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A Comparative Study on Students' Acceptance of Using Mobile Device-based Student Response System for Classroom Learning *

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ABSTRACT

This study adopts quantitative approach to compare the students' perceptions in terms of perceived usefulness (PU) and perceived ease of use (PE) of using mobile device-based student response system (SRS) and to investigate the difference in the effects of contributing factors on the students' perceptions at two higher education institutions in Hong Kong. Seventy-eight students were sampled from the two institutions which represent students at their early and final stages of study. The significance of this study is that its findings can help the education management to implement mobile device-based SRS for learning in classrooms at different stages of study. An online survey was conducted to capture the students' perceptions and their contributing factors. The Kruskal-Wallis test results showed that there was no significant difference between the students' perceptions in these two institutions. Multiple regression analysis was then performed to investigate whether other factors that contribute to PU and PE, as those in combining Park et al's (2012) and Venkatesh and Davis' (2000) models, are different in the two groups. The results revealed that the effect of PE on PU and the effect of self-efficacy on PE were larger at the early stage of study.

KEYWORDS: Student Response System, Perceived Usefulness, Perceived Ease of Use, Mobile Device

* *This paper was presented at the International Conference on Library and Information Science in July, 2016.*

1 INTRODUCTION

Many studies have been exploring how digital technologies increase the student involvement in learning (e.g., Carnaghan et al, 2011; Hwang et al, 2011; Jungsun and Kizildag, 2011; Liu and Chen, 2015; Monk et al, 2013; Valle and Douglass, 2014). One major focus of these studies is the exploration of how student response system (SRS) enhances student engagement and interaction in classrooms (e.g., Carnaghan et al, 2011; Monk et al, 2013; Valle and Douglass, 2014), and many research findings reveal that SRS increases student engagement and interaction when learning (Cain et al, 2009; Lindquist et al, 2007; Monk et al, 2013; Park et al, 2012).

With the widespread usage of mobile devices such as mobile phones and tablets among students (Burns and Lohenry, 2010; Gikas and Grant, 2013; Liu and Chen, 2015; Shon and Smith, 2011), availability of free Internet access through wireless fidelity (Wi-Fi) or mobile broadband (such as 3G and 4G) technologies on campus and free polling software, mobile devices can be used by students as a response device of SRS in classrooms.

The mechanism of this mobile device-based SRS is shown in Figures 1 to 3. In Figure 1, a teacher uses a computer to post questions on a polling website through the Internet and displays the web address of the polling website to students through projecting that address on a classroom screen.

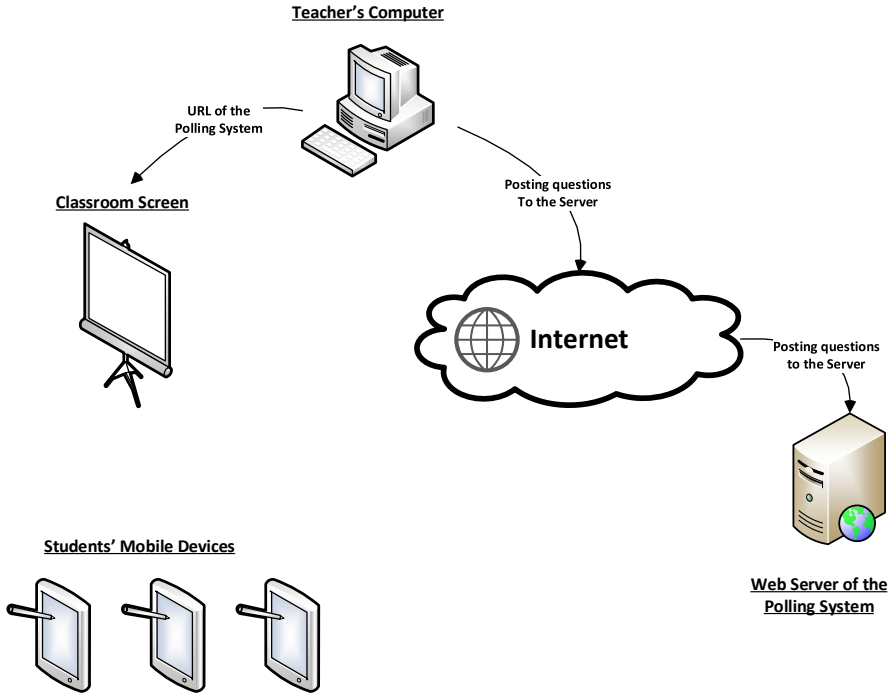

Figure 1: Teacher uses a computer to post questions on a polling website

In Figure 2, the teacher uses the computer while the students use their mobile devices to access the polling website's questions. The polling web server then broadcasts the teacher's posted questions to the teacher's computer and the students' mobile devices through the Internet. The questions displayed on the teacher's computer are also projected on the classroom screen.

