

**STUDENT PERCEPTION ANALYSIS ON
SMART CAMPUS IN NATIONAL DEFENCE
UNIVERSITY OF MALAYSIA (NDUM)**

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MASTER OF SCIENCE (COMPUTER SCIENCE)

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ABSTRACT

With the present advancement of science and technology such as Internet of Things (IoT), Big Data, Mobile Apps, High Speed Internet and Cloud Computing in Malaysia, it is time for smart campuses to be built and National Defence University of Malaysia (NDUM) should not fall behind. The smart campus is the improved form of a digital university, that provides better academic atmosphere for the campus residents.

A smart campus improves education, research, design, and delivering the relevant higher learning modules in order to pursue the most recent developments in ICT technology that can drive future educational growth and innovation. In summary, the smart university is to construct a safe and secure, stable, ecologically friendly, and energy-efficient campus. However, there is no standard smart campus concept as of yet. Nevertheless, status quo shows that there are no standard guidelines to follows in implementing smart campuses. Moreover, the smart campus concepts depend on the specific campus environment.

The main contribution of this thesis is to evaluate the student's perceptions on the smart campus from various application for each smart element. A total of 912 students from NDUM have participated as valid observations for data analysis. The data collected from the case study is analyzed using the Relative Importance Index (RII) approach. By assigning an RII to each criterion, the degree of importance of each criterion is determined, and they can be classified accordingly. The quantitative data is analyzed using the IBM SPSS software version 23 for descriptive statistics and analysis.

Data measurement in this research is made using mean, median, and standard deviation including RII for measuring the important level of each smart campus application.

The proposed smart campus framework is made up of four smart campus elements which are smart energy, smart card, smart learning, and smart classroom. These four elements and eleven applications are selected based on the respondent's opinions on the most important applications for each element in smart campus implementation.

The main contribution from this research is the evaluation of student's perception of the smart campus applications in NDUM which could be used as a benchmark for High Education Institution (HEI) to develop their smart campus concept. Future work could focus on the feedback from the staff and lecturers' points of view to propose a solid conceptual smart campus framework.

ABSTRAK

Dengan perkembangan semasa dunia sains dan teknologi kini mempunyai teknologi Data Besar (*Big Data*), *Internet of Things (IoT)*, pengkomputeran awan, dan Internet mudah alih di Malaysia. Kini sudah tiba masanya kampus pintar perlu ditubuhkan dan semua Institusi Pengajian Awam dan Swasta tidak harus ketinggalan. Kampus pintar adalah versi universiti digital yang dinaik taraf, menyediakan persekitaran akademik yang lebih kondusif kepada pensyarah dan pelajar.

Kampus pintar perlu dipertingkatkan bagi pendidikan, penyelidikan, reka bentuk, dan penyampaian modul pengajian tinggi yang sesuai untuk meneruskan perkembangan terkini teknologi ICT yang dapat memacu pertumbuhan dan inovasi pendidikan masa depan. Secara ringkasnya, kampus pintar dapat membina kampus yang selamat dan terjamin, stabil, mesra alam, dan menjimatkan tenaga. Namun, setakat ini, tiada konsep kampus pintar yang khusus untuk diikuti setiap Universiti Awam (UA). Di samping itu, sehingga ke hari ni, masih tiada lagi Garis Panduan Pembangunan Kampus Pintar untuk digunapakai. Oleh yang demikian, pembangunan kampus pintar bagi setiap UA adalah berdasarkan persekitaran masing-masing.

Tesis ini disediakan dari segi menilai persepsi pelajar terhadap pembangunan kampus pintar terhadap pelbagai aplikasi di dalam setiap elemen kampus pintar. Seramai 912 pelajar Universiti Pertahanan Nasional Malaysia (UPNM) telah turut serta di dalam kaji selidik dan data –data tersebut telah dianalisis. Setiap sampel data telah dinilai menggunakan kaedah Pengiraan Indeks Kepentingan Relatif (RII). Dengan menggunakan kaedah ini, darjah aplikasi berimpak tinggi dapat dikenalpasti. Semua kuantitatif data telah diukur penilaiannya menggunakan perisian IBM SPSS versi 23.

