can easily access by leveraging the ease of navigation, attractiveness of the display, and usability of the web or site. Websites for learning can provide learning resources in the form of electronic files that can be accessed via navigation features on websites such as curriculum, glossary, material, quizzes, and so on (Nurhayati et al., 2021). Overall, the purpose of this research is:

- I. Designing a one-stop central platform Computer System Architecture Course.
- II. Developing a one-stop central platform for Computer System Architecture Courses.
- III. Evaluating the usability features of the one-stop center platform developed.

3 METHODOLOGY

The i-Learn CSA development process utilizes the ADDIE model, which consists of five phases: Analysis, Design, Development, Implementation, and Evaluation as shown in Figure 1. This instructional design process can be incorporated into any learning strategy, as it is adaptable and straightforward to apply (Mohd Jais et al., 2022). Cheung (2016) stated the ADDIE model's simplicity allows it to support instructors in developing a curriculum in a structured manner for teaching knowledge, skills, or attitudes. Ensuring a well-defined prototype also guarantees that the i-Learn CSA caters to the learning needs and preferences of users.



Figure 1: ADDIE Model Framework (Mohd Jais et al., 2022)

Phase 1: Analysis

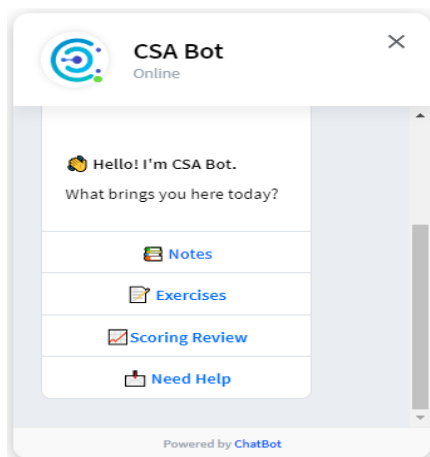
To perform the analysis, the researchers employed various information gathering technologies and separated the analysis into four parts: needs analysis, task analysis, learner analysis, and performance analysis (Cheung, 2016). The researchers began by identifying the platform's goals, target student group, and software usage strategy. In addition, they gathered information about the users' desired knowledge, skills, and attitudes, as well as what needs to be taught to achieve these goals (Mohd Jais et al., 2022).

Phase 2: Design

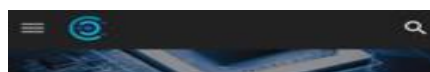
This phase involves transferring information from the analysis phase into a physical representation. The specific design phase for i-Learn CSA likely involved creating the content, layout, and user interface for each of its features, such as notes, exercises, sample final examination questions, a chatbot, a calculator, and a platform for checking coursework marks. Clear learning objectives ensure that the instructional materials have a specific and defined focus and purpose.

Phase 3: Development

The development phase is where the physical image or design is translated into a real form using software and programming tools. In the case of i-Learn CSA, images are designed using Canva software. The CSA bot is developed using HTML code, which includes several quick links to make it easier for users to access important links. Furthermore, i-Learn CSA provides two types of calculators: a scientific calculator and a base number calculator, which can help students solve questions involving the conversion of base numbers in base 2, 8, 10, or 16 (see Figure 2). Referring to Figure 2, students can check their continuous assessment scores through a link built using Data Studio as a dashboard integrated with the Google Sheet of student marks. Additionally, i-Learn CSA provides sample questions by topic and sample final examination questions, which can help students get used to the question form of each topic.



CSA Bot



Topical exercise



(b) Base number calculator



(d) Continuous checking marks

Figure 2: i-Learn CSA platform interface.

Phase 4: Implementation

The i-Learn implementation phase begins in Session I: 2022/2023. Students of Class DDT1A and Class DDT1B have used this platform. CSA's i-learn platform can be accessed through links distributed by course lecturers. Students are free to access CSA's i-Learn platform using their respective computers, tablets or smartphones through this link <https://sites.google.com/view/csapmj/home>.

Phase 5: Evaluation

The evaluation phase is an important phase to test the readiness to use i-Learn CSA before it is distributed to all students taking the Computer System Architecture course. The information gathered would be used as a guide for re-designing or improving the platform. A total of 69 students were sampled to answer a questionnaire regarding the usability of i-Learn CSA during Session I:2022/2023. This evaluation process ensures that the instructional materials are continuously optimized for better learning outcomes.

