

Feasibility Study of Smart Campus as Downscaled Smart City

**Mohd Erwan Sanik^{1*}, Nur Maghfirah Zulkifli¹, Fatin Nur
Izzati Hussin¹, Nur Shafiqah Mohd Haekal¹**

¹Universiti Tun Hussein Onn Malaysia,
KM 1, Jalan Panchor, Edu-Hub Pagoh, Pagoh, 84000, MALAYSIA

DOI: <https://doi.org/10.30880/mari.2021.02.02.010>

Received 25 April 2021; Accepted 16 March 2021; Available online 30 May 2021

Abstract: Smart city is the combination of “smart city” and “digital city” concept where can integrates information and communication technology and various physical devices connected to the Internet of Things network and optimize the efficiency of city operations and services to connect with citizens. In Malaysia, people were lack of exposure to the smart city concept especially people in rural and suburban areas as well as students in various levels because it is not well introduced yet. Therefore, this study was carried out to produce feasibility study of smart campus as a downscaled of smart city. Google Form questionnaire was distributed to 384 respondents among students from various universities. Smart elements such as smart parking system, smart streetlight system, smart waste management, smart system for indoor environmental quality, smart bus management, smart security and safety, and smart campus living and learning are taken into consideration in the questionnaire. The research significance of this project is to identify understanding level of smart city concept among students. Moreover, it also study about suitability of smart campus during pandemic Covid-19 and the implementation of smart campus at UTHM Pagoh. The questionnaire consists of respondents' demographic, understanding level on smart campus and smart city with and without assisted video, important of smart campus characteristic and use of smart matric card, implementation of smart campus and smart city during Covid-19 and application of smart campus on UTHM Pagoh. The result shows that respondents' understanding was at medium level and significantly improved after watching the given informative video. Respondents also strongly agree on the statement of implementation of smart campus during pandemic Covid-19 because it have many benefits as it continued the teaching and learning process.

Keywords: Smart Campus, Smart City, Smart Living, Learning

1. Introduction

According to the University of Genova, smart city and digital city concept have been recurring topics, especially after 2010 [1]. It is because, smart and digital urban development is one of the strategies to improve the quality of life in the cities. Moreover, politicians, governments and hi-tech companies also thinks that the concept is refer to the ideal city that is more suitable to respond the needs

of citizens. However, smart city concept has been used in developing the idea of smart campus [2]. City is usually huge with involvement of many ownerships and stakeholders which is more complicated to manage. In a rather different situation, universities have control over their lands, and they own all the buildings, networks and have a captive audience in terms of the students. The smart campus idea was floated in Spring 2016 [3].

In Malaysia, people in rural and suburban and some in urban areas have lack of exposure to the smart city concept because it is not well introduced yet among Malaysians. The Housing and Local Government Ministry has launched the Malaysia Smart City Framework, a book that will serve as a guideline for local governments all across the country to develop cities into smart cities [4]. The concern is the level of acceptance among Malaysian if the level of understanding is low. Smart city is introduced in this study by highlighting the concept of smart city into smart campus through videos included in the questionnaire.

Moreover, this study was conducted to fulfil three objectives which are to identify the elements in a smart campus by using the concept of smart city, to measure the understanding of targeted population among students with regard to smart city and smart campus concepts and the last is to study the suitability of the smart campus implementation during current Covid-19 pandemic.

This project focuses on introducing smart campus with smart city concept through several smart elements such as smart parking system in open area, smart street light system, smart bus management, smart waste management, smart security and safety, innovation system for indoor environmental quality (IEQ) and smart campus living and learning. This study also study about students' understanding of the concept and the implementation of smart campus as a small scale of smart city during Covid-19.

2. Materials and Methods

This project was started by searching articles that related with the topic. Then, identification of smart campus elements such as smart parking, smart waste management, smart streetlight, smart IEQ, smart bus management, smart security and smart campus living and learning that will take into consideration. After that, responses were gathered from local university students using questionnaires through Google Form. The understanding of targeted population regarding smart city concept in terms of smart campus as downscaled smart city were measured from the responses. In order to cater current issues, the implementation of smart campus during Covid-19 also had been asked in the questionnaire. The results then were discussed and concluded.

