CONJOINT ANALYSIS FOR MOBILE DEVICES FOR UBIQUITOUS LEARNING IN HIGHER EDUCATION: THE KOREAN CASE

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ABSTRACT
Despite the increasing importance of mobile devices in education, the essential features of these devices for ubiquitous learning have not been empirically addressed. This study empirically investigated the necessary conditions for using mobile devices as an educational tool for ubiquitous learning in higher education by a conjoint method. The results show that respondents want to use Window-based large-screen devices for their educational purposes; thus, current tablet PCs might not be suitable in terms of screen size and type of platform. The findings also implied that potential users want to receive ubiquitous access by using advanced cellular networks, but they do not need comprehensive functions related to office documentation on their mobile devices. Therefore, this study suggests that both policy makers and business players consider developing the optimal educational mobile device as soon as possible for the successful dissemination of ubiquitous learning.
Keywords: educational mobile device, ubiquitous learning, higher education, consumer preference, conjoint analysis

INTRODUCTION

The rapid development of information and communication technologies (ICTs) has had an impact on the way we teach and learn (Eristi et al., 2011; Martin et al., 2011; Suki & Suki, 2011) and various types of advanced technologies and equipment, including smart boards (Gursul & Tozmaz, 2010; Al-Qirim, 2011), smart classrooms (Sevindik, 2010) and mobile devices (El-Gayar et al., 2011; Eristi et. al, 2011; Williams & Pense, 2011), have been introduced in education. In particular, as indicated in earlier studies, mobile devices have a tremendous potential for use in education (Hussain & Adeeb, 2009; Kumar et al., 2010; Martin et al., 2011; Williams & Pense, 2011) because they have directly changed from electronic learning to ubiquitous learning environments, where students can use digital textbooks and other educational content anywhere and anytime (Jun & Zhi-yi, 2010; Kalhoro et al., 2010; Kumar et al., 2010; Liu et al., 2010). Therefore, mobile devices can effectively contribute to the early growth of ubiquitous learning in education, although several obstacles to their use, such as small screens and limited computational power (Economides & Grouspoulou, 2009; Jeon et al., 2010; Liu et al., 2010), have been mentioned.

Various studies have investigated the potential of mobile devices for ubiquitous learning by designing ubiquitous learning systems and confirming their effectiveness (Huang et al., 2008; Triantafillou et al., 2008; Kalhoro et al., 2010; Zahrani, 2010; Jeong & Hong, 2011; Shih et al., 2011; Wang & Wu, 2011) or examining users' learning process or adoption process using the technology acceptance model (TAM) (Liu et al., 2010; Suki & Suki, 2011). However, empirical research on identifying essential features of mobile devices as educational tools for ubiquitous learning has not yet been conducted. Consequently, this study attempted to investigate empirically optimal characteristics of mobile devices in higher education by using an analysis of consumer preferences. Consumer preference might be useful in determining the essential features that mobile devices should have because a large part of the development of ICT products has been driven by the pull of demand rather than the push of technology (Kim et al., 2005). Therefore, this study can contribute to a better understanding of the essential characteristics of mobile devices for ubiquitous learning in higher education.

The remainder of the paper is organized as follows: Section 2 reviews previous studies focusing on the potential of mobile devices for ubiquitous learning in education. Section 3 empirically examines consumer preference for mobile devices in higher education by a conjoint method. Some meaningful implications for policy makers and business players are also suggested. The final section presents our conclusions

LITERATURE REVIEW: THE POTENTIAL OF MOBILE DEVICES FOR UBIQUITOUS LEARNING

Ubiquitous learning is usually defined as an education system that uses the technologies of ubiquitous computing, wireless communication, mobile devices and context-aware technologies in an educational context (Tsai et al., 2011). Although it seems to be quite similar to mobile learning, which is the kind of learning offered by mobile devices that offers learning that is independent of the time and place (Junfeng, 2010; Kalhoro et al., 2010; Liu et al., 2010; Eristi et. al, 2011), ubiquitous learning is generally regarded as an advanced system of mobile learning because it is a pervasive and persistent setting, allowing students to access learning materials flexibly and seamlessly, at any location at any time (Hsieh et al., 2011). Consequently, previous studies have suggested some common features of ubiquitous learning, including permanency, accessibility, immediacy, seamlessness, etc. (Shih et al., 2011; Tsai et al., 2011; Wang & Wu, 2011), and the effectiveness of ubiquitous learning in terms of students' motivation and learning (Shih et al., 2011).