Pengukuran data dalam penyelidikan ini dibuat menggunakan min, median, dan sisihan piawai disamping pengiraan RII untuk mengukur tahap kepentingan setiap aplikasi kampus pintar. Keputusan dari kajian selidik menunjukkan pelajar telah memilih sebelas aplikasi sebagai berimpak tinggi.

Rangka kerja kampus pintar yang dicadangkan terdiri daripada empat (4) elemen kampus pintar iaitu tenaga pintar, kad pintar, pembelajaran pintar, dan bilik darjah pintar. Keempat-empat elemen dan sebelas aplikasi ini dipilih berdasarkan hasil dapatan dari responden mengenai aplikasi yang paling penting dan perlu dilaksanakan bagi setiap elemen dalam pelaksanaan kampus pintar. Hasil dari penyelidikan ini boleh dijadikan penanda aras bagi UA lain di dalam membangunkan Pelan Pembangunan Kampus Pintar mereka. Sebagai penutup, di masa akan datang penyelidikan ini boleh memberi tumpuan kepada maklum balas daripada kakitangan dan sudut pandangan pensyarah dalam merangka kertas kerja pembangunan kampus pintar

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APPROVAL

The Examination Committee has met on **6th October 2021** to conduct the final examination of **Mohd Faizal bin Mustafa** on his degree thesis entitled **STUDENT PERCEPTION ANALYSIS ON SMART CAMPUS IN NATIONAL DEFENCE UNIVERSITY OF MALAYSIA (NDUM)**. The committee recommends that the student be awarded the Master of Science (Computer Science).

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TABLE OF CONTENTS

	Page
ABSTRACT	ii
ABSTRAK	iv
ACKNOWLEDGEMENTS	vi
APPROVAL	vii
DECLARATION	ix
TABLE OF CONTENTS	x
LIST OF TABLES	xiv
LIST OF FIGURES	xv
LIST OF ABBREVIATIONS	xvii
CHAPTER	
1 INTRODUCTION	
1.1 Background of the research	1
1.2 Problem Statement	4
1.3 Research Objectives	5
1.4 Research Questions	5
1.5 Research Scope and Limitation	6
1.6 Significance of Study	6
1.7 Thesis Outline	7
2 LITERATURE REVIEW	

2.1 Introduction	9
2.2 The Internet of Things (IoT)	11
2.3 IoT in Education	11
2.3.1 Cloud Computing Services	12
2.3.2 Cloud Computing in Education	14
2.3.3 Smart Learning	16
2.3.4 Smart Classroom	19
2.3.5 Smart Laboratories	22
2.4 IoT in Waste and Water Management	22
2.5 IoT in Cashless Campus	24
2.6 IoT in Safer Campus	28
2.6.1 Video Surveillance	31
2.6.2 Smart Locks and Access Control	31
2.6.3 Tracking Assets	32
2.6.4 Tracking People	33
2.7 IoT in Energy Efficiency and Cost Saving	33
2.7.1 Maintenance Automation Control	34
2.8 IoT in Mobile Application	34
2.8.1 Smart Attendance System	36
2.8.2 QR-Code	37
2.8.3 Occupancy Detection and Tracking	43
2.8.4 Achieve Efficient Parking	43
2.9 IoT in Smart Library	44
2.10 Smart Campus Challenges	45

2.11	Recent Smart Campus Framework	46
2.12	Research Gap	51
2.13	Summary	52
3	RESEARCH METHODOLOGY	
3.1	Introduction	53
3.2	Research Design	54
3.2.1	Sample Size	54
3.2.2	Questionnaires Survey Design	56
3.2.3	Data Collection Process	57
3.2.4	Data Assessment and Analysis	58
3.3	Summary	60
4	DATA ANALYSIS AND RESULTS	
4.1	Introduction	61
4.2	Smart Campus Student Survey	61
4.2.1	Demographic Analysis	62
4.2.2	Background Analysis	66
4.2.3	Perception Analysis	69
4.2.4	Usability Analysis	84
4.3	The Proposed Smart Campus Framework	88
4.4	Summary	91

5	CONCLUSION AND FUTURE WORK	
	5.1 Introduction	92
	5.2 Main Contribution and Conclusion	92
	5.3 Future Works and Limitations	98
	5.4 Summary	98
	REFERENCES	100
	LIST OF PUBLICATION	107
	APPENDIX	108
	BIODATA OF STUDENT	109

