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STUDENT PERCEPTIONS ON THE USE OF STUDENT RESPONSE SYSTEM IN HIGHER EDUCATION IN HONG KONG

Abstract:

The SRS (Student Response System) is a software tool that is designed to facilitate students to learn by making the lessons more interesting and interactive, quickly assessing their understanding of the subject, and inspiring discussions. While the traditional SRS makes use of custom-made devices called Clickers, recently there are many mobile phone-based SRSs developed and accessible through the Internet. However, many university teachers are hesitant to use SRS due to the lack of research about student perception of the application of SRS in higher education. Our study will report on the student perception of using mobile phone-based SRS in a self-financed higher education institution in Hong Kong. Data were collected from over 400 students using online surveys during the autumn semester in 2017.

This paper will start a concise overview of the SRS technology. Then it will report the sampling method and survey procedure. Finally, it will show the analysis of the results using the Technology Acceptance Model (TAM).

This research shows that the students have positive perceptions on the usefulness and ease of use of the SRS. However, the students in the early stage of study have a significantly more positive perception on the ease of use than the students in the final stage of study. All the students have positive intention to continue to use SRS. Hence, we recommend teachers should adopt SRS in their classroom teacher, with more attention in making questions easier to understand for final stage students.

Keywords:

Student Response System, Mobile phones, Technology Acceptance Model, Self-financed, Higher Education, Clickers, Audience Response Systems

JEL Classification: C88, C25, I23

1. Background of Student Response Systems (SRS)

As digital technology continues to improve and become more economically viable to schools, many researches have been done to exploit digital technologies to increase the student engagement (Hwang, Wu, Tseng, & Huang, 2011; Jungsun & Kizildag, 2011; Liu & Chen, 2015). Recently, many researches have focused on the use of SRS (Student Response Systems) in which teachers can gather and summarise answers from students inside the classroom immediately (Carnaghan, Edmonds, Lechner, & Olds, 2011; McLoone, Villing, & O'Keeffe, 2015; Monk, Campbell, & Smala, 2013; Valle & Douglass, 2014).

In a classroom where no SRS is used, the teacher cannot get real-time feedback from their students. Without a SRS, the teacher can only request students to answer questions verbally, raise their hands to for a quick poll, or write down their answers on pieces of paper. Since no technology is involved in these traditional methods, there is no special knowledge or equipment requirement. However, these traditional methods have some shortcomings that greatly reduce its effectiveness. When the teacher invites verbal answers from students for open-ended questions, Chinese students are often too shy to give their answers in front of their classmates (Wang et al., 2009). It is also possible that when students try to answer questions, their answers are not heard by the teacher and the rest of the class clearly. This problem becomes more serious in Hong Kong universities where classes are often conducted in English, but the mother tongue of most students is Chinese. When the teacher invites students to raise their hands for a quick poll, many of them are afraid to be the first ones to raise their hands. Conversely, when most of the students raised their hands, the remaining few students are likely to raise their hands too due to peer influence (Withey, 2010). Besides, hand-raising polls create problems for the teacher. It is hard to count the number of hands raised, and even harder to keep track of who raise their hands in which polls (Caldwell, 2007). If the teacher collects answers in written form in class, then the teacher has the extra effort of handling paper and try to interpret styles of writing that are sometimes difficult to read (Bae & Kim, 2014).

The limitations of the traditional methods stated above can be solved by using a SRS. With SRS, the teacher can collect and show answers instantaneously on screen. Students will not feel anxious to answer questions because they can only see the statistics of the answers, but not the names of students who gave the answers. However, the teacher can track the answers to individual students using reports provided by the software. There is no extra effort to count hands and handle paper. The typical SRS involves the use of clickers and they can be called Clicker-based SRS. There are some problems in using clicker-based SRS. Firstly, the schools or the students have to purchase the hardware and software (Monk et al., 2013). Secondly, the clickers are usually small numeric keypads that have limited text entry capabilities (Caldwell, 2007).

