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A User Perspective on Smartphone by Using Conjoint

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Abstract

Rapid technological advancements and widespread adoption of smart phones in recent years provide students with new opportunities for getting knowledge and making researches in innovation century. As the penetration of smart phone devices in education increases, there is a large growth in the use of these devices especially among the youth. In spite of increasing importance of smart devices in education, the significant features of these technology devices for general learning have not been experientially addressed. In this study we are going to investigate the comparison of smart phone devices and find the necessary conditions for using mobile devices as an educational tool by a conjoint method. There will be five attributes: screen size, batter type, mobile OS, memory capacity and price. By surveying we got the results which showed us the respondents' desire of using specific smart phone; thus, we defined that screen size attribute is the most important device characteristic.

Keywords : Conjoint Analysis, Technology, Smart Phone, Education

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1. Introduction

Information and communication technologies have greatly changed the way we live and have become an inseparable part and moreover have played a big role in our lives. Many people, especially the youth, use these technologies on a daily basis and for various purposes. People use computers to make researches, to get some important information on the internet [Davis, 1989], to watch videos, to play games with their friends and to communicate with others. On the other hand most people have smart phones and use them on-the-go. If in the past people used their mobile devices only for making calls or sending messages, nowadays smart phones [Lopez et al., 2013] have many functions as the personal computer have. Therefore, people can watch movies, listen to music online, play different games, connect to internet and check their email, manage social networking sites, pay some bills, order food, read the latest news and etc. The rapid development of technology has had an influence on the way we teach and learn and various types of advanced technologies and equipment, including smart boards, mobile devices has been introduced in education. In particular comparing to PCs, mobile devices have a huge potential for use in education because they have directly changed from electronic learning to general learning environments, where both students and professors can use digital textbooks and other educational content anywhere and anytime [Jun and Zhi-yi, 2010]. Therefore, mobile devices can effectively contribute to the early growth of education, although several obstacles to their use, such as small screens and limited computational power, have been mentioned. Nowadays the students with their head buried in a smart phone screen are found everywhere. But the question like what is being done or read or otherwise achieved on these devices has not been sufficiently addressed yet. The difference in the use of technology for this generation from those that came before it has been well-documented. Having grown up with the modern technology, internet, smart phones, instant messaging, video games and cell phones, the “millennial” generation, as it has become known, has a very different view of information access than their parents and grandparents. Various studies have investigated the potential of computer and mobile devices for education by designing education systems and confirming their effectiveness or examining users’ learning process or adoption process using the technology acceptance model. However, empirical research on comparing essential features of smart devices as educational tools for learning has not yet been conducted. And yet, there is a lack of empirical research on comparison of mobile technology in education nowadays.

The possession of internet devices has seen a significant increase by undergraduate students in recent years. But unfortunately, popular literature shows that most of these devices are generally used for playing games, entertainment and communication. Therefore, this study attempted to investigate empirically optimal characteristics of mobile devices in education by using a conjoint analysis of consumer preferences [Nikou et al., 2014]. Consumer preference

might be useful in determining the essential features that mobile devices and computers should have because a large part of the development of technology products has been driven by the pull of demand rather than the push of technology. Thus, this study can provide to a better understanding of the essential characteristics of mobile devices for helping in education by consumer preferences on mobile devices or computers for helping in education using a conjoint approach [Gustafsson et al., 2003]. The method is generally used to understand the importance of different product components or features. In addition to the characteristics technology devices and based on the conjoint analysis requirements, some concepts which essentially influence consumers' objectives to choose and use a specific technology device have been identified for the purpose of this study to be used in the questionnaire.

This study attends to survey and determine what kind of smart phone device is more used and obtain the best smart phone according to screen size, price, battery type, memory and platform that would be used by consumers after making conjoint analysis.