LIST OF TABLES

TABLE NO.	TITLE	PAGE
1	Students with Smartphones	67
2	NDUM and Smart Campus Characteristics	68
3	RII calculations for Question A.	71
4	RII calculations for Question B.	73
5	RII calculations for Question C.	75
6	RII calculations for Question D.	77
7	RII calculations for Question E.	79
8	The impact level based on RII value	80
9	RII values for all applications with impact level	81
10	What are the challenges and issues faced in implementing the Smart Campus?	87

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
1.1	Element of Smart Campus	2
1.2	Smart Technology Enabled Integration and Governance	3
2.1	Idea of Smart Campus	10
2.2	Microsoft Education Cloud Solution	13
2.3	Education Cloud	15
2.4	Smart Learning Key challenges, adopted	17
2.5	Smart Classroom Concept	20
2.6	Main Equipment for Smart Classroom	21
2.7	Higher Education 4.0	27
2.8	Cashless Campaign on Campus	27
2.9	CCTV Surveillance	29
2.10	Traditional CCTV vs IP base CCTV	30
2.11	Tracking People by Face Recognition	32
2.12	Access Control & Attendance	33
2.13	Mobile application architecture	35
2.14	QR Code	37
2.15	USM Campus Virtual Tour	43
2.16	IoT in Making Smart Parking Systems	44
2.17	IoT Based Secured Smart Library System	45
2.18	UNITEN Smart University Framework	46
2.19	UM Smart University Framework	47
2.20	USIM Smart University Framework	48
2.21	UPM Smart University Framework	49
2.22	UTM Smart University Framework	50
2.23	UNIMAP Smart University Framework	51
3.1	Research Methodology Steps	53
3.2	Sample Questionnaire Survey Design	57
3.3	The process of collecting information	57

3.4	Inputs, activities and results of empirical studies	60
4.1	The print-screen of the online survey	62
4.2	The percentage of the student's level of study/studied	63
4.3	The percentage of students and their year of studies	64
4.4	The percentage of students and their perspectives faculties/academic centers	65
4.5	Word Clouds' Responses	68
4.6	Question A responses – the importance rate of each application in smart cards element.	71
4.7	Question B responses – the importance rate of each application in smart classroom element.	73
4.8	Question C responses – the importance rate of each application in smart energy element.	75
4.9	Question D responses – the importance rate of each application in smart sensor element.	76
4.10	Question E responses – the importance rate of each application in smart learning element.	79
4.11	The number of student's opinion on the campus resident's knowledge on how to use the existing technology	84
4.12	The number of challenges and issues related to the Smart Campus implementation	87
4.13	Proposed NDUM Smart Campus	88
4.14	Proposed Smart Campus Project Planning Schedule	91

LIST OF ABBREVIATIONS

RII	Relative Importance Index (RII)
IR 4.0	Fourth Industrial Revolution
IoT	Internet of Things
ICT	Information Communication Technology
MoHE	Ministry of Higher Education
HEI	Higher Education Institution
SPSS	Statistical Package for the Social Sciences
RFID	Radio-frequency identification
QR	Quick Response
SaaS	Software as a Service
M365	Microsoft 365
DC	Data Centre
HCI	Human Computer Interaction
CCTV	Closed-circuit television
PoE	Power over Ethernet
ATM	Automated Teller Machine
NDUM	National Defense University Malaysia
ID	Identity Document
PJTI	General Tun Ibrahim Library
Wi-Fi	Wireless Fidelity
TCP / IP	Transmission Control Protocol/ Internet Protocol
BPP	<i>Bahagian Pembangunan dan Penyelenggaraan, UPNM</i>
PPA	<i>Pusat Pembangunan Akademik, UPNM</i>

CHAPTER 1

INTRODUCTION

1.1 Background of the research

A traditional campus consists of educational buildings such as libraries, classrooms, residential halls, cafeterias, student centers, computer labs, and administration offices. These facilities were built to provide students with an exclusive study environment where they would spend most of their campus life.

On the latest developments and trends in education, cloud computing and high-speed internet matters have attracted many researchers inside and outside of the country as their application has become increasingly popular and much more interesting to explore. Nowadays, many traditional data recovery centers have slowly converted into cloud computing technology based on the lower cost and less skilled man powers to sustain (Y. L. Liu, Zhang, and Dong, 2014).