With the widespread use of smart mobile phones, it is possible to replace the clickers with mobile phones, and the proprietary software with commercially available polling website. At the institute in which the author is teaching, there is preliminary evidence that mobile phone-based SRS is well perceived by students (Wong, 2015). However, more empirical data is needed from a bigger sample to confirm this previous finding. In particular, this research attempts to find out the if students in the early stage (year 1 or year 2) and in the final stage (year 3 or year 4) have positive perceptions about mobile phone-based SRS (mSRS). Furthermore, the research attempts to find out if there is a significant difference between the perceptions of the students in these two different stages. This research is based on the survey data collected from about 400 students who are at different stages of study in a self-financed higher education institution in Hong Kong. The results will be analysed using the Technology Acceptance Model (TAM). The research questions (RQs) are stated as follows:

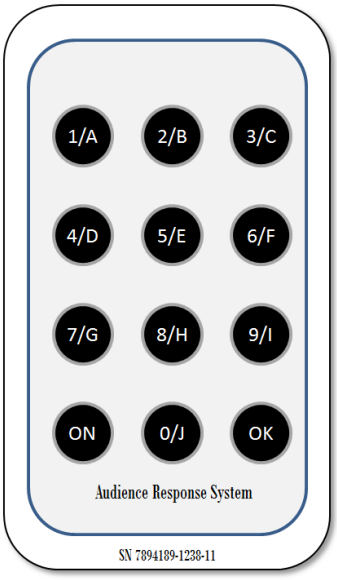
RQ1: Do students in the early stage and final stage of higher education have positive perception on the SRS in terms of perceived usefulness (PU) and perceived ease of use (PE)?

RQ2: Is there significant difference between the two groups of students in their perceptions on PU and PE?

2. Literature Review

2.1 Clicker-based SRS versus Mobile phone-based SRS

In a typical SRS, students are given small, portable devices called “Clickers” (Lindquist et al., 2007). The clickers have numeric keys, on which students can choose their answers to the questions posted by the teacher (Figure 1). Then the students‘ answers are summarised and shown on the projector screen in real-time (Figure 2). The main advantage of a SRS is that it allows the teacher to quickly find out how well each student understands a subject immediately. This is because students are not afraid to answer questions as the whole class can only see the statistics of the different answers, but not who gave the answers. Therefore the SRS is especially useful in creating a more engaging environment in a large lecture hall. Many studies revealed that SRSs are effective in increasing students’ engagement and active learning (Cain, Black, & Rohr, 2009; Lindquist et al., 2007; Monk et al., 2013; Park, Nam, & Cha, 2012; Şad & Göktaş, 2014).



This is a typical clicker in a Student Response System, also known as Audience Response System.

Note that students can only provide numeric answers using this this clicker.

More advanced form of clickers may have an LCD screen.

Figure 1. A typical clicker that has only numeric keys (Source: The authors of this research).

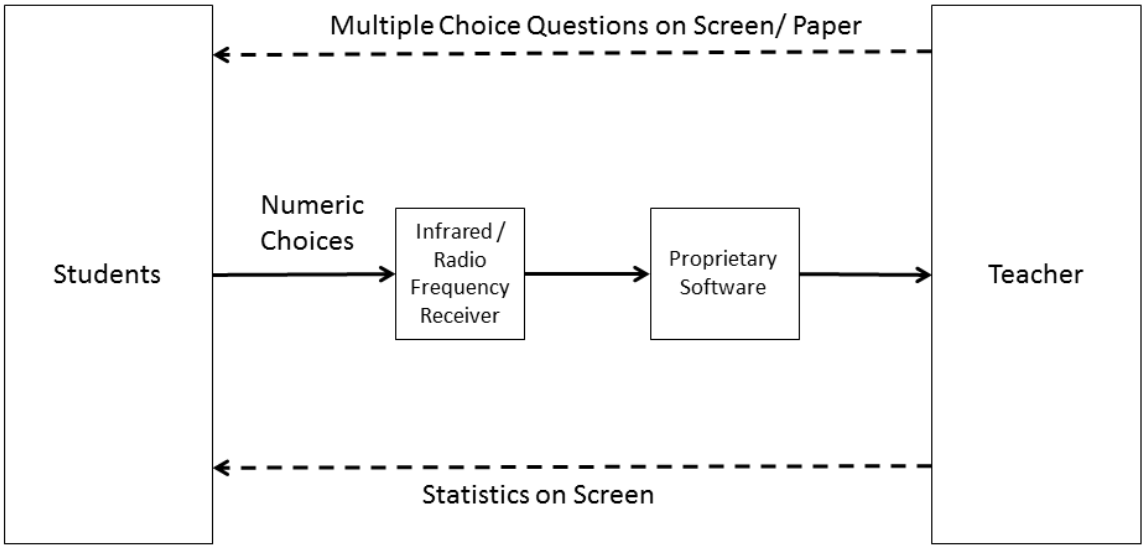


Figure 2. The mechanism of the clicker-based SRS (Source: The authors of this research).