In ubiquitous learning, mobile devices are essential elements by enabling learners to learn using a variety of digital resources from anywhere in the world at any time (Hsieh et al., 2011). In addition, Tsai, Tsai, and Hwang (2011) confirm that ubiquitous learning is conceptualized as the application of technology in the learning process by students. In other words, mobile devices can be regarded as not one of elements in ubiquitous learning but ubiquitous learning itself. Therefore, many studies highlight the importance of mobile devices in both ubiquitous learning and education. For example, Martin and his colleagues (2011) suggested by bibliometric analysis that mobile devices are currently the most important technologies in education for the near future. Triantafillou, Georgiadou, and Economides (2008) also empirically confirmed that the use of mobile devices in education has numerous advantages over full-size computers. Economides and Grousopoulou (2009) found that mobile devices have a positive impact on students' learning and careers. However, some studies have raised concerns regarding the use of mobile devices in education (Huang et al., 2008; Jun & Zhi-yi, 2010; Kumar et al., 2010; Eristi et. al, 2011), commonly mentioning the small screen, limited computational power and limited memory capacity as obvious obstacles in the use of mobile devices.

Considering the potential of mobile devices in ubiquitous learning, previous studies also investigated possible specific mobile devices to support ubiquitous learning. Junfeng (2010) reviewed several mobile devices including personal digital assistants (PDA), e-Book readers, and smart phones and analyzed their pros and cons. Williams and Pence (2011) mentioned that smart phones have many valuable capabilities that have a tremendous potential for use in chemical education. El-Gayer, Moran, and Hawkes (2011) analyzed the factors affecting college students' acceptance of tablet PCs in education. Eristi and his colleagues (2011) examined students' opinions about the use of PDAs in a learning environment.

One interesting point is that in previous studies there has not been a general consensus about the optimal features of mobile devices for ubiquitous learning in education. For example, while many studies empirically confirmed the effectiveness of ubiquitous learning by using PDAs (Jun & Zhi-yi, 2010; Shih et al., 2011; Wang & Wu, 2011), Eristi and his colleagues (2011) suggested that students were not satisfied with the features of PDA equipment because of the small screen and the inconvenience of the keypad. In other words, while most studies focus on either the effectiveness of designed ubiquitous learning systems or learners' acceptance behaviors, the essential features of mobile devices have not been empirically addressed yet. Although previous studies suggested some technological challenges in the use of mobile devices in education, this is still not sufficient for identifying the crucial characteristics of mobile devices for ubiquitous learning. Therefore, by investigating consumer preferences for mobile devices for ubiquitous learning in higher education, this study hopes to contribute to a fuller understanding of the potential of mobile devices in ubiquitous learning.

EMPIRICAL ANALYSIS

Research Design

This study empirically examined consumer preferences for mobile devices for ubiquitous learning in higher education using a conjoint approach. The conjoint analysis method is generally used to understand the importance of different product components or features (Kargin et al., 2008; Jeon et al., 2010; Min et al., 2011; Nam et al., 2011). As conjoint analysis has become an increasingly popular approach to estimate the benefits received from the attributes of a product (Song et al., 2009), it has been widely used as a quantitative tool, not only in marketing research (Kargin et al., 2008) but also in ICTs (Kim et al., 2005; Jeon et al., 2010; Joo et al., 2010; Min et al., 2011) and ICT services (Ahn et al., 2006; Jeong et al., 2008; Song et al., 2009; Nakamura, 2011).

Setting Attribute and Levels

Before performing a conjoint analysis, reasonable attributes and the level of each attribute should be set (Min et al., 2011). In this study, four attributes were selected to examine consumer preference for mobile devices for ubiquitous learning in higher education. The first attribute was the screen size of mobile devices. Screen size is the most critical factor in determining the form of the mobile device (Kim et al., 2005) and a small screen display is usually recognized as a clear limitation of a mobile device for mobile learning in education (Huang et al., 2008; Jun & Zhi-yi, 2010; Eristi et al., 2011). Considering several screen sizes of mobile devices that are currently being introduced, this study considered the following four sizes: 4 inches (the general size of smart phones), 7 inches (a popular size for tablet PCs), 10 inches (another popular size for tablet PCs), and 12 inches (the size of small laptops).