The questionnaire consist of five likert scales to measure the understanding of smart campus concept, namely strongly disagree, somewhat disagree, neither agree, somewhat agree and strongly agree. The parts of the questionnaire are as follows:

1. Respondents' demographic
2. Understanding on Smart Campus and Smart City without any guidance from video
3. Understanding on Smart Campus and Smart City with guidance from video
4. Important of Smart Campus characteristic
5. Important of smart matric card
6. Implementation of Smart Campus and Smart City during Covid-19
7. Application of Smart Campus on UTHM Pagoh

3. Results and Discussion

This section presents the result of the study obtained through questionnaire that focusing on targeted student population. This result of the research shows in terms of pie charts and table as to make it clearly and easily to understand. Regarding number of data, it is collected from 10% of targeted population which is 384 responses [5].

3.1 Demographic Information of Respondent

Demographic elements that were asked consist of gender, age, race and institute of higher education. Based on the feedback, out of 384 respondents, 59.4% or 228 respondents are female and 40.6% are male which equal to 156 respondents. Next element is age that listed in few of categories. From the data shows the youngest respondent is 18 years old and 27 years old for the oldest. The categories of age divided into 4 groups starting from the highest record of the data which is average age 18-20 years old with 72.7% or 280 respondents then 20.6% or 80 respondents of 21-23 years old categories while there are 5.5% of 24-26 years old and the lowest record of categories is 27 and above years old with percentage of 1.3% or 5 respondents.

There are 3 races response to the questionnaire with 89.8% are Malay or in other words, there are 346 respondents are Malay. The balance of the overall data obtained as 30 Chinese and 8 of Indian respondents. Figure 1 shows the percentages of each institute of higher education of this particular respondents.

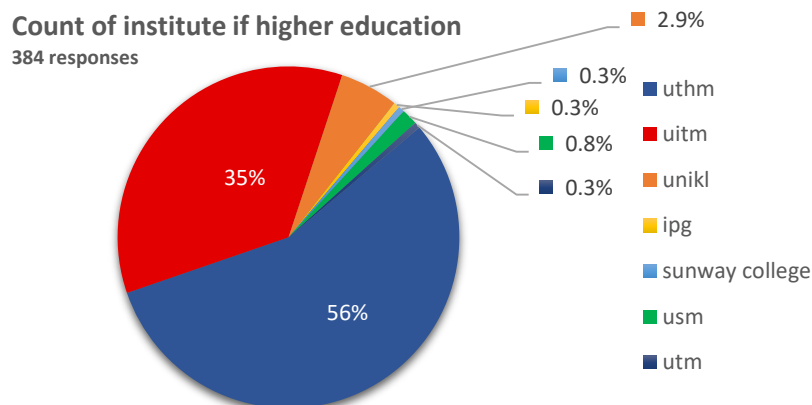


Figure 1: Pie chart of percentages of institute of higher education

Referring to Figure 1, various universities' students responded to the questionnaire including Universiti Tun Hussein Onn Malaysia (UTHM), Universiti Teknologi Mara (UiTM), Universiti Kuala Lumpur (UniKL), Institut Pengajian Guru (IPG), Sunway College, Universiti Sains Malaysia (USM), and Universiti Teknologi Malaysia (UTM). Involvement of various of higher institutions is essential in order to have smart campus network in the future.

3.2 Understanding on Smart Campus and Smart City without Any Guidance from Video

Based on Table 1, the respondents have indeterminate level of understanding about smart campus and smart city concept without any guidance from video as shown by highest average of 35.7% respondents for both statements. It shown that most respondents have heard about smart city and smart campus but somehow do not have any details on the subject matter. Therefore, a short video is provided to briefly educates the respondents before answering next question.

Table 1: Understanding on smart campus and smart city without any guidance from video

Statement	Strongly Disagree (1)	Somewhat Disagree (2)	Neither agree (3)	Somewhat Agree (4)	Strongly Agree (5)
I have an understanding about smart campus concept	5.2 (20)	24 (92)	37.8 (145)	23.2 (89)	9.9 (38)
I have an understanding about smart city concept	5.5 (21)	24.2 (93)	33.6 (129)	26 (100)	10.7 (41)
Average Percentage	5.3	24.1	35.7	24.6	10.3

Notes: percentage % (number of respondents)

3.3 Understanding on Smart Campus and Smart City with Guidance from Video

Table 2 shows that after watching the video, the respondents' understanding level somehow increased as shown in the response of the first statement which 214 and 145 respondents were somewhat and strongly agreed, respectively. While, 217 and 131 respondents were somewhat and strongly agreed, respectively, with the second statement. It shows that the concept of smart city and smart campus are not difficult to understand and the provided video might also explained it well. This may also due to basic knowledge that they already possessed before answering the questionnaire.

