

Design and Development of a Smart CNF App for DEC30023 Computer Networking Fundamentals Course

Bong Siaw Wee¹, Chen Wong Keong¹, Diana anak Ringgau¹

¹Politeknik Mukah, KM 7.5, Jalan Oya, 96400 Mukah, Sarawak, Malaysia.

Corresponding Author's Email: 1shaweibong2016@gmail.com

Article History : Received 10102022; Revised 31102022; Accepted 21112022;

ABSTRACT –Mobile (M) learning has been expanded to all educational sectors as learning multiple contexts through social and content resources. Computers, iPad and mobile cannot be denied functioning as technology tools to enhance student's abilities and talents, revolutionize their way of thinking and give them access to the world. Therefore, Computer Networking Fundamentals Application (CNF App) for the DEC30023 Computer Networking Fundamentals course was developed to provide high-quality and practical learning to Polytechnic Students. This innovation project aims to encourage and instigate the learning interest in computer networks and increase student satisfaction and performance. CNF App is a platform for the Computer Networking Fundamentals course to gather all the related teaching and learning tools, such as notes, slides, lab sheets, exercises, videos, and others. This app was developed using user-friendly features in the google site platform and can be used on various devices: phones, tablets and web browsers. Lecturers can access online information from various educational articles published on the net, project the culled information in an exciting presentation, and share the links with students via Smart Educational App. Students utilize smart devices to access digital resources through wireless networks and immerse in personalized and seamless learning. A study was conducted among students who took the Computer Networking Fundamentals course to analyse the effectiveness of this application. The effectiveness study of a developed CNF App in the Computer Networking Fundamentals Course shows that the content and design of this application are exciting, and the information provided is beneficial to students in the Computer Networking Fundamentals Course. The average overall mean score is 4.84, which is good / agree. In addition, this application is also very suitable to be used as a Teaching and Learning (T&L) tool, and the overall average mean score is 4.93, which is good / agree. Thus, this study found that the objectives of building this application are achieved successfully. Hence, the CNF App will encourage the students to learn more in this course, not limited to printed textbooks.

KEYWORDS : *Smart Educational App, M-learning, Computer Networking Fundamentals, Teaching and Learning, Education Technology*

1.0 INTRODUCTION

In the modern era, technology devices have become mobile, portable, and networked to the point that they have become pervasive in everyday life [1, 2]. The knowledge expansion system is quickly changing due to the rapid development of mobile devices based on next-generation information technology (IT) convergence technology, and information acquisition is progressing actively and swiftly as well [3, 4]. Recent research has shown that the use of technology has revolutionized the teaching techniques of lecturers and methods of studying students. As a whole, how education is handled conforms with the present era [5]. IT delivery software is considered a productivity tool that can help lecturers in teaching, learning, and other tasks [6, 7]. Computers, iPads, and mobile devices cannot be denied as functioning technology tools to enhance students' abilities and talents, revolutionize their thinking, and give them access to the world [8]. Basically, educational software could be run on an internet browser interface, such as Internet Explorer, Google Chrome, or Microsoft Edge, and could also run as a smartphone application, which could be further divided into Android and iOS technologies. Besides, there are many educational learning online platforms to cater to the online learning process, such as Skillshare, Mindvalley, Coursera, Udemy, Brilliant.org, edX.org, Udacity, LinkedIn Learning, MasterClass, and Futurelearn. However, these platforms have to be borne by high costs of maintenance by institutions.

In the past few years, online learning has drastically evolved and changed the face of modern education. However, many educational online learning platforms cannot be published in the Google Playstore as an Android educational application because of different formats,

and some educational online learning platforms require payment. Currently, Google Sites have emerged as a popular platform for online learning. Many educational institutions have published their involvement in using Google Sites as learning platforms. The advantages of Google Sites are that it is fast and easy to edit, free, requires no programming or database skills, requires no software installation, and the creator has full control over page access and permissions.