The second attribute is the type of platform, which usually refers to the hardware configuration, operating system (OS), software framework, or any other common entity on which a number of associated components or services run (Ballon & Van Heesvelde, 2011). In contrast to laptops whose platform is based on Windows, smart phones and tablet PCs include both a web browser, which provides access to the wealth of material on the World Wide Web, and inexpensive applications based on mobile platforms such as Google's Android (Al-Qirim, 2011). In other words, compared with the traditional PC-based platforms including Windows, mobile platforms provide different user interfaces and user experiences for end users. Therefore, the following two levels were then considered: a PC-based platform (usually Windows) and a mobile-based platform (including Apple's iOS and Google's Android).

The third attribute is the level of office productivity provided by the mobile devices. Since most students read and make document files using Microsoft Office applications such as Word, PowerPoint and Excel, the level of the functions related to these applications can affect the preference for mobile devices in higher education. From the perspective of hardware, input equipment may be directly related to office productivity. A keyboard with a trackball mouse is the preferred input equipment but it has limits in portability, whereas a touch screen, which is the main input equipment of smart phones and tablet PCs, has disadvantages in making document files (Kim et al., 2005). From the point of view of software for mobile devices, the function of office applications in mobile platforms has some limitations compared with PC platforms. This study consequently proposed the following three levels of office productivity: high (easy to make and read document files), medium (easy to read but not so easy to make document files), and low (can only read document files).

The last attribute is the wireless access technology that mobile devices offer. To support seamlessness, one of the features of ubiquitous learning (Shih et al, 2011; Tsai et al., 2011), data connection with mobile networks using data access technology is necessary. Currently, most mobile devices support Wi-Fi technology and some of them can access a cellular network. For this aspect, the following two levels were considered: support for Wi-Fi technology only and support for both Wi-Fi and a cellular network. Attributes and their levels are described in Table 1.

Table 1. Attributes and their levels

Attribute	Level
Screen Size	4 / 7 / 10 / 12 inches
Platform	mobile-based / PC-based (Windows)
Office Productivity	high / medium / low
Data Access	Wi-Fi only / Wi-Fi + cellular

Setting Profiles and Survey

Considering the attributes, this study initially generated 72 (3^2 x 2 x 4) profiles based on the full profile method, where the number of hypothetical services was obtained by multiplying the number of levels associated with each attribute (Song et al., 2009). Because respondents would clearly find it difficult to complete all profiles, fractional factorial design (FFD) were used, which simplifies the number of profiles to be tested and maintains the effectiveness of sorting and evaluating the relative importance of a product's multidimensional attributes (Kim et al., 2005; Song et al., 2009; Min et al., 2011). Based on FFD, the number of initial profiles was reduced to 16, and after excluding six unrealistic and inappropriate combinations, the final 10 profiles were used to conduct the survey, as described in Table 2.

Table 2. Conjoint alternatives

Alternative #	Screen Size	Platform	Office Productivity	Data Access
1	7 inches	mobile-based	high	Wi-Fi only
2	4 inches	mobile-based	low	Wi-Fi only
3	7 inches	mobile-based	low	Wi-Fi + cellular
4	10 inches	mobile-based	medium	Wi-Fi only
5	12 inches	mobile-based	low	Wi-Fi only
6	4 inches	mobile-based	medium	Wi-Fi + cellular
7	10 inches	mobile-based	low	Wi-Fi + cellular
8	7 inches	PC-based (Windows)	medium	Wi-Fi only
9	10 inches	PC-based (Windows)	high	Wi-Fi only
10	12 inches	mobile-based	high	Wi-Fi + cellular

To examine consumer preference for mobile devices for ubiquitous learning in higher education, this study carried out a survey asking respondents to rank a set of alternatives. Each respondent was asked to rank the 10 profiles describing the form of mobile devices as an educational tool according to their own usage intention on a scale from 1 (most preferred) to 10 (least preferred). The respondents were selected in an "A" class national university in South Korea because all the students in the university receive a laptop as their educational device without any cost. This study assumed that the university was about to consider giving all students other forms of mobile devices as educational devices. Therefore, respondents could evaluate the profiles regardless of the price of the mobile device. In addition, most undergraduate students have more knowledge about mobile devices including smart phones and tablet PCs. Thus, this work could obtain more meaningful results from the respondents who were the main users of mobile devices as an education tool if the price of the devices was not taken in consideration.