Table 2: Understanding on smart campus and smart city with guidance from video

Statement	Strongly Disagree (1)	Somewhat Disagree (2)	Neither agree (3)	Somewhat Agree (4)	Strongly Agree (5)
From the video, I have a better understanding about smart campus and smart city	0.3 (1)	0.8 (3)	5.5 (21)	55.7 (214)	37.8 (145)
Smart campus or smart city is a new era of innovation which uses high technology, more efficient, energy-saving and others	0 (0)	1.6 (6)	7.8 (30)	56.5 (217)	34.1 (131)
Average Percentage	0.2	1.2	6.7	56.1	36.0

Notes: percentage % (number of respondents)

The elements of smart campus are as shown in Table 3. The understanding level about elements were studied after watched the video and it can be summarized that understanding level were high which the respondents were agreed with the statement. Referring to Table 3, the highest average is somewhat agreed with 45.8% respondents.

Table 3: Statement of understanding level on characteristic of smart campus as a downscaled of smart city

Statements:	Strongly disagree (1)	Somewhat disagree (2)	Neither agree (3)	Somewhat agree (4)	Strongly agree (5)
I think I have knowledge about the characteristic of a smart campus as a small scale					
Smart parking	0.3 (1)	9.4 (36)	15.4 (59)	51.6 (198)	23.4 (90)
Smart streetlight	0.5 (2)	9.6 (37)	15.1 (58)	49.2 (189)	25.5 (98)
Smart waste management	0.3 (1)	11.5 (44)	18.5 (71)	41.9 (161)	27.9 (107)
Smart bus management	1.3 (5)	15.1 (58)	15.4 (59)	42.7 (164)	25.5 (98)
Smart innovation system for indoor environmental quality	2.6 (10)	15.6 (60)	14.6 (56)	44.5 (171)	22.7 (87)
Smart security and safety	0.5 (2)	9.6 (37)	10.7 (41)	48.4 (186)	30.7 (118)
Smart living and learning	2.1 (8)	12.8 (49)	12.5 (48)	42.2 (162)	30.5 (117)
Average Percentage	1.1	11.9	14.6	45.8	26.6

Notes: percentage (number of respondents)

3.4 Important of Application Smart Campus Characteristics at the Campus

The researcher also highlights the question about the important of application of smart campus characteristic at the university. Overall, there are seven questions in this part that were explained and analysed as shown in Table 4. It can be summarized that only small percentage of respondents were not agreed with the statements which consist of 5.5% respondents. While, the percentage of respondents that were somewhat and strongly agreed of all statements are 80.6%. Then, it shows that majority of respondents voted to have smart campus devices at the university. It is a hope for these students to see all the mentioned facilities to be equipped in their university and to have more conducive study environment.

Table 4: Important of application smart campus characteristic at campus

Statements: I think my campus should have:	Strongly disagree (1)	Somewhat disagree (2)	Neither agree (3)	Somewhat agree (4)	Strongly agree (5)
Parking using sensor which know where the parking lot is empty	1.8 (7)	6.8 (26)	14.3 (55)	36.5 (140)	40.6 (156)
Streetlight which turns on when the pedestrian was detected	0.8 (3)	4.7 (18)	12.8 (49)	39.3 (151)	42.4 (163)
Waste management which sends the information to the collector when the dustbin is full	0.5 (2)	4.2 (16)	9.6 (37)	36.5 (140)	49.2 (189)
Smart bus management which arrive at the time and know where the bus is	0.3 (1)	3.1 (12)	13.3 (51)	36.2 (139)	47.1 (181)
Smart innovation system for indoor environmental quality	1 (4)	7.3 (28)	15.1 (58)	35.9 (138)	40.6 (156)
Smart security and safety which use the new technology of video surveillance and smart things	0.3 (1)	3.6 (14)	10.7 (41)	34.1 (131)	51.3 (197)
Smart campus living and learning which using of reduction of operational time and increase efficiencies of the things	0.8 (3)	2.9 (11)	14.8 (57)	39.8 (153)	41.7 (160)
Average Percentage	0.8	4.7	12.9	36.9	44.7