However, clickers are limited to making choices in the form of numbers, and students are not willing to use them if they have to pay for the clickers. Due to the widespread use of mobile phones in Hong Kong, the availability of free WiFi access on campus and commercially available polling software, mobile phones become a viable alternative to proprietary SRS using “clickers”. There is little research about the use of mobile phones by students as a SRS device. Therefore, the purpose of this research is to investigate student’s acceptance of the technology using the TAM (Technology Acceptance Model),

which was first proposed by Davis (1989). Furthermore, this research also investigate if there is any difference in student's perception across different stages of their study.

Compared with the clicker, the mobile phone is an attractive alternative because of its small size and high penetration rate among students. Research has found that over 99% of students own a mobile phone (Burns & Lohenry, 2010; Gikas & Grant, 2013; Liu & Chen, 2015; Shon & Smith, 2011). Therefore, the mobile phones can be an effective substitute for clickers, laptops or even computers in the lab. The clicker-based SRS requires the installation of a receiver in the classroom, while the mobile phone-based SRS uses the Internet as the connection medium (Figure 3). This means the teacher has more flexibility because the polling website can be switched when better features are required.

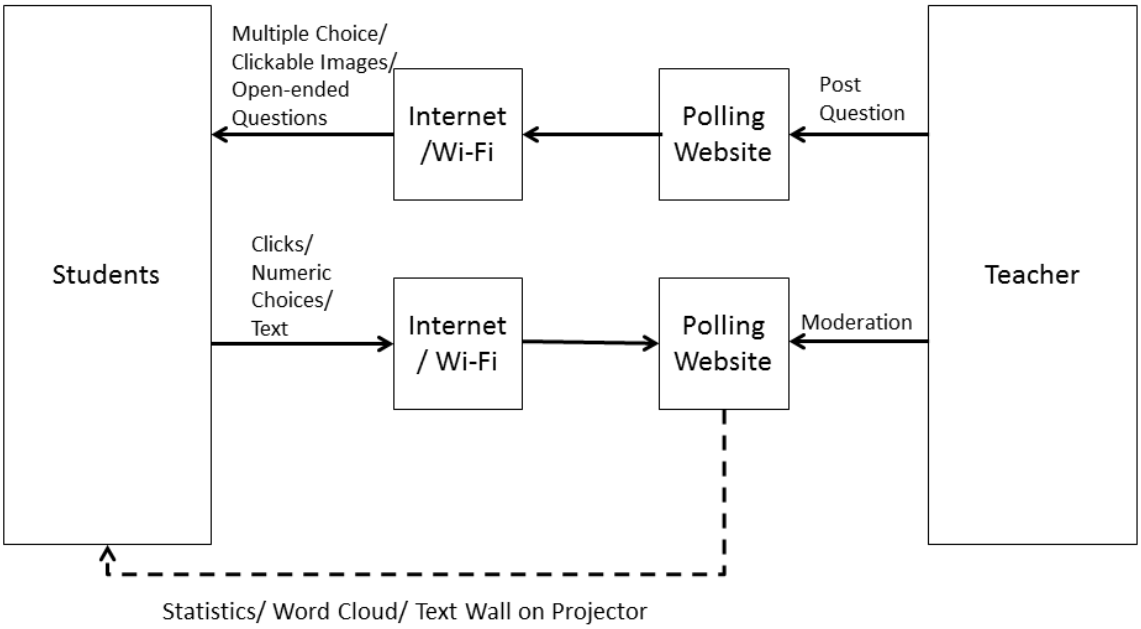


Figure 3. The mechanism of the mobile phone-based SRS (Source: The authors of this research)

2.2 Technology Acceptance Model

In addition to the major criteria such as the availability of mobile devices, Internet access facility in classrooms and the polling software for using mobile device-based student response system (SRS) in the classrooms, Wong and Wong (2016) regard that the users' acceptance of adopting SRS is important for implementing SRS in classrooms. Their study is based on Davis' (1986) technology acceptance model (TAM) to investigate the users' acceptance of SRS in terms of the students' acceptance of adopting SRS in classrooms. They pioneered a cross-cohort approach to explore the students' perceptions on the mobile-device based SRS at their different stages of study.