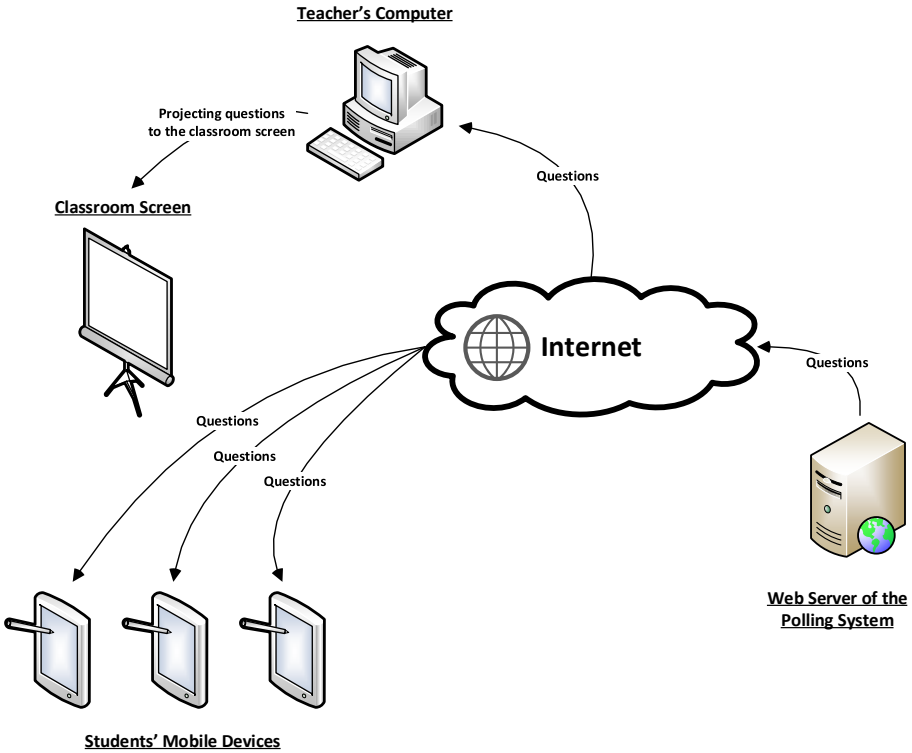

Figure 2: Students use their mobile devices to access the polling website's questions

In Figure 3, the students answer by entering numeric or text data or clicking on an icon on the mobile devices. The answers will then be sent from the mobile devices to the polling web server through the Internet. After receiving the answers sent from the students, the polling web server will then send the answers to the teacher's computer through the Internet. These answers will also be projected on the classroom screen.

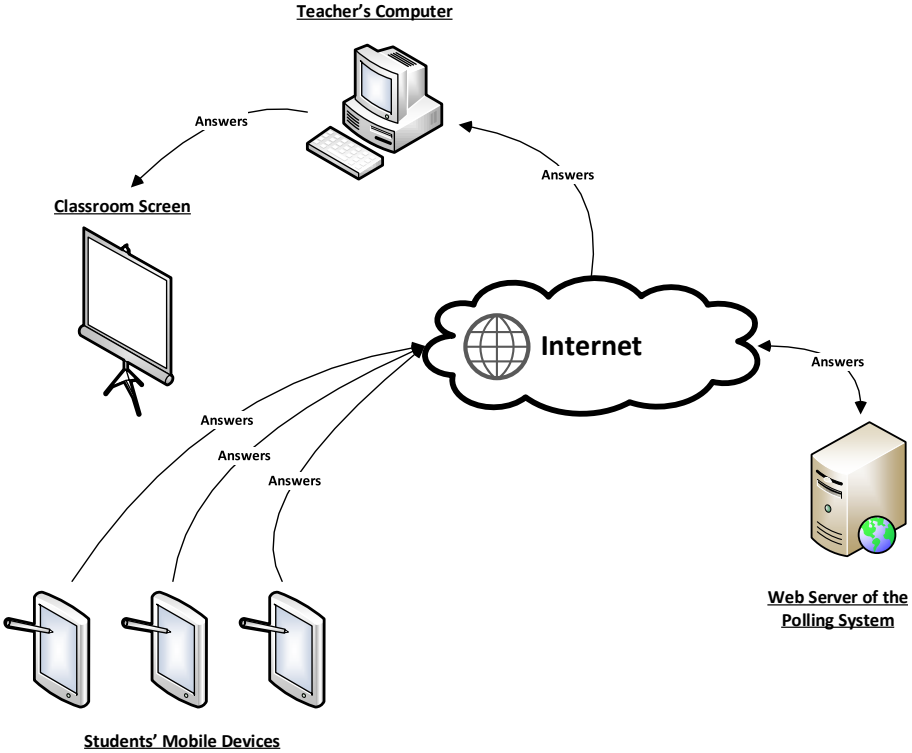

Figure 3: Students answer by entering text data or clicking

With the SRS, the teacher and the students can view different answers from the students on the classroom screen in real-time mode. This system helps the teacher to get instant response from the students and realize how the students learn and discuss. This system also helps to overcome the difficulty in getting all students' answers in a large class (e.g. class size > 70).

The availability of mobile devices, Internet access in classrooms and polling software facilitates the use of SRS in classrooms. In addition, the users' acceptance of adopting mobile device-based SRS has to be investigated when implementing this SRS in classrooms.

