

# The Impact of the Adoption of Classroom Response Systems on University Students' Subject Learning Experience

Calvin Cheng, Simon Yuen, and Vanessa Liu

**Abstract**—Universities worldwide have long been looking for ways to improve and enhance their students' learning experience in subjects. Classroom response systems are one of the most popular e-learning tools used by universities to help students learn subjects more effectively and interactively. This paper reports a study of the factors determining university students' subject learning experience and the impact of using classroom response systems on their subject learning experience. With 262 university students took part in it, the study found that university students' subject learning experience was determined by subject usefulness, assessment design, subject contents and teaching materials. It also revealed that classroom response systems improved university students' evaluation of all subject factors and eventually their learning experience in a subject.

**Index Terms**—E-learning, classroom response systems, university students, learning experience.

## I. INTRODUCTION

Learning is the acquisition of knowledge or skills through study, observation or experience. It is a lifelong process that human beings are doing, from the time they were born to the time they die. Having said that, most people learn their essential linguistics, cultural, literacy, technical and workplace knowledge from their schools. For them, university is always their last school and training stop before joining the 'real work' and starting their career.

As of January 2019, there were around 28,000 universities all over the world. The number of students studying at universities worldwide has reached 57 million [1]. Given the high number of student enrolment and the importance of university learning for the successful employment and future of students, universities have long been looking for measures to improve their students' learning experience in subjects (here a 'subject' refers to a course which is normally undertaken by a university student over a semester). One initiative is to adopt e-learning technology and tools in the subjects. The objectives of this study are to understand the determinants of university students' subject learning experience and examine the impact of the adoption of an e-learning tool (Classroom Response Systems) on university students' subject learning experience. In the following

sections, the concept of e-learning is reviewed and the Classroom Response Systems are discussed. Then, the literature review, research framework development and research methodology of the study are presented. Following, the results and findings of the study are discussed. Finally, a conclusion with discussion is given.

## II. E-LEARNING

E-learning is also known as online learning, internet learning, web-based learning or computer-based learning. It is the use of online technologies to deliver learning materials and to support collaboration and communication amongst learners and between the learners and their tutor [2]. E-learning involves the utilization of wide range of technology applications, tools and strategies that offer learners the means to increase their knowledge and enhance their skills. It provides a convenient and effective way for people to acquire skills and competencies that they need to compete and survive in this rapid changing society [3].

The history of e-learning can be traced back to 1970s when various media (print, audio and video) were used in teaching the distance learning students by higher education institutions worldwide. In the following two decades, different new technologies were invented and put into use, for instance, interactive computers, Internet and World Wide Web. In late 1990s, people started to apply the new technologies to distance learning to improve the students' learning experience and thus, the concept of e-learning was born [4]. At the very beginning of its development, e-learning was mainly characterized by the use of Internet technologies in delivery and administration of learning materials and activities. Stepping into the 21st century, with the further advancement of Information and Communication Technology (ICT), e-learning has been extended to provide people with the ability to learn interactively and collaboratively through different communication electronics, mobile devices, virtual learning environments, video conferencing, learning platforms and a wide range of apps. The most popular e-learning tools used in university teaching nowadays include Virtual Learning Environment (e.g. Moodle and Blackboard), Learning Management Systems (e.g. Kallidus and SharePoint), Classroom Response Systems, Discussion Boards, Voting Pads and Blogs.

## III. CLASSROOM RESPONSE SYSTEMS

Classroom Response Systems (CRSs), so-called clickers, are one of the most popular e-learning tools used in

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universities. CRSs are polling systems that provide real-time and instant results to the teacher and students [5]. Traditionally, students had to buy a clicker which was used as the device for answering questions raised by the teacher. With CRSs, students have the option of using different communication devices, like mobile phones or tablets, for responding the polling questions. CRSs have the advantages of providing the teacher with real-time data, regarding the students' understanding and comfort level, with the topics. Based on the results, the teacher may then amend the intended instruction and, if needed, modify the teaching materials for future classes. CRSs not only can increase students' participation and engagement with the subject, but also can help teachers assess students' learning [6].

Today, CRSs have grown in popularity in universities to support and facilitate interactive learning, in particular in large lecture classes. CRSs offer a number of advanced functions, including attendance tracking with geolocation functions, video-based learning, real-time interactive discussion boards and multiple types of questions and response features (e.g. multiple choice, ranking, click on target, open-end questions, etc.) [7]. There are numerous CRSs offered in the market by multiple vendors, such as Turning Technologies, iClicker, Poll Everywhere, Kahoot!, UniDoodle, Audience Response Systems, Echo360, ClickerSchool, OMBEA, Infuse Learning, Via Response, Top Hat Monocle, Socrative, Quiz Socket, NearPod, Zeetings, Text the Mob and Shakespeak. Among all, Poll Everywhere is one of the most famous ones.