Notes: percentage (number of respondents)

3.5 Important of Implementation of Smart Matric Card

Matric card is very synonym with university students because it is like an identity card within campus territory. Therefore, in a smart campus, matric card must also to be smart. Hence, the researchers carry out the survey about the important of implementation of smart matric card among the students. There are three suggestions proposed for application of smart matric card and an open suggestion by respondents on what the smart matric card should be able to do. It can be concluded that only minimum numbers which are 4.1% respondents were not agreed and 70.3% were agreed with the statements. The detail is as presented in Table 5.

Table 5: Characteristic of smart matric card

Statements:	Strongly disagree (1)	Somewhat disagree (2)	Neither agree (3)	Somewhat agree (4)	Strongly agree (5)
I think my campus should have:					
Access to the classroom, library and laboratory as used in smart lock and access control	0.5 (2)	2.1 (8)	15.9 (61)	32 (123)	49.5 (190)
Class attendance system or identity-check	0.8 (3)	2.9 (11)	14.8 (57)	34.1 (131)	47.4 (182)
E-Wallet function to pay for meals, parking and other fees on campus	1.6 (6)	4.2 (16)	16.4 (63)	33.1 (127)	44.8 (172)
Average Percentage	1.0	3.1	15.7	33.1	47.2

Notes: percentage (number of respondents)

Besides, the researchers also asked the important to have smart matric card and it can be concluded that 89.1% respondents agreed to have smart matric card with zero votes for strongly disagreed, as can be seen in Table 6.

Table 6: Important to have smart matric card

Statements	Strongly disagree (1)	Somewhat disagree (2)	Neither agree (3)	Somewhat agree (4)	Strongly agree (5)
From the question above, I think it is very important to have smart matric card	0 (0)	1.6 (6)	9.4 (36)	38.3 (147)	50.8 (195)
Average Percentage	0	1.6	9.4	38.3	50.8

Notes: percentage (number of respondents)

3.6 Implementation of Smart Campus and Smart City during Covid-19

Considering of the current issue, this study also obtains a response to the Covid-19 pandemic that may be addressed through the implementation of a smart campus and smart city. A question was being asked regarding this matter: "Is smart campus or smart city relevant to be implemented during this pandemic". The result shows that 81% or 311 respondents agreed and 19% or 73 of it disagreed. Later, three statements were asked to respondents who agreed with this question. The result is as shown in Table 7 which is most of the respondent agreed with average of 84.4% for all statements.

Table 7: Reason to implement smart campus and smart city during Covid-19

Statements:	Strongly disagree (1)	Somewhat disagree (2)	Neither agree (3)	Somewhat agree (4)	Strongly agree (5)
If yes, what are the reason					
Crisis can be managed wisely and more efficient	1.2 (4)	2.1 (7)	11.5 (38)	54.7 (181)	30.5 (101)
Save energy and time consuming because using the high technology	1.2 (4)	2.4 (8)	12 (40)	48.5 (161)	35.8 (119)
Crisis can be handled quickly	0.6 (2)	2.1 (7)	13.6 (45)	46.7 (155)	37 (123)
Average Percentage	1.0	2.2	12.4	50.0	34.4

Notes: percentage (number of respondents)

As for the remaining 19% respondents who did not agree with the previous question, two related statements were given to get their response and the result is as presented in Table 8. More than half of these respondents were agreed that to deal with the crisis, it is depending on human and not the technology and wasting money to buy high technology machine.

Table 8: Reason not to implement smart campus and smart city during Covid-19

Statements: If No, what are the reason	Strongly disagree (1)	Somewhat disagree (2)	Neither agree (3)	Somewhat agree (4)	Strongly agree (5)
To deal with the crisis, it is depending on human and not the technology	5.1 (9)	15.3 (27)	19.9 (35)	35.2 (62)	24.4 (43)
Wasting money to buy high technology machine	8.7 (15)	15.7 (27)	23.3 (40)	35.5 (61)	16.9 (29)
Average Percentage	6.9	15.5	21.6	35.4	20.7

Notes: percentage (number of respondents)

3.7 Application of Smart Campus at Universiti Tun Hussein Onn Malaysia (Pagoh Campus)

In conducting this study, the researchers also carry out survey regarding the application of smart campus characteristic such as smart parking, smart bus management, smart waste management, smart living and learning, smart security and safety and others in UTHM Pagoh Campus. The result is as shown in Figure 2 and the majority of students say that smart campus implementation is in the range of 21 to 40%. While 22.9% say that the range is in the range of 41 to 60% and 20.1% students believe it is only at 0 to 20%. This result showed that the UTHM Pagoh branch campus still lack of smart campus application, may be due to the priority given to the main campus over the branch campus in enhancing the smarter facilities.