1.1 Technology Acceptance Model TAM

To address the issue of the users' acceptance of adopting mobile device-based SRS, Davis' (1986) technology acceptance model (TAM) was considered. TAM theorizes that the use of technology is determined by an individual's intention to use that technology. This intention is in turn determined by that individual's two perceptions – one, namely perceived usefulness (PU), is the individual's belief in using a particular technology can enhance his or her performance while the other, namely perceived ease of use (PE) is that individual's perception of the ease of use of the technology. TAM has been applied in different areas of technology acceptance (e.g., Agarwal and Karahanna, 2000; Chen et al., 2002; Moon and Kim, 2001; Venkatesh and Davis, 2000). In this regard, the researchers considered applying TAM in the users' acceptance of adopting mobile device-based SRS.

1.2 Extension of Technology Acceptance Model TAM

When reviewing the literature on applying TAM in mobile device-based SRS acceptance for learning, the researchers considered combining Venkatesh and Davis' (2000) extension of TAM called TAM2 and some of Park et al's (2012) models and came up with the model shown in Figure 4.

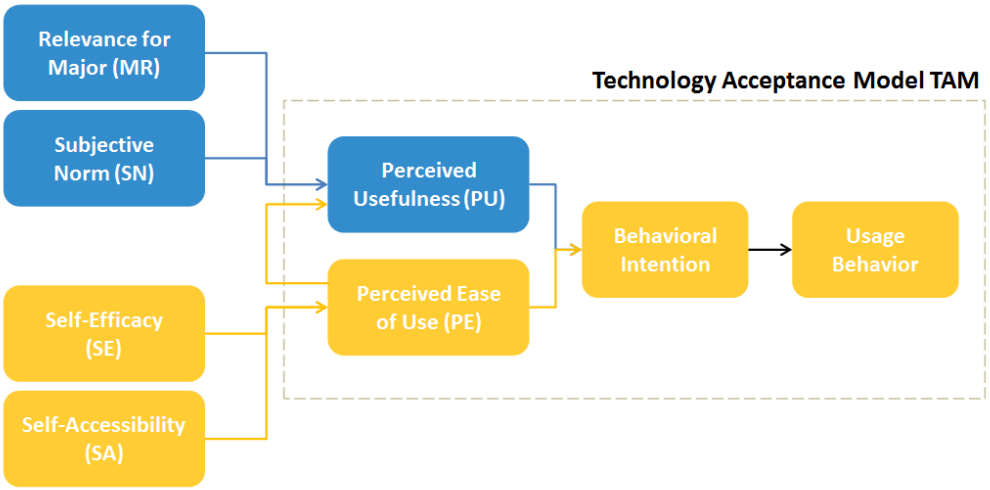

Figure 4: Technology Acceptance Model

In Figure 4, an arrow represents influence. For example, the four constructs in TAM are PU, PE, behavioral intention which is a person's intention to use a technology and usage behavior which is a person's actual usage of the technology. PU and PE influence an individual's behavioral intention, and behavioral intention influences one's usage behavior. Four other constructs in this figure are relevance for major (MR), subjective norm (SN), self-efficacy (SE) and self-accessibility (SA). MR is a person's belief that his major of study

is related to mobile devices such as computer science and information management system. SN is one's perception that most people important to that one think that he or she should or should not perform the behavior. SE is one's belief that he or she is able to complete tasks. SA is one's own autonomy for accessing the devices (i.e., mobile devices, website, Internet access) when learning. This model is based on Venkatesh and Davis' (2000) TAM2 in which SN and PE influence PU. This model is also based on Park et al's (2012) model in which MR influences PU, and SE and SA influence PE.

1.3 Research Objectives

One characteristic of higher education in Hong Kong is bilingual education in which most students are Chinese but they learn using less familiar English language (Gibbons, 1987; Wong, 2015). In the Hong Kong higher education context, the medium of instruction used in lectures and tutorials is English and the teaching materials including notes and books are written in English, barring courses focusing on languages other than English. There are two main recommendations for bilingual education in the Hong Kong higher education context. First, using English as the medium of instruction in Hong Kong higher education helps to keep the students standard of English high for maintaining the international trading power in Hong Kong (Education Commission, 1996; 1999). Second, students' proficiency in English helps them to grasp the primary significant studies in many disciplines, mostly written in English (Johnson et al, 1993; Li et al, 2001). However, there is difficulty in achieving student engagement in a classroom where the majority of the students are Chinese, thus causing an obstacle to achieving the learning outcomes (Wang et al, 2009). Students would rather engage in online discussion than interaction with teachers and other students in classrooms as they do not have to respond instantly in their less familiar English language (Chin et al, 2000). Also, students with less English proficiency do not want to be identified in the classroom engagement. Wong (2012) noted that teachers' clarification and guidance can help to correct the mistakes found in the students' online discussion.