Therefore, a Smart Computer Networking Application (CNF App) for DEC30023 Computer Networking Fundamentals course was proposed and developed using Google Sites as an online learning platform. The DEC30023 Computer Networking Fundamentals course is a compulsory course that students of Diploma in Electrical and Electronic Engineering (DEE) must take at Politeknik Mukah and Polytechnic Malaysia. This course covers knowledge in the fundamental area of theoretical and practical work for the concepts and principles of data transmission, computer networks, and troubleshooting and securing the network. The Smart CNF App created in Google Sites can also be shared and published in the Google Playstore for better accessibility. This app can provide high-quality and practical learning to Polytechnic Students. The aim of this innovation project is to inspire and instigate learning interest in Computer Networking Fundamentals through the creation of a user-friendly Smart CNF App. This app is a platform to gather all the related teaching and learning tools, such as notes, slides, lab sheets, exercises, videos, and others for the Computer Networking Fundamentals course. There are several advantages to the Smart Educational App. The first advantage is that this app was developed using user-friendly features in the Google Sites platform and can be used on various devices, including phones, tablets, and web browsers. Users can give feedback to the app developer after using this app for further development and improvement. The second advantage is that lecturers can easily upload and share the latest information about the course with the students. Students can easily access all the related information of the course in one stop platform app. This course's teaching and learning materials are presented by chapters in different categories, such as notes, slides, lab sheets.

2.0 LITERATURE REVIEW

Mobile (M) learning has been expanded to all education sectors [9]. M-learning is learning multiple contexts through social and content resources using personal electronic devices [10]. In addition, m-learning environments provide a wide range of new and exciting learning opportunities supported by wireless technology [11]. Table 1 shows a review of M-learning from existing studies.

Table 1. A review of M-learning from existing studies

Authors & Year	Title
(Jain, Chakraborty, & Chakraverty, 2018) [12]	Smartphone apps for teaching engineering courses: Experience and scope
(Bano, Zowghi, Kearney, Schuck, & Aubusson, 2018) [13]	Mobile learning for science and mathematics school education: A systematic review of empirical evidence
(Mutambara & Bayaga, 2021) [14]	Determinants of mobile learning acceptance for STEM education in rural areas
(Papadakis, 2021) [15]	Advances in Mobile Learning Educational Research: Mobile learning as an educational reform
(Dias & Victor, 2022) [16]	Teaching and learning with mobile devices in the 21st-century digital world: Benefits and challenges
(Al-Jarf, 2022) [17]	Specialized dictionary mobile apps for students learning English for engineering, business and computer science

Mobile devices have introduced a new generation of educational tools that allow for creative use and instant access to a wealth of resources. This learning is more interactive and involves more contact, communication, and collaboration with people. It can provide educational content and resources on personal pocket devices such as smartphones, tablets, personal digital assistants (PDAs), iPads, mobile phones, and others. Flexible, collaborative, blended, and interactive learning are the pedagogical advantages of mobile learning (M-learning). Therefore, the CNF App for the Computer Networking Fundamentals course was proposed and developed in this research. The CNF App's development is based on the Technology Acceptance Model (TAM) theory. The TAM has been regarded as one of the most fundamental and influential theories in predicting M-learning adoption. The technology acceptance model identifies the relationships between external variables, perceived usefulness, perceived ease of use, and behavioral attitude.

3.0 METHODOLOGY

When designing an educational application, several guidelines for usability should be referred to and applied. A successful website/application should be designed for usability, including how easy it is for users to use and experience (UX), as well as how enjoyable it is to interact with the website/application. Some important features for a good website/application include simplicity (colours, typeface, graphics), visual hierarchy, navigability, consistency, responsiveness, and accessibility.

The CNF App was developed using Google Site, as shown in Figure 1, and then shared and published as an application on the Google Play Store. The development mainly involved five essential steps:

- Step 1: Create a new Google Site with the course name.
- Step 2: Design the course's homepage with content blocks for different topics and their pages with all the course materials, respectively. Then, create a linkage between them.
- Step 3: Publish the Google Site when all work is finished.
- Step 4: Generate the website as an .aab file.
- Step 5: Upload the .aab file to the Google Play Console and publish it as an educational application on the Google Play Store.



Figure 1. Google sites for Educational App development

The Flow chart for Smart CNF Application development process is shown in Figure 2.