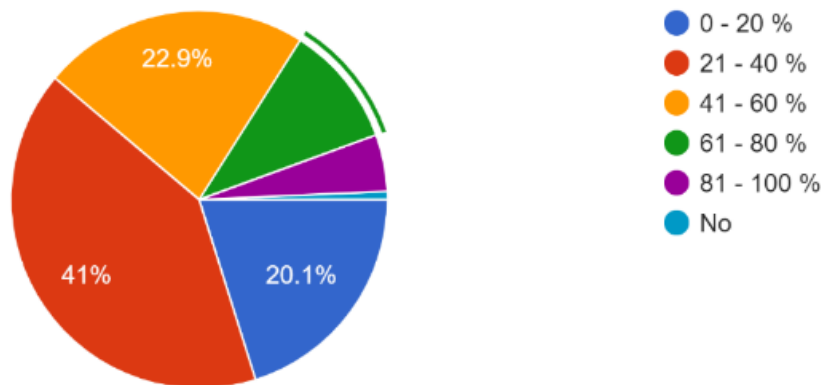


Figure 2: Application of smart campus at UTHM Pagoh

4. Conclusion

4.1 Concluding remarks

From this study it can be concluded that:

- i. The elements in the smart campus by using the concept of smart city were identified. The elements are smart parking, smart waste management, smart streetlight, smart IEQ, smart bus management, smart security and safety and smart campus living and learning.
- ii. The understanding of targeted population among students with regard to smart city and smart campus concept was measured. Overall, the level of understanding is at indeterminate level. However, it increased significantly after educating respondents through videos. Besides the important of smart campus characteristic also had been study and it shows that most of the respondents were agreed.

- iii. The suitability of smart campus implementation with regard to current Covid-19 pandemic was studied. Results show most of the respondents were agreed if the smart campus to be implemented as it had many benefits. One of it is the teaching and learning process will be continued as usual by using distance learning devices such as live streaming from lecturer's home, submit and download assignment using application and others.

4.2 Recommendations

Researchers should conduct more open-ended surveys to everyone without focusing solely on students and collecting results based on people's understanding of smart campuses and smart cities. Researchers can perform more accurate methods besides using Google Form such as using models to collect data based on people's understanding of smart city applications on smart campus.

Acknowledgement

All authors would like to thank Centre for Diploma Studies, University Tun Hussein Onn Malaysia (UTHM) for its support.

References

- [1] R.P. Dameri and A. Cocchia (2013). Smart City and Digital City: Twenty Years of Terminology Evolution, Proceedings of the X Conference of the Italian Chapter of AIS, Università Commerciale Luigi Bocconi, Milan (Italy). pp 119 – 126.
- [2] N. Verstaevel, J. Boes, and M. P. Gleizes (2018). From smart campus to smart cities issues of the smart revolution, IEEE SmartWorld Ubiquitous Intell. Comput. Adv. Trust. Comput. Scalable Comput. Commun. Cloud Big Data Comput. Internet People Smart City Innov. SmartWorld/SCALCOM/UIC/ATC/CBDCOM/IOP/SCI 2017 - Conf. Proc., no. April 2018, pp. 1–6.
- [3] Zofia Niemtus. (2019). Are University Campuses Turning into Mini Smart Cities?. Retrieved from link of website <https://www.theguardian.com/education/2019/feb/22/are-university-campuses-turning-into-mini-smart-cities>
- [4] Cindi Loo. (2019). Ministry launches Malaysia Smart City Framework, The Sun Daily on 23 September 2019. Retrieved from <https://www.thesundaily.my/local/ministry-launches-malaysia-smart-city-framework-BN1395377>
- [5] R. V Krejcie and D. W. Morgan, "Determining Sample Size For Research Activities" vol. 38, pp. 607–610, 1970.