In the original TAM, there are four constructs, namely, perceived usefulness (in short, PU), perceived ease of use (PE), behavioral intention and usage behavior in Davis' (1986) TAM (Figure 4). PU is a student's belief that using the SRS can enhance his or her performance, PE is that student's perception of the ease of use of the SRS, behavioral intention is the student's intention to use SRS and usage behavior is the student's actual usage of SRS. In this model, PU and PE influence a student's behavioral intention, and behavioral intention in turn influences that student's usage behavior.

For this research, four constructs have been added in order to suit the context of higher education. The constructs are Major Relevance (MR), Subjective Norm (SN), Self-Efficacy (SE) and Self-Accessibility (SA) (Park, Nam, & Cha, 2012). As shown in Figure 4, MR is a student's belief that his/her major is related to SRS, SN a student's believe that most people important to them think that the student should use SRS, SE is a student's belief in his/her own ability to complete learning tasks using SRS, and SA is a student's own autonomy for accessing the mobile device when using SRS (Park, Nam, & Cha, 2012). In this research, all the students have access to their mobile phones, free and unlimited access to the WiFi provided by the School, and SRS accounts pre-configured for them. Therefore, SA is not regarded as a variable in the regression analysis.

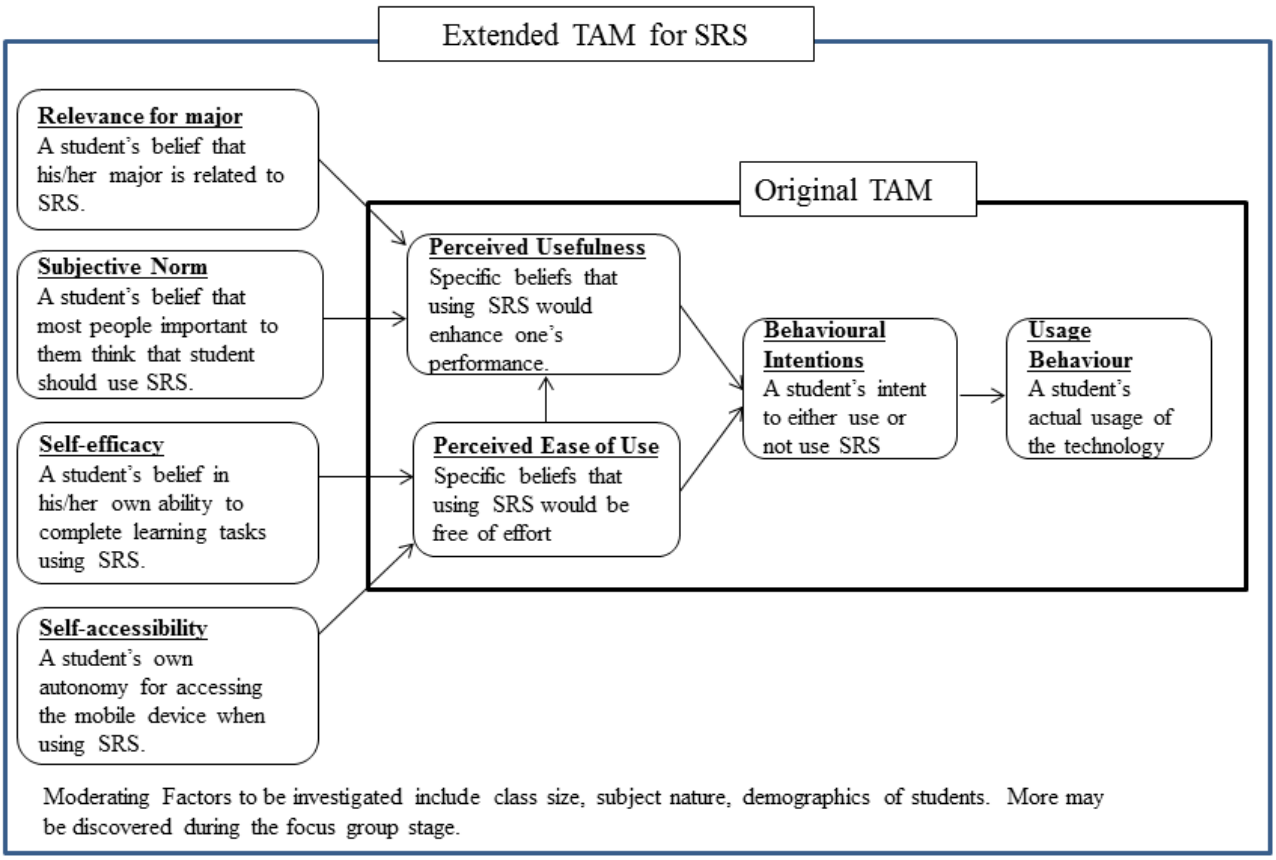


Figure 4. The original TAM (Davis, 1989), plus the constructs suggested in this research on SRS.

3. Research Objectives

The analytical results in Wong and Wong (2016) review that the students exhibited high PU and PE on the mobile-device based SRS despite the difference at their stages of study. As identified by Wong and Wong (2016), there are three limitations in their study. First, their study did not cover