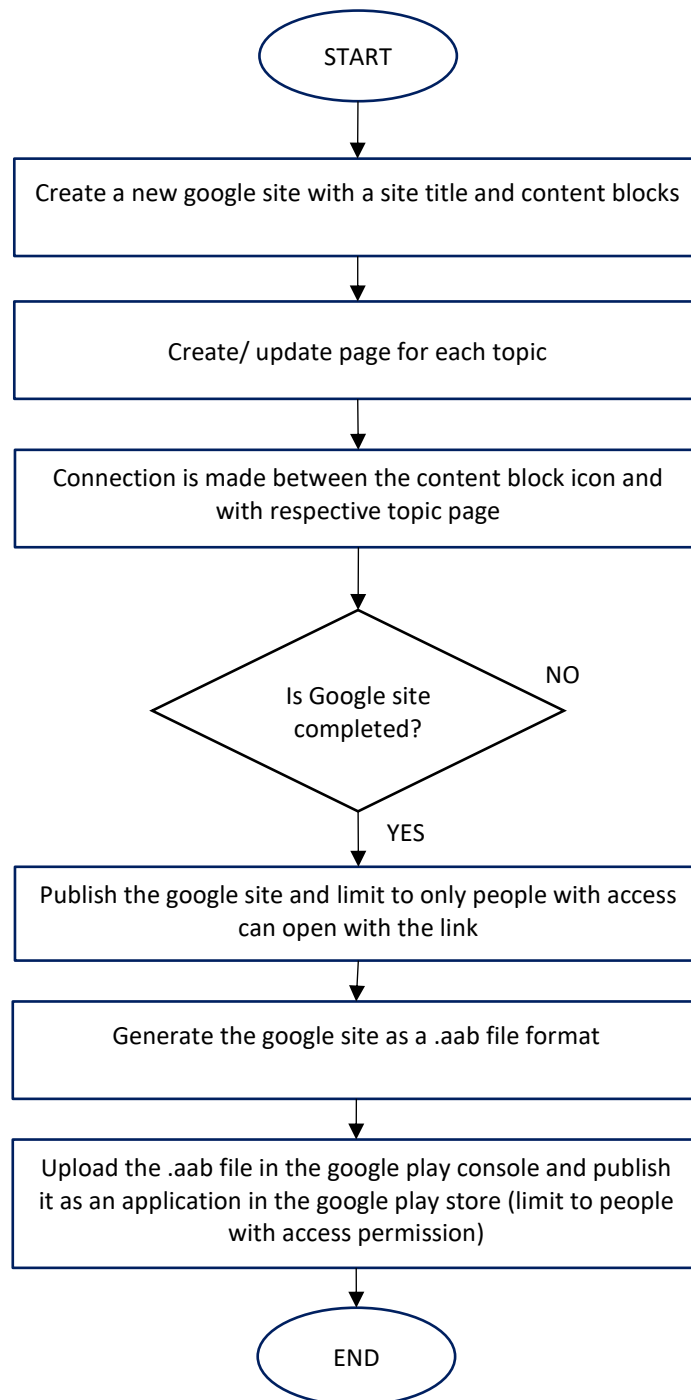


Figure 2. Flow chart for Smart CNF Application development process

The early development of this educational app is shown in Figures 3-7. Figure 3 shows the initial development stage, where a new Google Site was created with site tiles and content blocks as topic icons. Next, a page was created for each course topic, as shown in Figure 4. Figure 5 shows the link between the content block icon and the page contents. Once all the contents were ready on the Google Site, they were published with restricted viewers. The completed Google Site was then used to generate a .aab file for the next stage, as shown in

Figure 6. Finally, the generated .aab file was uploaded to the Google Play Console as an educational application on the Google Play Store, which can be easily accessed by students.

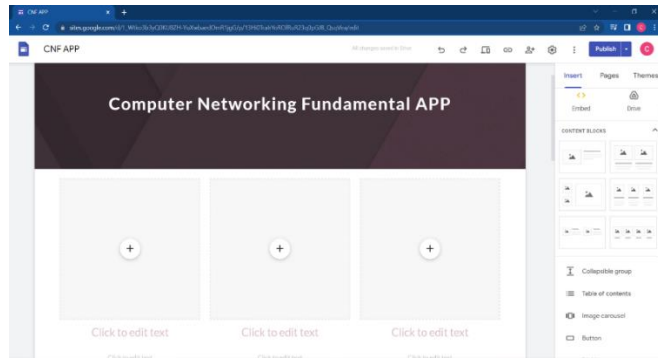


Figure 3. Create a new google site with a site title and content blocks as topic icons

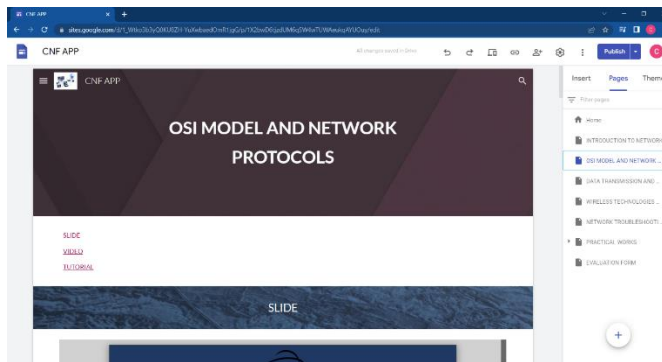


Figure 4. Create the page for each topic which has been uploaded with all the topic materials for the students' access, including slides, videos and tutorial questions.