4 RESULTS AND DISCUSSION

4.1 Questionnaire

The data collected from the questionnaire was analysed using XLMiner Analysis ToolPak. To measure the reliability of the data, Cronbach's α (alpha) was conducted on a sample of respondents, $N=10$. The overall reliability score of $\alpha = 0.970$ is considered acceptable, as values in the range of 0.9 to 0.99 are generally considered strongly reliable (A. Field, 2005). Referring to Table 1, students' perceptions towards i-Learn CSA obtained an overall mean of 4.36, which is verbally interpreted as "Agree". The highest-ranked item was "i-Learn CSA helped improve my understanding of the CSA course" ($\bar{x}=4.46$), followed by "the font used in i-Learn CSA is easy to read" ($\bar{x}=4.43$). The lowest mean was obtained for item 10, "I got the information I needed by using i-Learn CSA" ($\bar{x}=4.25$). The effectiveness of i-Learn CSA in improving students' understanding is indicated by the close proximity of the mean distribution for each item. Furthermore, the platform's accessibility through phones, tablets, or computers makes it an attractive teaching aid. The questionnaire findings provide valuable feedback for the author to enhance the i-Learn CSA platform in accordance with the perspectives of its primary users, the students.

Table 1: Student Perception toward I-Learn CSA Platform

Item	Mean, \bar{x}	Verbal Interpretation
1. i-Learn CSA helped improve my understanding of the CSA course	4.46	Agree
2. i-Learn CSA made me interested in reviewing the CSA course	4.36	Agree
3. i-Learn CSA meets my needs in understanding and reviewing CSA	4.33	Agree
4. i-Learn CSA helped me revise quickly for the final exam	4.36	Agree
5. I think I will use i-Learn CSA regularly	4.33	Agree
6. The navigation menu in i-Learn CSA is easy to use	4.39	Agree
7. The elements in i-Learn CSA are very helpful	4.35	Agree
8. The image display in i-Learn CSA is clear	4.35	Agree
9. The font used in i-Learn CSA is easy to read	4.43	Agree
10. I got the information I needed by using i-Learn CSA	4.25	Agree

i-Learn CSA offers flexible learning options, granting students a range of choices regarding when, where, and how they engage in their learning process (Gordon, 2014). Additionally, it supports

interaction with instructors, effective time management, access to learning materials, and assessment (Palmer, 2011). Engaging in i-Learn CSA activities and embracing these characteristics contribute to enhanced academic performance and the attainment of exceptional grades in course assessments (Jacob & Issac, 2014). i-Learn CSA fosters student-centered learning, enabling self-directed problem-solving and innovative thinking. It offers expanded access to a wider learner population and facilitates diverse learning settings, experiences, and areas of study.

4.2 CORR Report Review

The Course Review Report (CORR) is a summary report that outlines the Course Learning Outcome (CLO) and Program Learning Outcome (PLO) for a course in the diploma program. This report is generated to assess the level of achievement in CLO percentages set by the Department of Polytechnic Studies and Community Colleges (JPPKK). In the Computer System Architecture course, Table 2 identifies two (2) CLOs: CLO1C is aligned with PLO 0001 while CLO2A is aligned with PLO 0004. The CORR achievement in Session I: 2022/2023 is improved compared to Session II: 2021/2022. The increase in student performance in continuous assessments, such as quizzes, Theory Test, and Practical Based Exercise, has contributed to an overall increase in CLO1 to 72%. Additionally, CLO2 has increased to 81% due to the enhanced student achievement in the Problem Based Task assessment.

Table 2 : CLO comparative analysis

CLO/ PLO	Explanation CLO and PLO	Session II : 2021/2022	Session I: 2022/2023
CLO1C	Explain computer function in central processing unit, arithmetic, logic and assembly language in computer system (C2, PLO 1)	65%	72%
CLO2A	Discuss among group members in explaining the assembly language solutions. (A2, PLO 4)	77%	81%
PLO0001	Practice Information and Communication Technology (ICT) skill in performing diagnostic and documenting processes in ICT related fields	65%	72%
PLO0004	Demonstrate effective communication both orally and in writing to other including peers, experts and non-experts.	77%	81%

5 CONCLUSION

In conclusion, the implementation of i-Learn CSA has proven to be effective in aiding students in the Computer System Architecture course at Politeknik Mersing. The five phases of the i-Learn CSA development process were successfully executed, resulting in a platform that includes various features such as notes, exercises, sample questions, calculators, and a chatbot. The evaluation phase shows students generally agreed i-Learn CSA usage improves their understanding of the course. Furthermore, the Course Review Report for the Computer System Architecture course demonstrated an increasing of student achievement in both PLO 0001 and PLO 0004. Overall, the utilization of the i-Learn CSA platform has significantly enhanced the teaching and learning experience for students in the Computer System Architecture course. For future improvement, the content of the i-learn CSA platform can be improved by adding any teaching aids such as explanatory videos for each course topic.

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