These issues provided the researchers the insight into the use of mobile device-based SRS to enhance engagement among teachers and students in classrooms in the Hong Kong higher education context. The engagement can be encouraged by setting the mobile device-based SRS in the way that the answer options posted in the polling website provide hints for the students to respond, and the students taking part in the SRS are not required to log in the system and therefore are not identified. In this regard, all the students using the SRS in a classroom can view the different answers on the classroom screen without knowing who have given the answers.

Having this observation in mind, the researchers proposed to investigate the students' acceptance of mobile device-based SRS in the Hong Kong higher education context. This investigation adopts TAM and its extension shown in Figure 4 as a theoretical framework to focus on the students' perceptions in terms of PU and PE of using mobile device-based SRS which are the factors influencing the students' acceptance of adopting the system. This investigation also focuses on the effects of contributing factors (i.e., MR, SN, SE and SA) on the students' perceptions. In view of all these factors directly and indirectly related to the students' acceptance of adopting mobile device-based SRS, the researchers proposed to compare the students' PU and PE of using mobile device-based SRS and to investigate the difference in the effects of MR, SN, SE and SA on the students' PU and PE at their different stages of study. The findings in this comparative study can help the education management to implement mobile device-based SRS for learning in classrooms at different stages of study.

2 LITERATURE REVIEW

To understand how the comparison of the students' PU and PE of using mobile device-based SRS and the effects of MR, SN, SE and SA on the students' PU and PE at their different stages of study had been addressed in the existing literature, the researchers reviewed the relevant literature. When performing the literature review, the researchers decided which articles to be included in the review process by determining the inclusion criteria. The studies which did not meet the inclusion criteria were excluded. For example, the proposed research focused on mobile device-based SRS, so studies on SRS using a device other than mobile device such as a clicker were excluded. The studies were included in the review process if they met any of the following inclusion criteria:

- Empirical studies comparing the students' PU and PE of using mobile device-based SRS at their different stages of study.
- Studies reporting the effects of MR, SN, SE and SA on the students' PU and PE.
- Studies explaining the relationship between any of the independent variables (i.e., MR, SN, SE and SA) and any of the dependent variables (i.e., students' PU and PE).
- Empirical studies comparing the effects of MR, SN, SE and SA on the students' PU and PE at their different stages of study.

The literature review methodology included two stages. The first stage was identification of the search terms. These search terms were derived from the aspects identified from the inclusion criteria. The second stage was to use the search engines in the Internet, publications, papers on relevant literature reviews and references to select the relevant literature based on the search terms.

2.1 Search Terms

The search terms derived from the aspects of the inclusion criteria included comparative study descriptors, theoretical issue descriptors, response system descriptors, independent variable descriptors, outcome descriptors, relationship descriptors and explanation descriptors. The comparative study descriptors included "comparative study/studies", "comparison", "X versus Y" and "X is stronger/weaker than Y" where X and Y are students' PU and PE of using mobile device-based SRS at their different stages of study. The theoretical issue descriptors included "theories/ frameworks of technology acceptance model/TAM". For the response system descriptor "student response system/SRS", similar terms "personal response system", "classroom communication system", "electronic voting system" and "classroom response system" are widely used in the literature, but its emphasis is using mobile device in the response system. The independent variable descriptors included "relevance for major/MR", "subjective norm/SN", "self-efficacy/SE", "self-accessibility/SA" and "perceived ease of use/PE". The outcome descriptors included "perceived ease of use/PE" and "perceived usefulness/PU". The relationship descriptors such as "effect", "relationship", "correlation", "regression", "multiple regression", "influence", "affect" and "contribution" were used to link the independent variable descriptors to the outcome descriptors. When linking in the search, the "AND" operator was used to look for the articles that included all identified independent variable, relationship and outcome descriptors. To look for the studies that explained the effects of PE, MR and SN on PU, and the effect of SE and SA on PE, the explanation descriptors such as "explanatory study/investigation/ examination/research", "reasons", "explanation" were linked with the "AND" operator to the identified independent variable, relationship and outcome descriptors.

2.2 Search Methods

The researchers used the search terms and required operators (i.e., "AND" and "OR") to search for literature in three ways. First, the researchers searched through the libraries. The researchers read through the tables of contents and parts of the chapters on the books,

abstracts of the journal articles found from the libraries to ensure all relevant articles were captured. Second, the researchers used the search engines in the Internet to conduct a comprehensive literature search. These search engines included British Education Index (BEI) (http://www.bei.ac.uk/index.html), Education Resources Information Centre (ERIC) (http://www.eric.ed.gov/), Educational Research Abstracts Online (http://www.informaworld.com/), Google search engine (http://www.google.com) and ProQuest (http://www.proquest.com). Third, references from the books and journal papers provided recursive literature search that identified the relevant studies missed by the previous two ways – library search and Internet search.