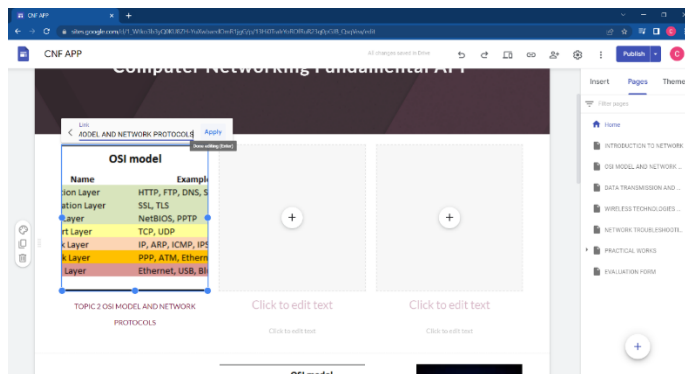


Figure 5. Connection is made between the content block icon and with respective topic page.

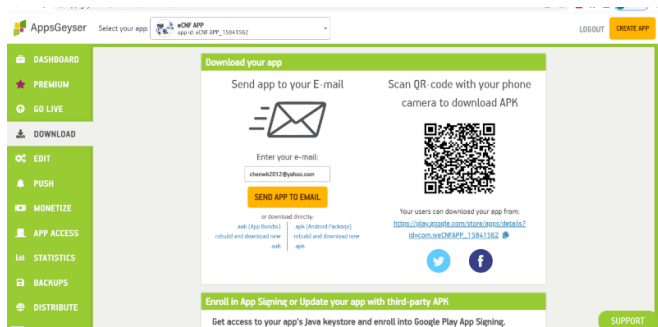


Figure 6. Generate the google site as a .aab file

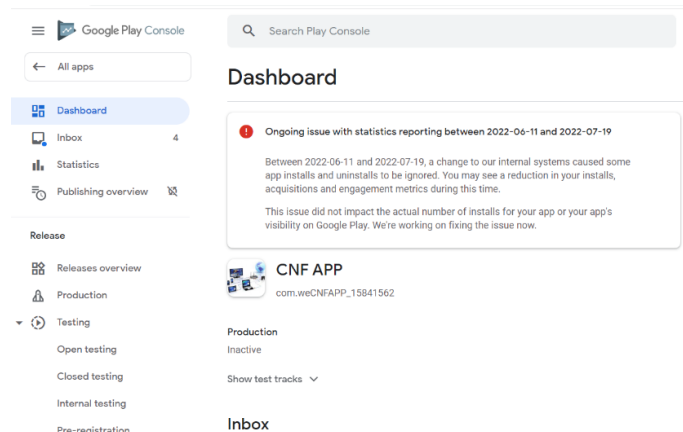


Figure 7. Upload the .aab file in the google play console and publish it as an application in the google play store

4.0 RESULTS AND DISCUSSION

4.1 A design of Smart CNF App for Computer Networking Fundamentals Course

Gone are the days when teaching and learning were limited to classroom sessions that relied on white chalk, dusters, and blackboards. Nowadays, smart classrooms have emerged, making learning fun through the use of digital equipment like laptops and computers connected to projectors.

The Computer Networking Fundamentals App was developed as a platform to gather all the relevant teaching and learning tools, such as notes, slides, lab sheets, exercises, videos, and others for the Computer Networking Fundamentals course. This course is part of the Diploma in Electrical and Electronic Engineering program, specifically the Electrical Engineering Department. The Computer Networking Fundamentals course introduces students to the concepts and principles of data transmission and computer networks. It equips them with the ability to use standard terminology in describing the main Local Area Network (LAN) topologies, hardware, and software components used in networking. Additionally, the course provides students with the knowledge and skills to build a network infrastructure using copper cabling and wireless devices effectively. They also learn how to troubleshoot and secure the network.

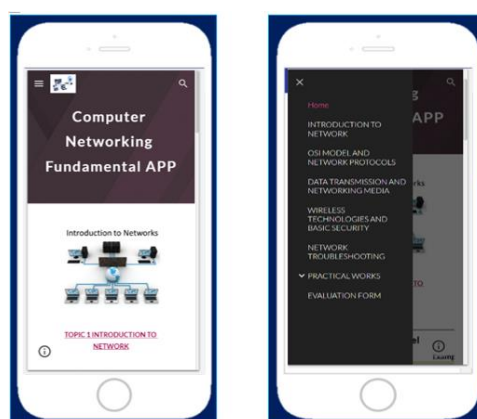


Figure 8. Main view of the Educational Application with side menu

Figure 8 depicts the various views of the Chapters Function in the Computer Networking Fundamentals App. The first section introduces the Computer Networking Fundamentals Course, which includes an explanation and a video. The subsequent section contains notes, slides, lab sheets, exercises, and videos for Chapters 1 to 5. Finally, Figure 9 illustrates the Chapter detail with a list summary of different teaching and learning tools.