a complete range of years of study. The early stage participating students are the year 1 students while the final stage participating students cover year 3 and year 4 students. This problem suggests covering a complete range of years of study in future research. In this regard, year 2 students were not covered in their study. Second, the sample size was relatively small with only 78 students. This problem suggests that the future research should also adopt a much larger sample. Third, their study did not reflect the issue of the changing effects of some constructs in Davis' (1986) TAM over time. As noted in Venkatesh and Davis (2000), some constructs in TAM may change over time. This problem of changing effects of some constructs in TAM suggests further investigation at different times after the institutions first implemented the SRS is needed.

Regarding the three limitations in Wong and Wong (2016), as there is difficulty in covering a complete range of years of study and large classes in the class settings in the targeted two institutions, this study proposes an additional study to find out if there are changing effects of the students' perceptions on the mobile-device based SRS after the institutions have implemented the SRS since the study conducted in 2016. The researchers propose to compare the students' PU and PE at their early and final stages of study. The findings of the proposed comparative study can help the education management to understand the different effects of the students' PU and PE and therefore provide implications for the implementation of SRS for learning in classrooms at early and final stages of study. The theoretical model in this research is shown in Figure 5.

The effects of the constructs MR, SN on PU, and the effects of SE, SA on PE, and the effects of PE on PU, and the effect of PU, PE on BI are represented as regression coefficients from r1 to r7.