2.3 Review Findings

The researchers were not aware of any comparative studies in the literature that compare the students' PU and PE of using mobile device-based SRS and investigate the difference in the effects of MR, SN, SE and SA on the students' PU and PE at their different stages of study. Among the studies explored, Venkatesh and Davis' (2000) study is relevant to this research in the sense that they developed and tested TAM2 in which PU and PE, and their factors were measured on the same sample at three different points in time. Their study was based on the theory and evidence that the effects of some model constructs may be weakened over time. For example, the effect of SN on behavioral intention may be weakened over time as a technology user would rather depend on skills developed by experiencing the technology than the opinions and influence of others as a basis for behavior intention (Hartwick and Barki, 1994, p. 458-459). Venkatesh and Davis' (2000) study explored the difference in the effects of the model constructs over time. The proposed study also looks into the difference in the effects of some constructs. Unlike Venkatesh and Davis' (2000) measures on the same sample, the proposed study measures the model constructs on different student samples at their different stages of study as the findings of these measures are applicable to the SRS implementation at different stages of study in an education institution. Another study by Park et al (2012) is also relevant to the proposed study as it investigated the factors (e.g., MR, SN, …) affecting university students' adoption of m-learning. Unlike Park et al's (2012) study, the proposed study investigates the factors affecting the students' adoption of mobile device-based SRS for learning in classrooms.

3 METHODOLOGY

In this research, survey was conducted at two higher education institutions in Hong Kong. One institution delivers a wide range of professionally-oriented programs including a diversity of top-up honors degree programs. The students in this institution are the final stage (year 3 to 4/junior to senior) students. The other institution offers a wide variety of associate degree and higher diploma programs for graduates from secondary or high schools. The students taking the associate degree or higher diploma programs at this institution are the early stage (year 1 to 2/freshmen to sophomore) students. When conducting the survey, the researchers explained the purpose, procedures and scope of the research to the participating students. The participating students responded with implied consent by completing an online questionnaire. In a survey, informed consent can be replaced with implied consent (Berg and Lune, 2012, p. 92). To ensure informant anonymity and confidentiality, the participating students were not required to provide their identities when filling the online questionnaire. Besides, data collected from this survey were stored in highly secure computer systems and protected with authorization and authentication mechanisms. The researchers do not state any information (e.g., the institutions attended by the participants) that may disclose the participants' identities in order for the participants to remain anonymous in any publications and report of this research.

The Kruskal-Wallis test was used to explore whether significant difference exists

between the students' perceptions in these two institutions. The students' PU and PE of using mobile device-based SRS were operationalized by the items measured on a 5-point Likert's (1932) scale ranging from "strongly agree" = 5 to "strongly disagree" = 1 and posted on the online questionnaire, as shown in Table 1. These measuring items are similar to the validated measuring items from the previous studies such as Davis' (1989) and Venkatesh and Davis' (2000).

Table 1 Measuring Items for PU and PE

Construct	Measuring Items
Perceived Usefulness (PU)	It is interesting to know the answers from all my classmates through SRS (PU1).
	Answering questions using SRS helps me to maintain my attention (PU2).
	Answering questions using SRS makes the lessons more interesting (PU3).
Perceived Ease of Use (PE)	I don't need to download special software to use SRS (PE1).
	I don't need much effort to use the SRS website (PE2).
	It is easy to answer questions using SRS (PE3).

Multiple regression analysis was then conducted to investigate whether other factors (i.e., MR, SN, SE and SA) that contribute to PU and PE, as shown in the combination of some models of Park et al's (2012) and Venkatesh and Davis' (2000) models in Figure 4, are different in the two student groups. All these constructs MR, SN, SE and SA were operationalized by the items measured on the same 5-point Likert's scale as that used in the Kruskal-Wallis test and posted on the online questionnaire, as shown in Table 2. These items are similar to the validated measuring items from the studies of Park et al (2012) and Venkatesh and Davis (2000).

Table 2 Measuring Items for MR, SN, SE, and SA

Construct	Measuring Items
Relevance for Major (MR)	Learning with SRS is relevant to the subject of "Management Information Systems" (MR1).
	Learning with SRS can help me understand the subject (MR2).
Subjective Norm (SN)	Answering questions using SRS has significant meaning as a university student (SN1).
	It is good that other people know I have experience in using SRS (SN2).
	Leaning about SRS can help me perform better in my future job (SN3).
Self-efficacy (SE)	I have the necessary skills for answering questions using SRS (SE1).
	I am skillful in answering questions using SRS with my mobile device (SE2).

	I am confident in using my mobile devices for answering questions using SRS (SE3).
	I understand mobile devices terms well for answering questions using SRS (SE4).
Self-accessibility (SA)	I can access the SRS website easily (SA1).
	My mobile device(s) work(s) well with the SRS website (SA2).

Internal consistency reliability was measured using Cronbach's (1951) coefficient alpha. All the constructs MR, SN, SE, SA, PU and PE contain similar statements which should yield similar Likert's scores. Cronbach's coefficient alpha was used to test this similarity and should ideally be above 0.7 (Nunnelly, 1978).

3.1 Data Collection

Data were collected in November and December in 2015. In the data collection, the participating teachers of information technology (IT) courses at the two institutions were invited to post some questions related to the courses on a polling website called Polleverywhere (polleverywhere.com), which is a commercially available mobile device-based SRS.