The most significant advantage of the Smart Educational App is that it provides an opportunity for learning anytime and anywhere without any constraints, thus creating an effective learning environment for lecturers and students.



Figure 9. Different learning materials shared in each topic (a) List of learning materials, (b) slides and their preview, (c) videos and their preview, (d) tutorial exercises

Figure 10 shows the link and video for installing a Cisco Packet Tracer for practical works simulation. The Phone's vertical and horizontal views of the CNF App are shown in Figure 11. Moreover, the CNF Web-App also can be used in computer browser view, as illustrated in Figure 12.

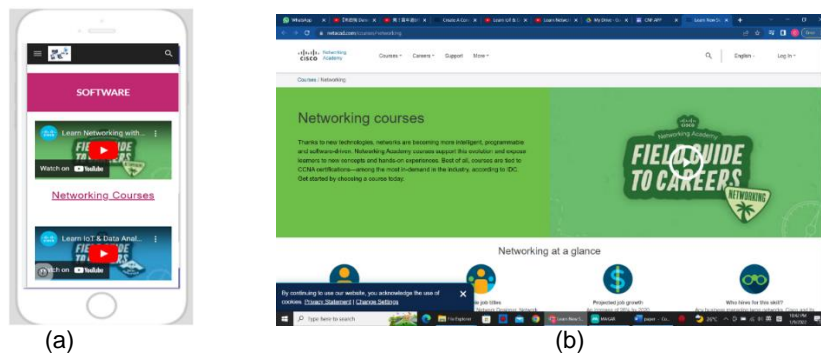


Figure 10. (a) Connection to networking practical software, (b) Internet login for networking practical software

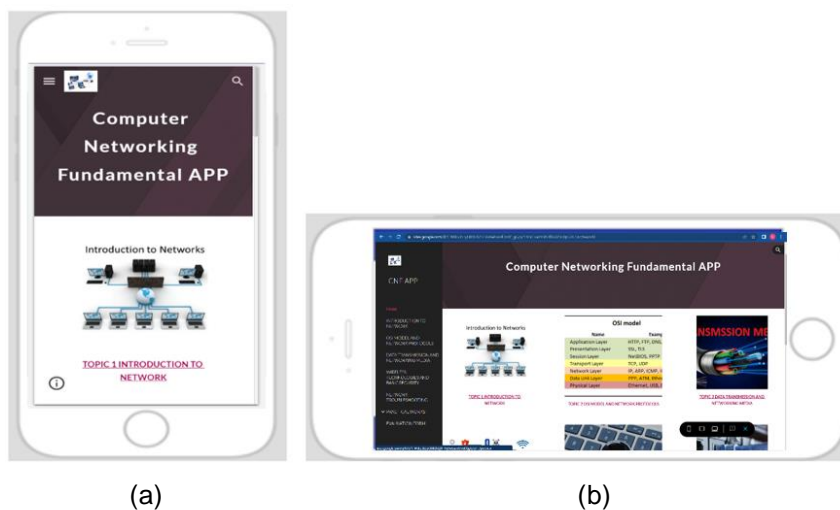


Figure 11. (a) Phone vertical view, (b) Phone horizontal view of Smart Educational App.



Figure 12. Full-screen computer browser view of the CNF App

Moreover, the CNF App can be used on other mobile devices by downloading and installing through Google Play, as illustrated in Figure 13. Figure 14.