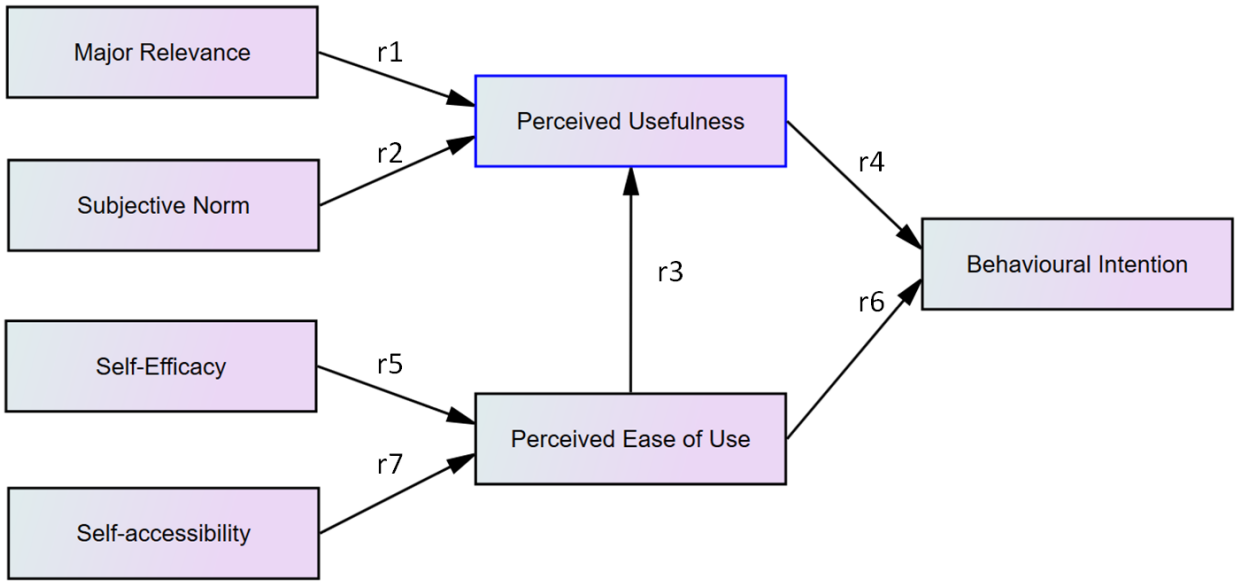


Figure 5. Technology Acceptance Model (modified by the authors for this research)

4. Methodology

A survey was designed to measure the students' PU and PE. This survey was conducted at two higher education institutions in Hong Kong which represent two different stages of study. One institution delivers a wide range of top-up honors degree programs mainly in the business areas for the final stage (year 3 to 4, or junior to senior) students. The other institution offers a wide variety of associate degree and higher diploma programs for the early stage (year 1 to 2, or freshmen to sophomore) students. The survey was conducted by inviting the participating students to complete an online questionnaire together with an explanation of the purpose, procedures and scope of this research. As the participating students responded with implied consent (Berg and Lune, 2012, p. 92) when completing the online questionnaire, their informed consent was not requested. To ensure informant anonymity and confidentiality, the participating students' identities such as their attended institutions remain anonymous in any publications and report of this research.

The students' PU and PE were operationalized by the online questionnaire items measured on a 5-point Likert's (1932) scale ranging from "strongly agree" = 5 to "strongly disagree" = 1, as shown in Table 1. These items are similar to the validated measuring items used in Davis (1989).

Table 1. Measuring items for the students' PU and PE (Source: Questionnaire designed by the authors of this article)

Construct	Measuring Items	
Relevance for Major (MR)	MR1	It motivates me to learn more about the subject .
	MR2	It helps me understand the subject .
Subjective Norm (SN)	SN1	Using SRS has important meaning as a student in higher education .
	SN2	It is good that other people know I have experience in using SRS .
Self-efficacy (SE)	SE1	I have the necessary skills for answering questions using SRS .
	SE2	I am confident in using SRS .
Perceived Ease of Use (PE)	PE1	It is easy to answer questions using SRS .
	PE2	Using SRS is not difficult .
Perceived Usefulness (PU)	PU1	I recommend keep using SRS .
	PU2	Studying through answering questions using SRS is a good idea .
Behavioral Intention (BI)	BI	I am willing to answer questions using SRS in future.

All these constructs PU and PE contain similar statements which should yield similar Likert's scores and Cronbach's (1951) coefficient alpha was used to test the internal consistency reliability.

5. Sampling & Data Collection

The participating teachers at the two institutions were invited to post questions related to the courses on a polling website Poll Everywhere (polleverywhere.com) in September to December in 2017. Then, their students experienced the mobile device-based SRS by using their mobile devices such as smartphones and tablets to give answers to Poll Everywhere in the classrooms.

The researchers used random sampling to select participating students who experienced mobile-device based SRS in the two higher education institutions. The sample size was generated by a priori statistical power analysis using G*Power (Erdfelder, Faul, and Buchner, 1996). As indicated in

Table 2, the sample size should be at least 88 in each of the two student groups which was generated by G*Power when t-test is used for the 5% significance level (α = 0.05), 95% statistical power which is more stringent than 80% proposed by Cohen (1992b) and the desired effect size d = 0.5 between medium and small effect (Cohen, 1992a).

Table 2. Using Statistical Power Analysis by G*Power to determine the Minimum Sample Size based on Erdfelder, Faul, and Buchner (1996)'s method.

t-test	Means: Difference between two independent means (two groups)	
Analysis	A priori: Compute required sample size	
Input	Tail	One
	Effect Size *d*	0.5
	Significance Level *α*	0.05
	Statistical Power 1 – *α*	0.95
Output	Critical *t*	1.6536580
	Degree of Freedom	174
	Total Sample Size	176
	Minimum Sample Size for Each Group	88
	Actual Power	0.9514254

With the help of the participating teachers, 400 students who experienced the mobile device-based SRS were randomly selected and invited to complete the online questionnaire in their classes. Calling the students to meet and complete the online questionnaire in their classes can improve response rate (Saunders, Lewis and Thornhill, 2012). Among the respondents,16 of the students did not complete the questionnaire. For the respondents who completed the questionnaire, 200 students are final stage students while 184 students are early stage students. The response rate is 96%. The questionnaire is hosted at Survey Monkey and all the students answered the questions anonymously.