39 final stage students taking the IT course experienced using their mobile devices to give answers to Polleverywhere in the classroom. 39 other students were randomly selected from another institution. This other 39-student group, representing the early stage students, used the mobile device-based SRS. These two institutions provide free Wi-Fi access to all students. Therefore, the students could just use their mobile devices to connect to the Internet and browse the polling website via Wi-Fi access.

After using the mobile device-based SRS, all these two 39-student groups were invited to complete the online questionnaire which was used to capture their demographics, the mobile devices they used, MR, SN, SE, SA, PU and PE. Noticing the survey using questionnaire conducted in meetings can improve response rate (Saunders et al, 2012), the researchers called the participating students to meet in the classrooms and completed the online questionnaire.

3.2 Data Analyses

To explore whether significant difference exists between the students' PU and PE of using mobile device-based SRS in the two independent student groups, the Kruskal-Wallis test was carried out for the main reason that it does not assume normality in the data, especially in a small sample size. However, the researchers had to test whether the distributions in each group (i.e., the distribution of each construct of the students' perceptions (PU or PE) for each group of the independent variable) have the same shape (or the same variability) as those in the other group as the Kruskal-Wallis test is applicable for the two groups that have the same shape.

The researchers were also concerned about investigating whether difference exists in the effects of the constructs such as MR, SN, SE and SA contributing to the students' PU and PE by using multiple regression analysis. The multiple regression analysis was used as it can explore the effect of the constructs on the perceptions in the following two regression models which could be derived from the two significant results (or models) from Park et al's (2012) models and Venkatesh and Davis' (2000) TAM2:

1. PE, MR, SN → PU
2. SE, SA → PE

The first model means that PE, MR and SN have effect on PU while the second model indicates that SE and SA have effect on PE. As the above models, each of which contains more than one independent variable and one dependent variable, were already in mind, multiple regression analysis could be used for explanatory research to determine the combined effect of a set of the independent variables (e.g., a set of PE, MR, SN) on the dependent variable (e.g., PU) and the relative effect of each of independent variables (e.g., SE or SA) on the dependent variable (e.g., PE) (Keith, 2006, p. 76-78).

For the data analyses, the statistical tool Statistical Package for the Social Sciences (SPSS) version 23 was used for computing Cronbach's coefficient alpha values, Kruskal-Wallis test and multiple regression analysis.

4 RESULTS

The demographics and device types used by the two samples, as shown in Table 3, indicated that most of the respondents (85% and above) used their own mobile phones as a response device in the mobile device-based SRS. This result is in line with the findings in the previous studies that most of the students own a mobile phone (Burns and Lohenry, 2010; Gikas and Grant, 2013; Liu and Chen, 2015; Shon and Smith, 2011).

Table 3

Device Type	Final Stage Students (n=39)		Early Stage Students (n=39)	
	Frequency	Percentage	Frequency	Percentage
Mobile phone	33	85%	35	89%
Tablet	2	5%	3	8%
Notebook Computer	4	10%	1	3%

In response to MR, SN, SE, SA, PU and PE, the mean scores on the measuring items and the values of Cronbach's coefficient alpha were computed by SPSS. Table 4 shows these mean scores and the values of Cronbach's coefficient alpha are all above 0.7, meaning that the internal consistency reliability is acceptable (Nunnelly, 1978).

Table 4

Construct	Measuring Items	Item Mean (Standard Deviation) (n = 78)	Combined Means	Construct Reliability (Cronbach's coefficient alpha)
PU	PU1	4.077 (.9773)	4.141	0.897
	PU2	4.192 (.9811)		
	PU3	4.154 (.9408)		
PE	PE1	4.128 (1.0239)	4.068	0.919
	PE2	3.987 (.9327)		
	PE3	4.090 (.9959)		
MR	MR1	4.051 (.9790)	4.064	0.752
	MR2	4.077 (1.0290)		
SN	SN1	3.936 (.9715)	3.915	0.883
	SN2	3.897 (1.0141)		
	SN3	3.910 (.9423)		

SE	SE1	4.128	(.9851)	4.099	0.926
	SE2	4.115	(.9114)		
	SE3	4.141	(.9899)		
	SE4	4.013	(.9736)		
SA	SA1	4.103	(.9200)	4.128	0.876
	SA2	4.154	(.8839)		

4.1 Kruskal-Wallis Test Results

It can be seen from Table 4 that all the combined means for PU and PE are close to or greater than 4, while the maximum possible combined mean is 5. This indicates that the students had positive perceptions about the mobile device-based SRS. Table 5 shows that the PU and PE means and standard deviations are similar in the two groups; all the items show comparable negative skewness and kurtosis, meaning the assumption that the Kruskal-Wallis test is applicable for the two groups that have the same shape of distributions is met (Vargha and Delaney, 1998).