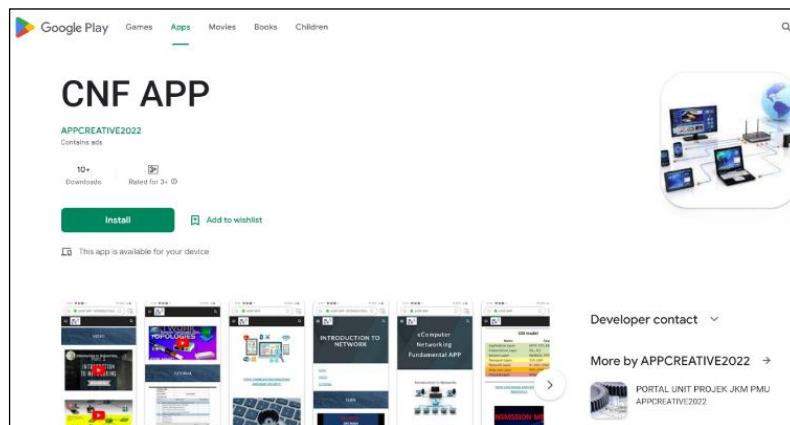


Figure 13. Google Play for installing CNF App

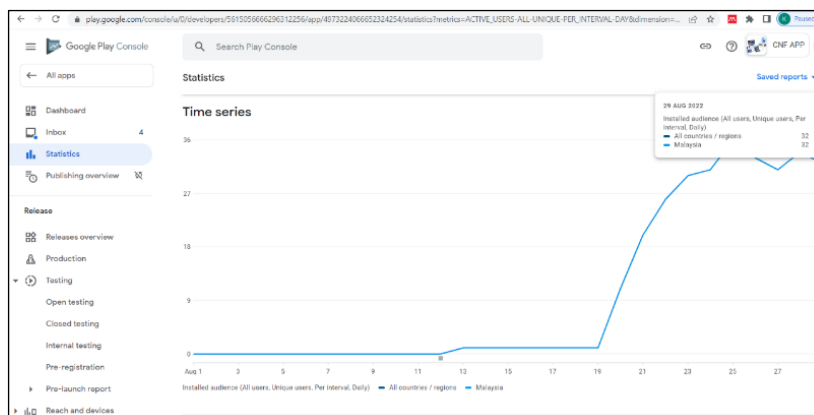


Figure 14. User Installation Graph



Figure 15. (a) Student used the CNF App on the computer, (b) student used the CNF App on mobile Phone and iPad

The development of the CNF App provides students with a more effective, efficient, flexible, and comfortable way of learning, as shown in Figure 15. With access to digital resources through wireless networks on their smart devices, students can engage in personalized and seamless learning. This has led to the increased attention on innovative education, a concept that describes learning in the digital age. Online resources are especially suitable for students who wish to go beyond their course curricula and improve their curiosity and creativity.

In addition, lecturers can also benefit from the CNF App by accessing online information from various educational articles and incorporating them into their presentations, which they can then share with students through the app. This allows lecturers to go beyond traditional printed material and excite students with the exhaustive information available on the internet.

4.2 Research Finding for the Effectiveness Study of a Developed Smart CNF App for DEC30023 Computer Networking Fundamentals Course

The Landell method is a statistical analysis method that is used to grade the mean score of a study based on three main criteria, namely "Good/Agree," "Neutral," and "Poor/Disagree." The mean score range for the "Good/Agree" level is typically high at 3.80-5.00, which indicates a high level of agreement among participants. This method is often used in educational research to evaluate the effectiveness of teaching and learning methods, as well as the usability and design of educational technologies such as the CNF App for Computer Networking Fundamentals Course.

Table 2. Landell method

Score Landell	Comprehension / Acceptance Level
1.00 – 2.39	Unsatisfactory / Disagree
2.40 – 3.79	Moderate / Disagree
3.80 – 5.00	Good / Agree

Data were analyzed using descriptive statistics, i.e. frequency and mean. Data are presented in pie charts as shown in Figure 16 and Figure 17.