A typical smart campus would have three phases: infrastructure, operations, and, of course, people. Each of these phases would be pervaded with intellect, but more

importantly, they would work in a unified and incorporated method to utilize resources efficiently (M. Liu and Li, 2018). Some of the features are shown in Figure 1.1:

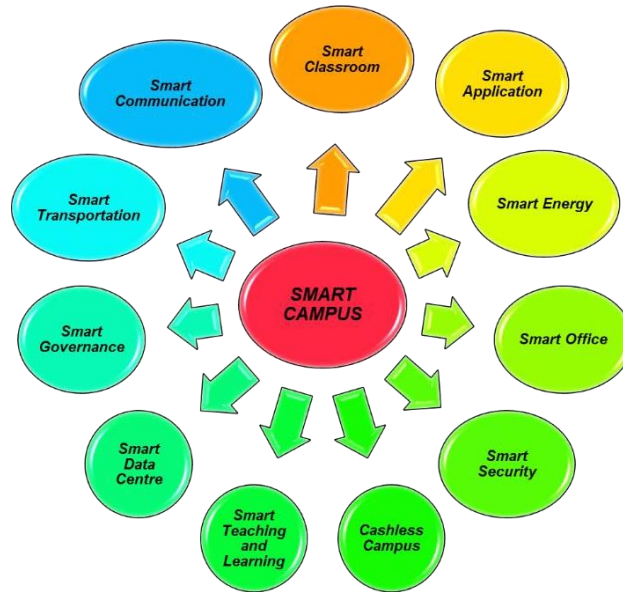


Figure 1.1: Element of Smart Campus (M. Liu and Li, 2018).

Colleges and universities are no longer “ivory towers”, a smart campus must be integrated within the community. In order to achieve the merging of physical and digital space, a network must be built that includes big data as the core, intelligent solution systems as nerve-endings to help solve online issues, Mobile Internet as the nerve, and smart applications as the support system (Yu, 2012).

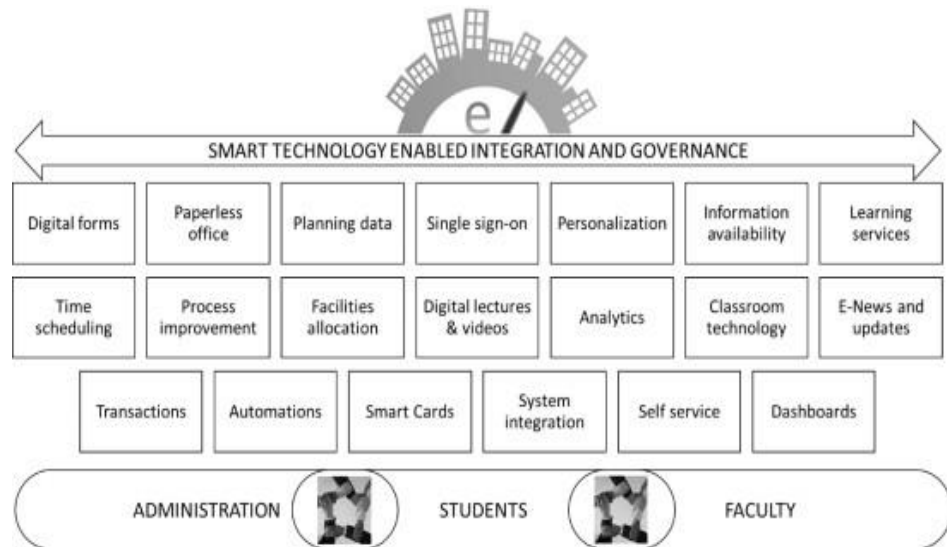


Figure 1.2: Smart Technology-Enabled Integration and Governance (Alghamdi and Shetty, 2016).

The smart campus can make them work together within the smart, fast, and the intelligent campus provides support for the management of the campus, teaching, learning, or research (Alghamdi and Shetty, 2016). The teaching environment for lecturers and students will alter as a result of a smart campus, particularly on a campus where innovative resources are readily available (refer to Figure 1.2).