Table 5

Group	Construct	Mean	Standard Deviation	Skewness		Kurtosis	
				Statistic	Standard Error	Statistic	Standard Error
Final Stage Students (n=39)	PU	4.085	0.8226	-1.408	0.378	3.708	0.741
	PE	4.034	0.8229	-1.429	0.378	3.525	0.741
Early Stage Students (n=39)	PU	4.197	0.9419	-1.342	0.378	2.020	0.741
	PE	4.103	1.0063	-1.176	0.378	1.225	0.741

The Kruskal-Wallis test results are shown in table 6. The asymptotic significance values range from 0.267 to 0.380. As all significance values are greater than 0.05, therefore, it is concluded that there was no significant difference between the students' PU and PE across the two institutions.

Table 6

	PU	PE
Chi-Square	1.230	0.770
df	1	1
Asymp. Sig.	0.267	0.380

4.2 Multiple Regression Analytical Results

The researchers considered simultaneous multiple regression. By simultaneous multiple regression, for each stage of study, all the independent variables were entered into the regression equation simultaneously in order to see the combined effect (as shown in the adjusted R^2 value) on the students' perceptions (i.e., PU and PE). It was also interesting to determine which independent variable has the stronger or lesser effect on the students' PU or PE at each stage of study by looking at the standardized coefficients for different independent variables as they had been converted to the same scale and therefore could be used for comparison (Keith, 2006).

Table 7 shows the multiple regression results that explained PU. It shows the effects of PE, MR and SN on PU at the two stages of study. This model explained between 61.6% and 90% of the variance in PU. The significant results, indicated by $\rho < 0.05$, show that PE was a stronger determinant of PU at both stages of study while MR was significant secondary

determinant of PU at the early stage of study. By comparing across different stages of study, PU was stronger at the early stage of study.

Table 7

Independent Variable	Final Stage Students (n = 39)		Early Stage Students (n = 39)	
	Adjusted R^2	β	Adjusted R^2	β
	0.616		0.900	
PE		0.378 **		0.736 ***
MR		0.289		0.239 *
SN		0.266		0.008

* $\rho < 0.05$, ** $\rho < 0.01$, *** $\rho < 0.001$ β standardized regression coefficients

Table 8 shows the multiple regression results that explained PE. It shows the effects of SE and SA on PE at the two stages of study. This regression model explained between 41.9% and 80% of the variance in PE. The significant results at $\rho < 0.05$ show that SE had stronger effect on PE at both stages of study. By comparing across different stages of study, SE was stronger at the early stage of study.

Table 8

Independent Variable	Final Stage Students (n = 39)		Early Stage Students (n = 39)	
	Adjusted R^2	β	Adjusted R^2	β
	0.419		0.800	
SE		0.467 *		0.565 ***
SA		0.246		0.408 ***

* $\rho < 0.05$, ** $\rho < 0.01$, *** $\rho < 0.001$ β standardized regression coefficients

5 DISCUSSION AND CONCLUDING REMARKS

The analytical results revealed that there was no significant difference on the students' PU and PE of the mobile device-based SRS. According to TAM and its extension, PU and PE are the determinants of behavioral intention which in turn influence the actual usage of a technology. That is, the difference on the acceptance (i.e., intention and usage) of the mobile device-based SRS did not exist between the students in the two institutions. The results of the larger effects of PE on PU and SE on PE at the early stage of study provide the implication that the students at their early stage of study have less experience of using mobile device technology in applications such as SRS and therefore their PE and SE exhibit stronger effects.

However, there are four limitations in this study. First, the two sample sizes (39 students each) were small which could produce insignificant results. In one regression model PE, MR, SN $\rightarrow$ PU with three independent variables, the threshold for each sample size in multiple regression is $50 + 8 \times 3 = 74$ or above in accordance with the threshold $N \geq 50 + 8v$, where v is the number of independent variables (Tabachnick and Fidell, 2013). This limitation suggests that the future research in this area should have larger sample sizes. Second, this study did not take into account MR well. Students in different disciplines should be sampled and the effects of MR from these students could then be compared. Third, this study relies on the theoretical constructs measured by the participating students' subjective views which may not accurately reveal how the constructs actually affect. Exploration of experimental manipulation and objective measures of the constructs in the future research is recommended. Fourth, this study cannot explain why there was no difference on the students' PU and PE at their early and final stages of study and why the effects of students' PE on PU and SE on PE were larger at their early stage of study. This limitation suggests that qualitative interviews could be used as a follow-up explanatory research.

REFERENCES

Agarwal, R. and Karahanna, E. (2000). Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage, *MIS Quarterly*, 24 (4), 665-694.

Berg, B. and Lune, H. (2012). Qualitative Research Methods for the Social Sciences, 8th Edition, Upper Saddle River, New Jersey: Pearson.

Burns, S. M. and Lohenry, K. (2010). Cellular phone use in class: Implications for teaching and learning a pilot study, *College Student Journal*, 44 (3), 805-810.

Cain J., Black E. P., and Rohr J. (2009). An audience response system strategy to improve student motivation, attention, and feedback, *American Journal of Pharmaceutical Education*, 73 (2): Article 21.

Carnaghan, C., Edmonds, T. P., Lechner, T. A., and Olds, P. R. (2011). Using student response systems in the accounting classroom: Strengths, strategies and limitations, *Journal of Accounting Education*, 29 (4), 265-283.