2. Literature Review

This study aims to fill a gap in the current research on comparison the mobile technology usage in education. There are many researches about technology usage, statistics, applications usability and provided analysis of findings, but no systematic research has been conducted on mobile devices' comparison in learning education. This will be the first study to initiate an empirical-based discussion on the comparison of nowadays' smart phone devices in educational field. While the majority of research on mobile technology has focused primarily on students, recently researchers have started exploring the potentials of mobile learning and devices [Economides and Grousopoulou, 2009] within teacher education. Most researchers do not have a clear sense of how to evaluate effective use of technology and professors do not know much about their universities' vision for the use of technology in their lectures. Due to the lack of sound understanding of the specific goals of technology integration, the use of technology per se may have become the goal in many cases. Universities, as well as educational technology research, often turn to how much time students spend using technology and what technology is available as indicators of successful technology integration, but do not measure whether or not, or how, technology is being used in meaningful ways in teaching and learning. Nowadays we know that technology sphere is very important for both children and young people. There are some types of technology devices which are preferred by a person himself to choose which is more desirable for him or her. If children get their training from these technology devices, young people get their ubiquitous knowledge [Zahrani, 2010]. Existing literature suggests the platforms have various strategies related to openness and flexibility to attract users. However, how people generally make decisions on using a specific device or adopting platforms has not been stu-

died yet. Nikou et al. [2014] studied which characteristics of digital platforms consumers most preferable. They focused on mobile platforms where application stores, operator portals, and service provider platforms compete for the consumer's attention. Moreover they conducted a conjoint analysis among 166 consumers to determine the most important characteristics of the mobile platforms. And after making their analysis they found that application related characteristics were most important, especially the number of available applications. Governance-related and technical characteristics were hardly important. Platform characteristics were considerably less important than the brand of the operating system linked to the platform. Nikou et al. [2014] study showed us some results according to their study on the usage of nowadays' technology by using conjoint analysis. Nevertheless we have to say that some of their attributes which they made in their work were not specific. In the operating systems levels they had Symbian from Nokia and Blackbery OS which are already almost not used nowadays. We all know that today's two giant mobile OS's are iOS and Android. And when they made a fractional factorial design and an orthogonal plan they excluded some important interaction of attributes. The number of application wasn't done in the most appropriate way.. In Lopez et al. [2013] study we see how authors showed the importance of development of customizable and adaptable applications which provide many benefits as it helps mold the learning process to different cognitive, sensorial or mobility impairments. They have devised a mobile platform called Picaa and designed to cover the main phases of the learning process : preparation, use and evaluation. Additionally they have formed a pre-experimental study about the use of this application by 39 students with special education needs and saw the positive effects in the development of learning skills like language, math, and awareness have been improved and finally got the result that the use of electronic devices increases their interest in learning and attention. But nevertheless we should say that there are many limitations in this study. Firstly, they have done an application only on the iOS mobile operating system. We have to mention that only ten percent of all smart phones are used in iOS, while for more than eighty percent all over the world people use Android. Secondly, there were very few amounts of students who participated in that experiment, and only from one country (Spain). In my point of view future researches should replicate these findings in more natural settings with different populations.

3. Research Methodology

As conjoint analysis [Gustafsson et al., 2003] has become an increasingly popular approach to estimate the benefits received from the attributes of a product, it has been widely used as a quantitative tool, not only in marketing research but also in ICTs and ICT services. Before performing a conjoint analysis, reasonable attributes and the level of each attribute should be set [Hagerty, 1985]. As we can see in <Table 1>, five attributes were selected to

examine consumer preference for mobile devices and computers. The first attribute was the screen size of devices. Screen size is the most critical factor in determining the form of the mobile device and a small screen display is usually recognized as a clear limitation of a mobile device for mobile learning in education. Considering several screen sizes of devices that are currently existing, I took in a consideration the following three sizes : small, regular and large. Device is the most important factor in determining the form of the technology we are going to use. The small screen sizes are those ones which have a diagonal less than 4 inches, the regular ones have a diagonal more than 4 inches and less than 5 inches and the third ones are those ones which have the diagonal more than 5 inches. The second attribute is the battery type. Here we have two levels : removable and unremovable. Removable batteries are those ones that we can change on our smart phones (e.g. Samsung Galaxy S4, S5 and etc). The smart phones like iPhones or last models of Samsung Galaxy, they have unremovable batteries. The third 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. In contrast to laptops whose platform is based on Windows or MacOS, globally, mobile OS market is currently dominated by two giant companies : Google with Android and Apple with its competing product iOS [Gafni and Geri, 2013]. In other words, compared with the traditional PC-based platforms including Windows and MacOS, mobile platforms provide different user interfaces and user experiences for end users. Therefore, the following four levels were then considered : a PC-based platform Windows, MacOS, and a mobile-based platform Apple's iOS and Google's Android. The forth attribute is a memory capacity. One of the most important features of the smart phones is their memory size, because everything that we store in our devices is kept there. Therefore here we have three levels : 16GB, 64GB and 256GB. The last attribute is the price of the device. Some people use only the last models of the mobile phones or laptops. They don't concern about the cost of the product because they only want the latest version and the fastest one. And other people prefer general type rather than the most expensive ones. Here we have three levels : 200$; 500$ and 800$.