The characteristics of a smart campus, include:

- High-speed ubiquitous Internet;
- Widespread usage of intelligent terminals;
- Convenient space for cooperation; and,
- Reference centers for ICT materials, documentation, and research and development of innovative ideas.

1.2 Problem Statement

The new emerging technologies, in particular the Industrial Revolution of 4.0 (IR 4.0), have had influenced on education transformation. Educational analysts have predicted a significant effect on the diversity of ICT technology advancement in National Education in recent years. Thus, public universities (UAs) nationwide should focus on higher education Themes 4.0: Knowledge, Industry, and people (Higher Education 4.0 – Knowledge, Industry, Humanity) which includes several initiatives introduced by the Ministry of Higher Education (MoHE) in line with the Malaysian Education Development Plan 2015-2025 (Higher Education). However, there are problems encountered, status quo shows that there are no standard guidelines to follows in implementing smart campuses. Moreover, the smart campus concepts depend on the specific campus environment.

The problem to implement Smart Campus from requirement students itself. So we need to know student's current situation based on activities in traditional way and what initiatives will be implement to enhance the students' quality of experience in the smart campus especially during Pandemic time.(Musa, Ismail, and Fudzee, 2021)

This research focuses the perspective view of implementation smart campus. Based on review of the supporting technologies and existing traditional way propositions, we define and we purposed smart campus framework that primarily intentions at inspiring students' learning experience and universities' education quality with the latest technologies. The expected outcome of this work is to provide a framework of the smart campus for teaching and learning (Dong et al., 2020).

NDUM should focus on the framework for the implementation of the smart campus so that each of the stakeholders can get remunerations from it (Musa, Ismail, and Fudzee, 2021)

1.3 Research Objectives

The objectives of this research are as follows:

- i. To study the smart campus concept and services.
- ii. To analyze the components of smart campuses, and identify the challenges through a case study on the National Defence University of Malaysia (NDUM) using quantitative analysis.
- iii. To propose a smart campus framework for NDUM based on Smart Campus architecture.

1.4 Research Questions

The aim of this research is to propose a framework to determine base on questions for implementation Smart Campus in NDUM. The questions of this research are as follows:

RQ1. What are the smart campus concept and its services?

RQ2. What are the students' understanding of a smart campus?

RQ3. What are the students' perception on implementing smart campus applications in NDUM?

RQ4. What are the critical challenges facing the implementation of a smart campus in NDUM?

RQ5. What are the smart campus elements and applications that can be adapted to build a smart campus solution in NDUM?

1.5 Research Scope and Limitation

The main purpose of this research is to concentrate on smart campus solutions for NDUM. To achieve the research objectives, the standard or familiar smart campus components are extracted from previous research studies on smart campuses. In order to select the most important components and their application suitable for the NDUM environment, the quantitative method with a suitable number of respondents is measured. Based on the assessment, the smart campus framework would be proposed. The respondents for this research are mainly students from different programs and faculties.

1.6 Significance of Study

Below is the list of significances of this study:

- i. This research aims to propose a framework that can be considered for existing traditional universities' campuses to turn into smart campuses solutions.
- ii. The anticipated results of this research include a benchmark for HEI in planning smart campus initiatives.

- iii. The top management in HEI can decide to adopt the proposed framework for a smart campus solution. Eventually, creating a conducive teaching and learning environment through ICT resources provided and ensure the continuity of the university activities.
- iv. This research is significant as it will contribute to the knowledge of implementation on smart campuses in HEI as well as suggestions for future research.
- v. Future areas of research could include in adopted the proposed framework and evaluate on boarding schools and colleges.
- vi. Furthermore, having a smart campus has the effect of reducing physical touch and dirty surfaces, especially during pandemic. The sensitivity of fingerprint biometrics and door access should be changed to iris biometrics to minimize the duration of obligatory contact and reduces the risk of germ transmission.

1.7 Thesis Outline

This research focuses on proposing the smart campus framework based on student's feedback towards the impact level of each selected smart campus application. This thesis consists of five (5) chapters and is outlined in the following order:

Chapter One introduces the background of study on smart campus elements and their application. The problem statement is extracted from the official statement from the Ministry of Education, Malaysia which smart campus should be implemented by the year 2025 to all public universities. However, until now, there are currently no standard guidelines to follows in implementing smart campuses. The research objectives as well