Chen, L., Gillenson, M. L., and Sherrell, D. L. (2002). Enticing online consumers: an extended technology acceptance perspective, *Information and Management*, 39 (8), 705-19.

Chin, K.L., Chang, V. and Bauer, C. (2000). The Use of Web-based Learning in Culturally Diverse Learning Environments, *Proceedings of the 6th Australian World Wide Web Conference*, Cairns, Australia

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests, *Psychometrika*, 16 (3), 297-334.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology, *MIS Quarterly*, 13 (3), 319–340.

Education Commission. (1996). *Education Commission Report No. 6*, Hong Kong: Government Printer.

Education Commission. (1999). *Education Blueprint for the 21st Century. Review of Academic System: Aims of Education*, Hong Kong: Printing Department.

Gibbons, J. (1987). *Code-Mixing and Code Choice: A Hong Kong Case Study*, Avon: Multilingual Matters Ltd.

Gikas, J. and Grant, M. M. (2013). Mobile computing devices in higher education: Student perspectives on learning with cellphones, smartphones and social media, *The Internet and Higher Education*, 19, 18-26.

Hartwick, J. and Barki, H. (1994). Explaining the role of user participation in information system use, *Management Science*, 40, 440-265.

Hwang, G., Wu, C., Tseng, J. C. R., and Huang, I. (2011). Development of a ubiquitous learning platform based on a real-time help-seeking mechanism, *British Journal of Educational Technology*, 42 (6), 992-1002.

Johnson, R. K., Shek, C. K. W. and Law, E. H. F. (1993). *Using English as the Medium of Instruction*, Hong Kong: Longman.

Jungsun, K. and Kizildag, M. (2011). M-learning: Next generation hotel training system, *Journal of Hospitality and Tourism Technology*, 2 (1), 6-33.

Keith, T. Z. (2006). *Multiple Regression and Beyond*, Boston: Pearson/Allyn and Bacon.

Li, N., Leung, D. Y. P. and Kember, D. (2001). Medium of instruction in Hong Kong universities: the mis-match between espoused theory and theory in use, *Higher Education Policy*, 14, 293-312.

Likert, R. (1932). A technique for the measurement of attitudes, *Archives of Psychology*, 140, 5-53.

Lindquist, D., Denning, T., Kelly, M., Malani, R., Griswold, W. G., and Simon, B. (2007). Exploring the potential of mobile phones for active learning in the classroom, *Proceedings of the 38th SIGCSE Technical Symposium on Computer Science Education*, Covington, Kentucky, USA.

Liu, P. and Chen, C. (2015). Learning English through actions: A study of mobile-assisted

language learning, *Interactive Learning Environments*, 23 (2), 158-171.

Monk, S., Campbell, C., and Smala, S. (2013). Aligning pedagogy and technology: A case study using clickers in a first-year university education course, *International Journal of Pedagogies & Learning*, 8 (3), 229-241.

Moon, J. W. and Kim, Y. G. (2001). Extending the TAM for a world-wide-web context, *Information and Management*, 38 (4), 217-30.

Nunnelly, J. C. (1978). *Psychometric Theory*, 2nd Edition, New York: McGraw Hill.

Park, S. Y., Nam, M. W., and Cha, S. B. (2012). University students' behavioral intention to use mobile learning: Evaluating the technology acceptance model, *British Journal of Educational Technology*, 43 (4), 592-605.

Saunders, M., Lewis, P. and Thornhill, A. (2012). *Research Methods for Business Students*, 6th Edition, Harlow: Pearson.

Shon, H. and Smith, L. (2011). A review of poll everywhere audience response system, *Journal of Technology in Human Services*, 29 (3), 236-245.

Tabachnick, B. G. and Fidell, L. S. (2013). *Using Multivariate Statistics*, 6th Edition, Upper Saddle River, New Jersey: Pearson.

Valle, M. and Douglass, C. (2014). Clicking for health: use of a student response system in a large interdisciplinary health class, *Academy of Educational Leadership Journal*, 18 (3), 87-92.

Vargha, A. and Delaney, H. D. (1998). The Kruskal-Wallis test and stochastic homogeneity, *Journal of Educational and Behavioral Statistics*, 23 (2), 170-192.

Venkatesh, V. and Davis, F. D. (2000), A theoretical extension of the technology acceptance model: Four longitudinal field studies, *Management Science*, 46 (2), 186-204.

Wang, M., Shen, R., Novak, D., and Pan, X. (2009). The impact of mobile learning on students' learning behaviours and performance: report from a large blended classroom, *British Journal of Educational Technology*, 40 (4), 673-695.

Wong, S. (2012). *Factors Influencing On-line Learning: A Study Using Mixed Methods in a Hong Kong Higher Education Institution*, Saarbrücken, Germany: LAMBERT Academic Publishing.

Wong, S. (2015). Exploring the relation of students' language proficiency, online instructor guidance and online collaboration with their learning in Hong Kong bilingual cyber education, *International Journal of Cyber Society and Education*, 8 (2), 115-132.