A total of 224 respondents were interviewed via a Web page from August 22 to September 2, 2011. 56 respondents were excluded because they failed to respond to some of the values. Thus, the analysis is based on the data from the final 168 respondents, consisting of 150 males (89.3%) and 18 females (10.7%). In addition, 155 (or 92.3%) of the final respondents had smart phones and 16 (or 9.5%) had tablet PCs.

Results of Conjoint Analysis

Table 3 shows the results of the conjoint analysis. Importantly, the results show that respondents considered all the attributes since the relative importance of each attribute was higher than 15%.

The most important attribute was screen size, with a relative importance level of 34.4%. An interesting finding was that respondents preferred mobile devices with a 12-inch screen, which current tablet PCs do not have. This implies that respondents want to receive digital educational content, including digital textbooks and lecture materials, on a large screen display, despite any difficulty in portability.

The next important attribute was the type of platform, with a relative importance of 24.5%. The result showed that respondents preferred the Windows platform to mobile platforms. This means that most respondents are accustomed to PC-based platforms (Windows) and for their educational purposes, they want mobile devices with a platform that is consistent with that of their PCs at home or at the university, even though they enjoyed using smart phones and tablet PCs with mobile-based platforms.

The results also showed that respondents prefer a medium level of office productivity, with a relative importance of 23.6%, implying that they do not need comprehensive functions when they make Office documents and other content. In terms of wireless technology (relative importance 17.4%), most respondents want to receive mobile content using Wi-Fi and cellular technology. In other words, respondents want to use educational content seamlessly; thus, cellular technology is principally required for the mobile devices for ubiquitous learning in higher education.

Table 3. Conjoint results

Attribute	Level (inches)	Utility Estimate	Standard Error	Relative Importance
Screen Size	4	–0.303	0.243	34.361
	7	–0.416	0.201	
	10	–0.046	0.201	
	12	0.766	0.243	
Platform	mobile-based	–0.553	0.186	24.489
	Windows	0.553	0.186	
Office Productivity	low	–0.049	0.176	23.615
	medium	0.318	0.188	
	high	–0.269	0.188	
Data Access	Wi-Fi only	–0.454	0.132	17.435
	Wi-Fi + cellular	0.454	0.132	
Constant	–	5.974	0.176	-

Pearson's R = 0.964 (0.000), Kendall's tau = 0.822 (0.000).

Implications of the Empirical Findings

The empirical results have a number of interesting and meaningful implications for policy makers and business players to understand the essential characteristics of mobile devices for the successful growth of ubiquitous learning in higher education.

First, in terms of screen size, the result indicates that current smart phones and tablet PCs may not be optimal mobile devices for ubiquitous learning because potential users may not be satisfied with 7- or 10-inch screens on the mobile devices. Although device makers have introduced several kinds of smart phones and tablet PCs, the optimal screen size for educational mobile devices needs to be larger than that of current tablet PCs. Therefore, business players need to consider developing and introducing specialized mobile devices for ubiquitous learning in higher education. Moreover, as specialized mobile devices for educational purposes may contribute to the growth of the ICT industry in South Korea, policy makers also need to promote the development of specialized mobile devices for ubiquitous learning.

Second, in terms of the type of platform, the result shows that potential users may require a consistent platform regardless of the device they use. This implies that digital educational content should be delivered equally through devices with a single platform-based N-screen. In that case, Microsoft may have advantages in planning the N-screen strategy based on the Windows platform because the latter platform is preferred for educational mobile devices. Not surprisingly, Microsoft recently announced the latest integrated platform called 'Windows 8,' which supports both PCs and mobile devices, including tablet PCs. Therefore, device makers need to cooperate with Microsoft to develop specialized mobile devices for educational purposes in the short term, while other platform providers including Google and Apple should make efforts to overcome the current limitations for ubiquitous learning. Policy makers also need to consider introducing Windows-based tablet PCs for ubiquitous learning in the short term, although it has some limitations in screen size.