6. Analysis

The researchers used the Statistical Package for the Social Sciences (SPSS) version 24 to use Cronbach's coefficient alpha to internal consistency reliability, t-tests and multiple linear regressions. The t-test was used 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 causal effect of the constructs in the extended TAM model was determined by multiple linear regression coefficient's (r1 to r7) using AMOS.

6.1 Construct Reliability

To verify that the items in the survey questionnaire are reliable measures, the Cronbach's coefficient alpha are calculated for each of the items in the questionnaire. Table 3 shows these mean scores for the items that constitute the constructs in this research. It shows the values of Cronbach's coefficient alpha which are all above 0.7, meaning that the internal consistency reliability is acceptable (Nunnelly, 1978). Therefore, the means of the

items in each construct are combined to form a combined and reliable measure of the construct itself.

Table 3. Mean scores and internal consistency reliability of the measuring items (Source: Empirical data collected for this research)

Construct	Measuring Items	Item Mean (Standard Deviation) (n = 384)	Combined Means	Construct Reliability (Cronbach's alpha)
PU	PU1	3.69 (.811)	3.73	0.883
	PU2	3.77 (.759)		
PE	PE1	3.79 (.811)	3.81	0.819
	PE2	3.84 (.828)		
MR	MR1	3.66 (.789)	3.66	0.832
	MR2	3.67 (.762)		
SN	SN1	3.57 (.812)	3.57	0.831
	SN2	3.57 (.796)		
SE	SE1	3.81 (.779)	3.80	0.867
	SE2	3.79 (.799)		

The PU and PE means and standard deviations in the two groups are shown in Table 4.

6.2 Comparison of Student Perceptions at the Different Stages of Study

The means and standard deviations of PU and PE are listed in Table 4. All the means are greater than 3, which stands for "neutral" in the 5-point Likert scale. This shows that the students in both final and early stages of the study have positive perceptions on the use of SRS. It can be seen that the students in the early stage have given higher scores to both PU & PE than the students in the final stage.

Table 4. Statistics on PU & PE from the two groups of students. (Source: Empirical data collected for this research)

Group	Construct	Mean	Standard Deviation
Final Stage Students (n=200)	PU	3.76	0.822
	PE	3.87	0.8229
Early Stage Students (n=184)	PU	3.85	0.640
	PE	4.04	0.704

To find out whether the difference between the two stages is due to random error or not, the t-test is performed on the data. As shown in Table 5, the t-test results indicate that there is no significant difference between the students' PU with $t(381) = 1.332$ and $\rho = .184$ (two-tailed) but significant difference between the students' PE with $t(382) = 2.142$ and $\rho = .033$ (two-tailed) across the two institutions. Table 5 also shows the magnitude of the differences in the PU and PE means and effect sizes using eta squared. According to

Cohen (1988, p. 284-287), the effect size of .0046 is very small, meaning that only 0.46% of the variance in PU is explained by the stage of study. By comparison, the effect size of .0119 is a bit larger, meaning 1.19% of the variance in PE is explained by the stage of study.

Table 5. Comparing the means of PU & PE between the two groups using the t-test. (Source: Empirical data collected for this research)

Item	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference		Effect Size Eta Squared
					Lower	Upper	
PU	1.322	381.074	.184	.093	-.044	.231	.0046
PE	2.142	382	.033	.168	.014	.322	.0119

To compare the student's attitude on their intention to use SRS in future, the means and standard deviations of BI (behavioural intention) in the two groups are compared in Table 6. As the means from both groups are above 4 in a scale of 1 to 5, the results indicate that the students have very high intention to use SRS in future in their studies.