Poll Everywhere is a CRS produced by the same-name company which is based in San Francisco, California. Poll Everywhere is a web-based platform for collecting and analysing instant poll responses from students in class by using devices like laptops, tablets or smart phones. It gives students the opportunity to individually participate and respond to activities set by their teachers [8]. Poll Everywhere offers a number of types of activities that a teacher can use to interact with the students, such as multiple-choice polls, word cloud, Q&A, rank order, clickable images, survey and open-ended questions. It allows teachers to customize the look of their polls, insert their polls into PowerPoint, present the live results, publish the results and report the results in different formats (executive summary, participant response history, survey results, response pivot table, gradebook and segmentation).

#### IV. LITERATURE REVIEW AND RESEARCH FRAMEWORK DEVELOPMENT

Learning experience refers to how a learner feels about the learning situation and how he or she can use previous knowledge and resources to understand and access the materials and skills that have been learnt [9]. It is the learner's cognitive, emotional and physical experience in the interaction with own self or others [10]. It includes the learner's perception about the effect of education on his or her skills and attitudes. Studies show that learning experience is crucial to students' learning. Learning experience can have long-lasting and big impact on students' educational outcomes [11]. A good learning experience can help students master new knowledge and skills more effectively [12].

Students who have had a good learning experience will critically examine beliefs and assumptions and engage in a collaborative search for wisdom and holistic personal development [13].

A CRS influences students' learning experience in a subject [14]. With the adoption of a CRS in a subject, each student has the opportunity to answer every question raised or join every activity set by the subject teacher in class without being embarrassed if his or her answer or action is wrong. The CRS increases students' intention and willingness to participate in the class. It allows students to get instant feedback and assess their understanding relative to those of their fellow classmates. It makes the subject more interesting and promotes students to learn it more actively.

Previous researches have recognized six subject factors that determine students' learning experience in a subject, namely subject contents, teaching materials, subject difficulties, subject workload, assessment design and subject usefulness. Fig. 1 shows the conceptual framework.

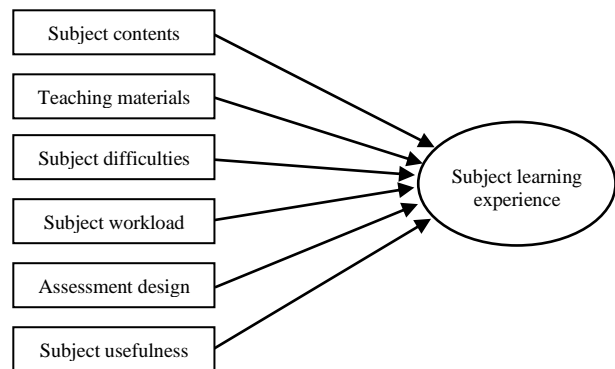


Fig. 1. The conceptual framework.

##### A. Subject Contents

Subject contents are the substance of teaching and what a student learns in a subject. It is one of the important factors that influence the students' subject learning experience. Heavy subject contents result in increased anxiety among students, and vice versa [15]. Students also learn better and are more successful with subject contents for which they have a well-developed interest [16].

##### B. Teaching Materials

Teaching materials are those materials which a teacher uses to help students learn a subject, such as handouts, subject outlines, textbooks and visual aids. Good teaching materials can motivate and raise students' interest [17]. If the teaching materials of a subject are good and authentic, students will learn better. The teaching materials of a subject aid students' development of study skills and maximize their learning effectiveness and experience [18].

##### C. Subject Difficulties

Subject difficulties refer to the difficulties a student associated when taking a subject. A subject is said to be difficult if the grades awarded or marks given are generally lower than that normally expected, or if the subject concepts are hard [19]. The levels of subject difficulties affect the emotions and motivation of students, and thus, affecting their learning experience [20]. As many teachers point out, subject difficulties frustrate students and affect their in-class learning

[21].

**D. Subject Workload**

Subject workload is the amount of time and effort required for an average student to complete a subject. There is a positive relationship between workload and student burnout (emotional exhaustion, reduced personal accomplishment and depersonalization) [22]. Subject workload influences students' perception of their learning experience in class [23]. A high level of subject workload leads to a high degree of stress for students in their learning [24].