Finally, the result also implies that, compared with laptops and smart phones, and despite their limitations, tablet PCs still have the potential to be the second-best mobile device for ubiquitous learning in higher education. Although potential users usually want a larger screen size than the one tablet PCs currently have, they also need to receive educational content seamlessly anytime and anywhere using cellular networks. Thus, portability and seamlessness may still be necessary for mobile devices in higher education, and current tablet PCs can be the second-best alternative for ubiquitous learning. Business players have already introduced emerging mobile devices that blur the line between smart phones and tablet PCs. Therefore, policy makers need to keep reviewing several alternatives and find the optimal one rather than wait for the best mobile device for ubiquitous learning.

CONCLUSION

Mobile devices can be used to deliver digital textbooks and other educational content to students anywhere and anytime, and thus they can effectively contribute to the early growth of ubiquitous learning in education despite their limitations, such as their small screen and limited computational power. This study investigated the essential features of mobile devices for ubiquitous learning by using a consumer preference approach. The results showed that, despite expectations, tablet PCs might not be optimal for ubiquitous learning in terms of screen size and type of platform. They also found that potential customers want to receive ubiquitous access by using advanced cellular networks, but they do not need to use comprehensive functions related to office documentation through their mobile devices. Therefore, the results suggest that business players develop specialized mobile devices for ubiquitous learning and policy makers consider promoting the development of a specialized mobile device for ubiquitous learning. However, for the early growth of ubiquitous learning, they also need to consider Windows-based tablet PCs as the second-best alternative in the short term.

Although this study has presented some meaningful findings, it also has some limitations. First, the work examined consumer preferences for mobile devices in higher education by considering four features. To fully understand the requirements of mobile devices for ubiquitous learning, further research should review other characteristics that mobile devices should have. Second, by limiting the focus of this paper to South Korea, the generality of the empirical results should be treated with caution. Therefore, a useful area of future research would be to extend the empirical analysis to other sample populations or to an international context.

REFERENCES

Ahn, J., Lee, J., Lee, J., & Kim, T. (2006). An Analysis of Consumer Preferences among Wireless LAN and Mobile Internet Services. *ETRI Journal*. 28(2), 205-215.

Al-Qirim, N. (2011). Determinants of interactive white board success in teaching in higher education institutions. *Computers & Education*, 56(3), 827-838.

Ballon, P., & Van Heesvelde, E. (2011). ICT platforms and regulatory concerns in Europe. *Telecommunications*