〈Table 1〉 Attributes and Their Levels are Described

Attributes	Levels		
Screen Size	Small	Regular	Large
Battery Type	Removable		Irremovable
Mobile OS	iOS		Android
Memory Capacity	16GB	64GB	256GB
Price	200$	500$	800$

Full profile conjoint approach consists of all the possible combinations of the attributes and levels. In this study if we count the combination of all the attributes and levels creates 108 (3×2×2×3×3) possible profiles. It would be a difficult task for respondents to answer all the questions when there are too many profiles. Therefore, to make the task easier for respondents, full profile conjoint analysis uses what is termed as

fractional factorial design to present a suitable fraction of all possible combinations of profiles as we can see below in <Table 2>. The resulting set is called orthogonal array. Orthogonal array considers only the main effect of each attribute level, and not the interaction effects between attributes. In this study in order calculate data SPSS software was used. The issue that needs to be addressed is the utility and partworth in conjoint analysis. Analysis of the data was done with the conjoint procedure and results were in a utility score. These utility scores are called a part-worth, for each attribute level. The obtained utility scores give a quantitative measure of the preference for separate parts of the product. The larger values indicate greater preference.

〈Table 2〉 Conjoint Alternatives

Card ID	Screen Size	Battery Type	Mobile OS	Memory Capacity	Price
1	large	removable	android	256GB	500$
2	large	unremovable	iOS	64GB	200$
3	regular	unremovable	android	16GB	200$
4	small	unremovable	android	16GB	200$
5	small	unremovable	android	64GB	500$
6	small	unremovable	iOS	16GB	500$
7	small	removable	iOS	256GB	200$
8	small	removable	android	64GB	800$
9	large	unremovable	iOS	16GB	800$
10	large	removable	android	16GB	200$
11	small	unremovable	iOS	256GB	200$
12	regular	removable	iOS	64GB	200$
13	regular	unremovable	android	256GB	800$
14	small	removable	android	16GB	200$
15	small	removable	iOS	16GB	800$
16	regular	removable	iOS	16GB	500$

4. Sampling

A questionnaire was developed, which estimated demographics (age, education, gender) as it is showed in <Table 3>, features of the smart devices. Respondents were asked “Imagine you would like to buy a new smart phone. How important are the following features for you in using it as an educational tool?” [Johnson and Orme, 1996] For preference ratings a seven-leveled Likert-Scale was used. Participants were asked to evaluate their level of agreement of disagreement on a symmetric agree-disagree scale. (1 = “is extremely unimportant” to 7 = “is extremely important”).

Data collection took about one week period. Unfortunately we couldn’t get data from many students; therefore not more than thirty respondents participated in this survey. The students who participated in this survey were daily smart phone users, we can’t say that they are experts but still all of them are familiar because most of them study in top universities of all over the world. We formally invited respondents to participate in the research project and to fill out an online survey questionnaire by the help of Google Docs. We used the English questionnaire for all students even if they are not native speakers. One condition for recruiting respondents to participate in this survey was that they should own a smart phone or be able to use it in a daily life. Respondents took an average of 10 minutes to complete the questionnaire. <Table 3> provides respondents’ demographics. Because our sampling strategy focused on students taking undergraduate and gra-

duate courses in the best universities, we expected respondents' relatively high level of education and their relatively young age.

〈Table 3〉 Sample Characteristics

Current Operating System	iOS 54%	Android 46%
Education	Bachelor : 62%	Master & PhD : 38%
Gender	Male : 77%	Female : 23%
Age	From 21 to 28 (Average 22.3)	

5. Results and Discussion

<Table 4> 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 13%.

The most important attribute was screen size, with a relative importance level of 24.563%. An interesting finding was that respondents preferred smart phones with a screen with more than 5 inches, which is more convenient to make some work. It means that respondents want to receive digital educational content, including digital textbooks and lecture materials, on a large screen display.