Table 6. Statistics on BI from the two groups of students. (Source: Empirical data collected for this research)

Group	Construct	Mean	Standard Deviation
Final Stage Students (n=200)	BI	4.84	.751
Early Stage Students (n=184)	BI	4.81	.859

In order to check whether there is any difference between the two groups of students in their BI, the t-test is performed. As shown in Table 7, the t-test results indicate that there is no significant difference between the students' BI with $t(381.017) = -1.484$ and $\rho = .139$ (two-tailed) across the two institutions. The table also shows the magnitude of the difference in the BI means and effect size using eta squared. According to Cohen (1988, p. 284-287), the effect size of .0057 is very small, meaning that only 0.57% of the variance in BI is explained by the stage of study.

Table 7. Comparing the means of BI between the two groups using the t-test. (Source: Empirical data collected for this research)

Item	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference		Effect Size Eta Squared
					Lower	Upper	
BI	-1.484	381.017	.139	-.122	-.238	.040	.0057

6.3 Regression Coefficients in the Extended TAM Model

To determine the casual effect of the constructs on PU and PE, multiple linear regresssions were performed as specified in the Extended TAM model in Figure 5. The results of the regression analysis are listed in Table 8. It shows that all the regression coefficients are significant at the 0.05 level or higher, except SN → PU, which is not significant at the 0.05 level. Each regression coefficient and the related discussions will be done in the following paragraphs.

Table 8. Regression Analysis in the Extended TAM model. Note that r7 is not included as explained in the text.

				Final Stage (n=200)		Early Stage (n=184)	
Regression Coefficient	Independent Variable		Dependent Variable	r	Adjusted R^2	r	Adjusted R^2
r1	MR	→	PU	.267 *	.600	.283 *	.512
r2	SN	→	PU	.160 **	.600	.022	.512
r3	PE	→	PU	.475 *	.600	.547 *	.512
r4	PU	→	BI	.622 *	.658	.600 *	.541
r5	SE	→	PE	.553 *	.303	.495 *	.241
r6	PE	→	BI	.242 *	.658	.194 **	.541

Legend: * $\rho < 0.0005$ ** $\rho < 0.01$ *** $\rho < 0.05$

The coefficients r1, r2, and r3 represent the effects of MR, SN and PE on PU. The results for PE and MR are significant at $\rho < 0.0005$ while the result for SN for the final stage students is significant at $\rho < 0.01$. This model explained between 51.2% and 60% of the variance in PU. The effect of PE was stronger than that of MR and SN on PU at both stages of study. By comparing across different stages of study, PE and MR were stronger at the early stage of study while SN was stronger at the final stage of study. As there is no significant result for SN at the early stage students, comparison was not appropriate for SN.

The coefficients r4 and r6 represent the effects of PU and PE on BI. Table 8 shows the adjusted R^2 values that the model explained between 54.1% and 65.8% of the variance in BI. The results for PU for all stages of study and PE for the final stage students are significant at $\rho < 0.0005$ while the result for PE for the early stage students is significant at $\rho < 0.01$. The effect of PU was stronger than that of PE on BI at both stages of study. The results show that both constructs PU and PE were stronger at the final stage of study.

The coefficient r5 represent the effect of SE on PE. It shows the adjusted R^2 values that the model explained between 24.1% and 30.3% of the variance in PE. All results are significant at $\rho < 0.0005$. The results show that SE was stronger at the final stage of study.

Conclusions, Implications and Further Research

Regarding RQ1, the analysis shows that students in both the early stage and final stage of higher education have positive perception on the SRS as indicated by the high scores in their intention to use SRS in future. Regarding RQ2, in terms of perceived usefulness (PU) and perceived ease of use (PE), there is no significant difference between the two groups of students in PU. However, there is a significant difference between the two groups of students in PE. The early stage students had a higher positive perception of the PE than the final stage. This may be due to the fact that the teachers at the final stage may choose to use a more diversified form of question formats as the subject materials are more advanced than the early stage.

The intention to use SRS in future is also very high for both groups of students. This implies that the teachers should continue to use SRS in the classroom, but the teachers who teach final stage students should pay more attention to the format of their questions so as to increase the perceived ease of use.

There are several suggestions for further research. Firstly, it is necessary to find out if the student's discipline of study will affect their perceptions on SRS. Secondly, qualitative research should be carried out to understand the meaning behind the statistics. Finally, there should be research to compare the effectiveness of difference pedagogies when combined with SRS.

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