Policy, 35(8), 702-714.
Economides, A., & Grousopoulou, A. (2009). Students' thoughts about the importance and costs of their mobile devices' features and services. *Telematics and Informatics*, 26(1), 57-84.
El-Gayar, O., Moran, M., Hawkes, M. (2011). Students' Acceptance of Tablet PCs and Implications for Educational Institutions. *Journal of Educational Technology & Society*, 14(2), 58-70.
Eristi, S. D., Haseski, H. I., Uluuysal, B., & Karakoyun, F. (2011). The Use of Mobile Technologies in Multimedia-Supported Learning Environments. *The Turkish Online Journal of Distance Education*, 12(3), 130-141.
Gursul, F., & Tozmaz, G. B. (2010). Which one is smarter? Teacher or Board. *Procedia - Social and Behavioral Sciences*, 2(2), 5731-5737.
Hsieh, S., Jang, Y., Hwang, G., & Chen, N. (2011). Effects of teaching and learning styles on students' reflection levels for ubiquitous learning. *Computers & Education*, 57(1), 1194-1201.
Huang, Y., Kuo, Y., Lin, Y., & Cheng, S. (2008). Toward interactive mobile synchronous learning environment with context-awareness service. *Computers & Education*, 51(3), 1205-1226.
Hussain, I., & Adeeb, M. A. (2009). Role of mobile technology in promoting campus-wide learning environment. *The Turkish Online Journal of Educational Technology*, 8(3), 48-57.
Jeon, H.J., Kim, M.S., & Sohn, S.Y. (2010). Conjoint and WTP analyses of future mobile phones for digital convergence. *Technological Forecasting and Social Change*, 77(3), 457-465.
Jeong, G., Koh, D., & Lee, J. (2008). Analysis of the Competitiveness of Broadband over Power Line Communication in Korea, *ETRI Journal*, 30(3), 469-479.
Jeong, H., & Hong, B. (2011). A Learning System Using User Preference in Ubiquitous Computing Environment. *Communications in Computer and Information Science*, 184, 240-247.
Jun, Y., & Zhi-yi, H. (2010). Learning anywhere anytime with mobile devices. *Proceedings of the 3rd International Conference on Artificial Intelligence and Education*, 768-771. October 29-30; Hangzhou, China
Junfeng, W. (2010). Mobile learning - A new type of distance education. *Proceedings of the International Conference on Educational and Information Technology*, 149-152. September 17-19; Chongqing, China
Kalhoro, Q., Chowdhry, L. L., Abbasi, T., & Abbasi, S. (2010). M-learning-an innovative advancement of ICT in education. *Proceedings of the 4th International Conference on Distance Learning and Education*, 148-151. October 3-5; San Juan, Puerto Rico.
Kargin, B., Basoglu, N., & Daim, T. (2008). Exploring mobile service adoption: A conjoint model. *Proceedings of Portland International Center for Management of Engineering and Technology*, 2623-2633. July 27-31; Cape Town, United States of America
Kim, Y., Lee, J., & Koh, D. (2005). Effects of consumer preferences on the convergence of mobile telecommunications devices. *Applied Economics*, 37(7), 817-826.
Kumar, L. S., Jamatia, B., & Aggarwal, A. (2010). Mobile phones as effective learner support devices: A case study. *Proceedings of the 4th International Conference on Distance Learning and Education*, 211-213. October 3-5; San Juan, Puerto Rico
Liu, Y., Li, H., & Carlsson, C. (2010). Factors driving the adoption of m-learning: An empirical study. *Computers & Education*, 55(3), 1211-1219.
Martin, S., Diaz, G., Sancristobal, E., Gil, R., Castro, M., & Peire, J. (2011). New technology trends in education: Seven years of forecasts and convergence. *Computers & Education*, 57(3), 1893-1906.
Min, S., Kim, H., Kwon, Y., & Sohn, S. (2011). Conjoint analysis for improving the e-book reader in the Korean market. *Expert Systems with Applications*, 38(10), 12923-12929.
Nakamura, A. (2011). Estimating switching costs after introducing Fixed-Mobile Convergence in Japan. *Information Economics and Policy*, 23(1), 59-71.
Nam, C., Kim, S., & Lee, H. (2008). The role of WiBro: Filling the gaps in mobile broadband technologies. *Technological Forecasting and Social Change*, 75(3), 438-448.
Sevindik, T. (2010). Future's learning environments in health education: The effects of smart classrooms on the academic achievements of the students at health college. *Telematics and Informatics*, 27(3), 314-332.
Shih, J., Chu, H., & Hwang, G. (2011). An investigation of attitudes of students and teachers about participating in a context-aware ubiquitous learning activity. *British Journal of Educational Technology*, 42(3), 373-394.
Song, J., Jang, T., & Sohn, S. (2009). Conjoint analysis for IPTV service. *Expert Systems with Applications*. 36(4), 7860-7864.
Suki, N. M., & Suki, N. M. (2011). Users' Behavior towards Ubiquitous M-Learning. *The Turkish Online Journal of Distance Education*, 12(3), 118-129.
Triantafillou, E., Georgiadou, E., & Economides, A. A. (2008). The design and evaluation of a computerized adaptive test on mobile devices. *Computers & Education*, 50(4), 1319-1330.
Tsai, P., Tsai, C., & Hwang, G. (2011). College students' conceptions of context-aware ubiquitous learning: A

phenomenographic analysis. *The Internet and Higher Education*, 14(3), 137-141.
Wang, S., & Wu, C. (2011). Application of context-aware and personalized recommendation to implement an adaptive ubiquitous learning system. *Expert Systems with Applications*, 38(9), 10831-10838.
Williams, A. J., & Pence, H. E. (2011). Smart Phones, a Powerful Tool in the Chemistry Classroom. *Journal of Chemical Education*, 88(6), 683-686.
Yoo, J., Yoon, Y., Choi, M. (2010). Importance of positive reputation for Smartphone adoption. *Proceedings of the International Conference on Information and Communication Technology Convergence*, 314-318, November 17-19; Jeju, Republic of Korea
Zahrani, M. S. (2010). The Benefits and Potential of Innovative Ubiquitous Learning Environments to Enhance Higher Education Infrastructure and Student Experiences in Saudi Arabia. *Journal of Applied Sciences*, 10(20), 2358-2368.