**E. Assessment Design**

Assessment design means the methods and strategies a teacher employs in assessing students in the subject. Common assessment methods used in universities include assignment, presentation, group project, test and examination. Assessment design drives and directs students' learning [25]. An effective assessment design can encourage students to learn a subject by reflecting their experiences and by linking theories to practices [26].

**F. Subject Usefulness**

Subject usefulness is a student's beliefs about the value of a subject. University subjects are usually defined based on academic disciplinary boundaries and are the preparatory stage to a profession [27]. Subject usefulness is found to be positively correlated with students' self-enthusiasm in learning a subject [28]. If students believe that a subject is useful to them, they will enjoy learning it more [29].

**V. RESEARCH METHODOLOGY**

A structured questionnaire measuring students' subject learning experience and the six determinants (subject contents, teaching materials, subject difficulties, subject workload, assessment design and subject usefulness) was used in this study. A 5-point Likert scale (ranging from '1 = strongly disagree' to '5 = strongly agree') was employed to measure all the items.

The questionnaire was administered to marketing students from a university in Hong Kong, who enrolled in two compulsory marketing subjects ('Consumer Behaviour' and 'Brand Management'), at two time points: before and after Poll Everywhere (a CRS) was adopted in the subjects. These students were taught by the same lecturer. For those who enrolled in the two subjects after the adoption of Poll Everywhere, they were asked to use Poll Everywhere to respond to all in-class questions and activities throughout the semester. The questionnaire was conducted at the end (the last class) of the subjects.

The data collected were processed and analysed using the SPSS 25 software. A multiple regression was run to examine whether the six subject factors were associated with subject learning experience. Independent-samples t-tests were also run to determine group differences.

**VI. RESULTS AND FINDINGS**

**A. Respondents Analysis**

In total, 262 respondents were successfully collected. 128

respondents (48.9%) enrolled in 'Consumer Behaviour', among whom 67 respondents (25.6%) enrolled in the subject before (i.e. without) the adoption of Poll Everywhere and 61 respondents (23.3%) enrolled in the subject after (i.e. with) the adoption of Poll Everywhere. Another 134 respondents (51.1%) were coming from 'Brand Management'. 74 of them (28.2%) took the subject before (i.e. without) the adoption of Poll Everywhere and 60 of them (22.9%) took it after (i.e. with) the adoption of Poll Everywhere. Table I depicts their profile.

TABLE I: PROFILE OF RESPONDENTS

Student Groups	Frequency	Percentage
Consumer Behavior (without Poll Everywhere)	67	25.6%
Consumer Behavior (with Poll Everywhere)	61	23.3%
Brand Management (without Poll Everywhere)	74	28.2%
Brand Management (with Poll Everywhere)	60	22.9%
Total	262	

**B. Multiple Regression Analysis**

To determine if the subject factors influence students' subject learning experience, a multiple regression analysis was conducted. The six independent variables were: subject contents, teaching materials, subject difficulties, subject workload, assessment design and subject usefulness. The linear combination of the six independent variables was significantly related to the dependent variable (subject learning experience), R square = 0.650, adjusted R square = 0.642, F (6, 255) = 78.922, p = 0.000 (Table II). An estimated 65% of variance of the subject learning experience could be accounted for by the linear combination of predictors (subject contents, teaching materials, subject difficulties, subject workload, assessment design and subject usefulness).

TABLE II: MULTIPLE REGRESSION ANALYSIS: MODEL SUMMARY

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate		
1	0.806	0.650	0.642	0.41684		
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	82.280	6	13.713	78.922	0.000
	Residual	44.308	255	0.174		
	Total	126.589	261			

Predictors: Subject Contents, Teaching Materials, Subject Difficulties, Subject Workload, Assessment Design, and Subject Usefulness  
 Dependent Variable: Subject Learning Experience

TABLE III: MULTIPLE REGRESSION ANALYSIS: COEFFICIENTS

	$\beta$	t	Sig.
(Constant)		1.515	0.131
Subject Contents	0.154	2.661	0.008
Teaching Materials	0.123	2.014	0.045
Subject Difficulties	0.101	1.717	0.087
Subject Workload	0.033	0.494	0.622
Assessment Design	0.219	3.281	0.001
Subject Usefulness	0.310	5.114	0.000

Dependent Variable: Subject Learning Experience

As indicated in Table III, four variables, namely subject contents, teaching materials, assessment design and subject usefulness were significant and related positively to subject learning experience. Among them, subject usefulness ( $\beta = 0.310$ ) was the most powerful predictor of subject learning experience, followed by assessment design ( $\beta = 0.219$ ) and subject contents ( $\beta = 0.154$ ). Teaching materials ( $\beta = 0.123$ ) was the least important variable.