The next important attribute was a memory capacity with 23.735%. We see that people worry about keeping data in their devices and we can see that the price of smart phones with a relative importance of 22.201% is almost the same as the memory which indicates that respondents do care about the price almost at the same level as the memory capacity. The result showed that respondents preferred the Apple's mobile platform. This means that most respondents are accustomed to iOS mobile operating systems and for their educational purposes, maybe they want mobile devices with a

〈Table 4〉 Conjoint Results

Attributes	Levels	Utility Estimate	Standard Error	Relative Importance
Screen Size	Small	-.974	.267	24.563
	Regular	-.138	.313	
	Large	1.112	.313	
Battery Type	Removable	.279	.200	13.975
	Unremovable	-.279	.200	
Mobile OS	Android	-.740	.200	15.526
	iOS	.740	.200	
Memory Capacity	16GB	1.507	.242	23.735
	64GB	3.014	.483	
	256GB	4.521	.725	
Price	$200	-.850	.242	22.201
	$500	-1.699	.483	
	$800	-2.549	.725	
Constant		8.391	.634	

Pearson's R = 0.951(0.000), Kendall's tau = 0.762(0.000).

platform that is compatible with their MacBook at home or at the university, even though they enjoyed using iPhones and iPads with iOS mobile-based platforms. The results also showed that respondents prefer removable batteries of their devices. This means that they would rather have several batteries and in the case of battery off they would change them instead of using power banks or always carrying a battery charge with themselves. The experiential results actually have significant implications for smart phone manufacturers to understand the important characteristics of mobile devices for the successful usage in education. First, in terms of screen size, the results show that current smart phones may not be optimal mobile devices for studying or working because users may not be satisfied with 3.5-or 4-inch screens on the smart phone devices. After all manufacturers have introduced some kinds of smart phones, the optimal screen size for educational mobile devices needs to be larger than those ones which are commonly used nowadays. Thus, manufacturers need to consider developing and introducing educational mobile devices for convenient use. Second, in terms of memory capacity and price, the results indicate that people want to have a large amount of gigabytes in their smart devices and get it as cheap as possible. On the other hand having many manufacturers is advantage for consumers, because nowadays there are many smart phone companies that decrease the prices of their products and make them competitive in the market. In terms of the type of platform, the results implicate that potential users prefer Apple mobile operating systems rather than Google's android. This may claim a consistent platform regardless of the device they use. It means that digital educational content should be delivered equally through devices with a single platform-based with large screen devices. Therefore, smart phone makers need to develop educational mobile devices in the short term and other platform providers should make efforts to overcome the current limitations. Finally, the result also shows that, smart phones with a removable battery are more preferable than the other one. Although potential users usually want a larger screen size which has more powerful battery it is not enough for consumers to use it regularly. Therefore they have to whether use power banks or carry battery charge with themselves which is not very convenient. Thus, manufacturers need to keep considering several alternatives for their battery and find the optimal one rather than just wait for the best smart phone device in education.

6. Conclusion

Smart phones are the devices that are able to be used to deliver digital textbooks, video materials, useful software applications [Bergvall-Kåreborn and Howcroft, 2011] which can be downloaded from the Apple store or Google play [Holzer and Ondrus, 2011] and other educational content to students anywhere and anytime [Jun and Zhi-yi, 2010], and therefore they can effectively facilitate studying or working despite their limitations, such as their small screen and limited computational power com-

pared to computers, laptops and tablets. This study investigated the significant features of smart phones as an educational tool by using a consumer preference approach. The results implied that, the most important features of all smart phones is its screen size. Therefore, the results suggest that manufacturers should develop educational mobile devices for convenient usage and policy makers consider promoting the development of educational smart phones as a mobile device. However, for the available usage of these devices, manufacturers also need to increase the memory capacity of their products and decrease the price in order to be used ubiquitously by consumers. Moreover they have to consider about a single platform-based products with large screen devices. Although this work has showed several significant findings, there is no doubt that it has some limitations too. First of all, the amount of respondents wasn't that enough to be objectively appropriate so that having a larger number of participants may provide more fruitful results. Secondly, this study examined user preferences for mobile devices in education by considering only five features. To fully understand the requirements of mobile devices, further research should review other characteristics and have some dependent variables to identify specific characteristics which mobile devices should have. We should take these things in a consideration in our future research.

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