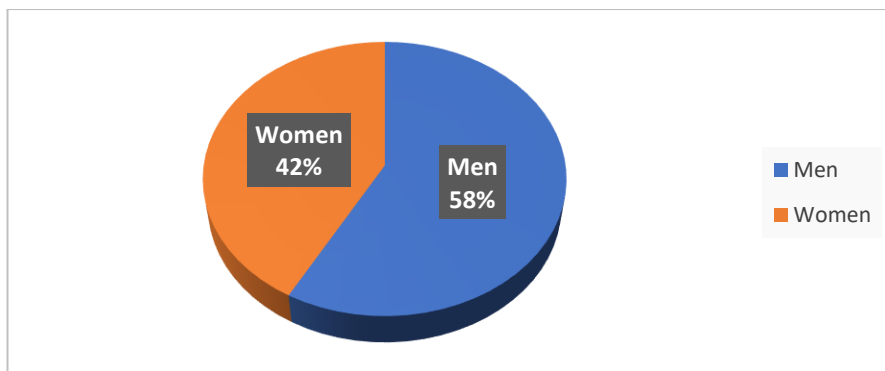


Figure 16. Gender of the respondents

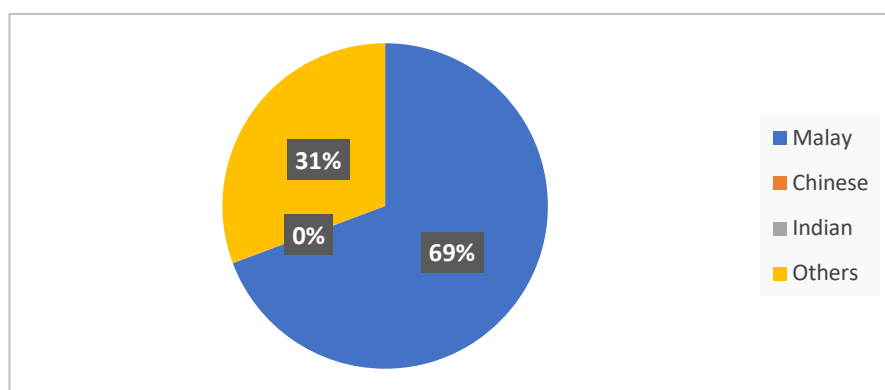


Figure 17. Race of the respondents

Table 3 shows the mean and standard deviation value for the Part II content and system design, while the Part III appropriateness of using this application for Teaching and Learning (T&L) is shown in Table 4.

Table 3. Content and System design After using the CNF App in Computer Networking Fundamentals Course

No.	Item	Mean	Interpretation	Std. Deviation
1.	Information in this application is complete.	4.90	Good / Agree	0.30056
2.	Information is easy to understand.	4.81	Good / Agree	0.75287
3.	Information is associated with the Computer Networking Fundamentals Course.	4.74	Good / Agree	0.57549
4.	Information is organized in an orderly fashion.	4.84	Good / Agree	0.45437
5.	The information provided is sufficient.	4.81	Good / Agree	0.40163
6.	The language used in this application is easy to understand.	4.90	Good / Agree	0.30056
7.	No spelling errors.	4.84	Good / Agree	0.37388
8.	The information is well-presented and interesting.	4.84	Good / Agree	0.37388
9.	The content presented is easy to understand.	4.84	Good / Agree	0.37388
10.	The content provided can facilitate me learning.	4.84	Good / Agree	0.37388
11.	The design of this application is good and interesting.	4.84	Good / Agree	0.45437
12.	The text is clear and easy to read.	4.84	Good / Agree	0.45437
13.	The colors used are interesting.	4.81	Good / Agree	0.40163
14.	The design of this application is easy to use.	4.87	Good / Agree	0.34078
15.	The icons used are consistent and easy to understand.	4.90	Good / Agree	0.30056
Overall average Mean		4.84	Good / Agree	

Table 4. Appropriateness of using this application for Teaching and Learning (T&L)
After using the CNF App in Computer Networking Fundamentals Course, I think ...

No.	Question	Score Mean	Interpretation	Std. Deviation
1.	This application is suitable for use as a teaching and learning tool.	4.90	Good / Agree	0.30056
2.	The content of this application is in accordance with the DEC30023 Computer Networking Fundamentals syllabus.	4.94	Good / Agree	0.24977
3.	I am interested in using this application as it can improve my knowledge in Computer Networking Fundamentals Course.	4.94	Good / Agree	0.24977
4.	I am more focused on the study, using CNF App.	4.90	Good / Agree	0.30056
5.	I am more confident answering the quizzes after using CNF App.	4.90	Good / Agree	0.30056
6.	CNF App is user friendly because I can use it anywhere and anytime.	4.94	Good / Agree	0.24977
7.	This application can be used on a variety of devices: phones, tablets, web browsers and more.	4.97	Good / Agree	0.17962
8.	After using the application, I also better understand the Computer Networking Fundamentals Course and my results also improved.	4.90	Good / Agree	0.30056
9.	Using CNF App is better than the traditional method.	4.97	Good / Agree	0.17962
10.	Overall, the CNF App is very informative.	4.90	Good / Agree	0.30056
Overall average Mean		4.93	Good / Agree	

The effectiveness study of a Developed CNF App in the Computer Networking Fundamentals Course shows that the content and design of this system are exciting, and the information provided is beneficial to students in the Computer Networking Fundamentals Course. The average overall mean score is 4.84, which is good / agree. In addition, this application is also very suitable to be used as a Teaching and Learning (T&L) tool, and the overall average mean score is 4.93, which is good / agree. Thus, this study found that the objectives of building this application are achieved successfully.

4.0 CONCLUSION

Overall, the CNF App for Computer Networking Fundamentals Course provides an innovative and practical learning platform for students and lecturers. Its user-friendly design and accessibility make it easy for users to access educational resources, and its flexibility enables learning to take place anywhere and anytime. The feedback obtained from the effectiveness study demonstrates the positive impact of the app on teaching and learning outcomes. This app serves as a good example of how technology can be used to enhance education and create new opportunities for students and lecturers alike.

REFERENCES

- [1] E. Baran, "A review of research on mobile learning in teacher education," *Journal of Educational Technology & Society*, vol. 17, pp. 17-32, 2014.
- [2] K. Balliamanda, "Perceptions of teachers on teaching and learning with mobile devices in higher education classrooms in Oman: A pilot study," *Studies in Technology Enhanced Learning*, vol. 1, 2021.
- [3] a. R. Diana, C. W. Keong, and B. S. Wee, "Development of To-Do List and Monetary Management System," *International ABEC*, pp. 90-97, 2021.
- [4] K. K. d. S. Oliveira and R. A. de SOUZA, "Digital transformation towards education 4.0," *Informatics in Education*, vol. 21, pp. 283-309, 2022.

- [5] R. Firmansyah, D. Putri, M. Wicaksono, S. Putri, A. Widiyanto, and M. Palil, "Educational Transformation: An Evaluation of Online Learning Due to COVID-19," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 16, pp. 61-76, 2021.
- [6] K. E. Darras, J. J. van Merriënboer, M. Toom, N. D. Roberson, A. B. de Bruin, S. Nicolaou, and B. B. Forster, "Developing the evidence base for M-learning in undergraduate radiology education: identifying learner preferences for mobile apps," *Canadian Association of Radiologists' Journal*, vol. 70, pp. 320-326, 2019.
- [7] A. Alam, "Employing Adaptive Learning and Intelligent Tutoring Robots for Virtual Classrooms and Smart Campuses: Reforming Education in the Age of Artificial Intelligence," in *Advanced Computing and Intelligent Technologies*, ed: Springer, 2022, pp. 395-406.
- [8] T. D. Cochrane, V. Narayan, S. Aiello, M. Alizadeh, J. Birt, E. Bone, N. Cowie, M. Cowling, C. Deneen, and P. Goldacre, "Analysing mobile learning designs: A framework for transforming learning post-COVID," *Australasian Journal of Educational Technology*, vol. 38, pp. 1-21, 2022.
- [9] D. Furió, M. C. Juan, I. Seguí, and R. Vivó, "Mobile learning vs. traditional classroom lessons: a comparative study," *Journal of Computer Assisted Learning*, vol. 31, pp. 189-201, 2015.
- [10] A. M. Al-Rahmi, W. M. Al-Rahmi, U. Alturki, A. Aldraiweesh, S. Almutairy, and A. S. Al-Adwan, "Acceptance of mobile technologies and M-learning by university students: An empirical investigation in higher education," *Education and Information Technologies*, pp. 1-22, 2022.
- [11] M. L. Bernacki, J. A. Greene, and H. Crompton, "Mobile technology, learning, and achievement: Advances in understanding and measuring the role of mobile technology in education," *Contemporary Educational Psychology*, vol. 60, p. 101827, 2020.
- [12] D. Jain, P. Chakraborty, and S. Chakraverty, "Smartphone apps for teaching engineering courses: Experience and scope," *Journal of educational Technology systems*, vol. 47, pp. 4-16, 2018.
- [13] M. Bano, D. Zowghi, M. Kearney, S. Schuck, and P. Aubusson, "Mobile learning for science and mathematics school education: A systematic review of empirical evidence," *Computers & Education*, vol. 121, pp. 30-58, 2018.
- [14] D. Mutambara and A. Bayaga, "Determinants of mobile learning acceptance for STEM education in rural areas," *Computers & Education*, vol. 160, p. 104010, 2021.
- [15] S. Papadakis, "Advances in Mobile Learning Educational Research (AMLER): Mobile learning as an educational reform," *Advances in Mobile learning educational research*, vol. 1, pp. 1-4, 2021.
- [16] L. Dias and A. Victor, "Teaching and learning with mobile devices in the 21st century digital world: Benefits and challenges," *European Journal of Multidisciplinary Studies*, vol. 7, pp. 26-34, 2022.
- [17] R. Al-Jarf, "Specialized dictionary mobile apps for students learning English for engineering, business and computer science," *Journal of Humanities and Education Development (JHED)*, vol. 4, pp. 1-9, 2022.