C. Independent-Samples T-tests

To find out if Poll Everywhere improves students' subject learning experience and the six subject factors, independents-samples t-tests were conducted to determine the differences in the means of the variables between the two student groups (without and with the adoption of Poll Everywhere) for each subject and the results are presented in Table IV and Table V. Results of the t-test showed that there were significant differences in all six subject factors and the subject learning experience between students taking 'Consumer Behaviour' without the adoption of Poll Everywhere and with the adoption of Poll Everywhere. For 'Brand Management', with 1 exception (subject contents), there were significant differences in the subject factors and subject learning experience between students without the adoption of Poll Everywhere and with the adoption of Poll Everywhere. Taken together, these two t-tests revealed that Poll Everywhere improved students' evaluation of the six subject factors and eventually their subject learning experience.

TABLE IV: INDEPENDENT-SAMPLES T-TEST FOR THE TWO GROUPS OF STUDENTS TAKING 'CONSUMER BEHAVIOUR'

Variable	CBwoP, N=67		CBwP, N=61		T-test for Equality of Means		
	Mean	Std. Deviation	Mean	Std. Deviation	t	df	Sig. 2-tailed
Subject Contents	3.96	0.684	4.23	0.693	-2.253	126	0.026
Teaching Materials	3.85	0.744	4.13	0.718	-2.165	126	0.032
Subject Difficulties	3.72	0.867	4.13	0.695	-2.968	126	0.004
Subject Workload	3.85	0.744	4.30	0.615	-3.663	126	0.000
Assessment Design	3.84	0.751	4.15	0.703	-2.418	126	0.017
Subject Usefulness	3.72	0.813	4.26	0.705	-4.041	126	0.000
Subject Learning Experience	3.75	0.751	4.12	0.624	-3.010	126	0.003

Note: CBwoP = Consumer Behavior (without Poll Everywhere); CBwP = Consumer Behavior (with Poll Everywhere)

TABLE V: INDEPENDENT-SAMPLES T-TEST FOR THE TWO GROUPS OF STUDENTS TAKING 'BRAND MANAGEMENT'

Variable	BMwoP, N=74		BMwP, N=60		T-test for Equality of Means		
	Mean	Std. Deviation	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Subject Contents	4.18	0.582	4.35	0.577	-1.731	132	0.086
Teaching Materials	4.15	0.655	4.37	0.610	-1.975	132	0.050
Subject Difficulties	3.97	0.662	4.22	0.715	-2.045	132	0.043
Subject Workload	4.07	0.627	4.38	0.613	-2.929	132	0.004
Assessment Design	3.92	0.678	4.33	0.752	-3.352	132	0.001
Subject Usefulness	4.01	0.712	4.35	0.633	-2.858	132	0.005
Subject Learning Experience	3.86	0.622	4.22	0.697	-3.142	132	0.002

Note:BMwoP = Brand Management (without Poll Everywhere); BMwP = Brand Management (with Poll Everywhere)

VII. DISCUSSION AND CONCLUSION

This study aims at identifying the factors that determine university students' subject learning experience and investigating the impact of using classroom response systems on their subject learning experience. The results of the study showed that the university students' subject learning experience was mainly determined by subject usefulness, assessment design, subject contents and teaching materials of a subject. The study also found that classroom response systems significantly improved students' evaluation of all subject factors and their subject learning experience.

Based on the above findings, there are two recommendations to universities for improving their students' learning experience in a subject. First, universities should work on the four important aspects of the subject: subject usefulness, assessment design, subject contents and teaching materials. Making the subject more useful and

valuable to students, such that it could help students develop new knowledge and skills as well as acquire competencies needed to be professionally successful. One example is to cover both advertising theories and advertising techniques in an 'advertising' subject. Developing assessments that are meaningful, engaging and formative, that include prompt feedback and aim for understanding rather than memorising, for instance, writing a reflection paper on topics covered in the subject. Designing subject contents that are interesting, concise and updated, that are related to the students' needs and at the same time meeting the subject objectives, like covering histories and stories of top brands in a 'branding' subject. Preparing and providing teaching materials that are relevant, accessible and interactive, for examples, PowerPoint presentation, web-based learning materials and e-books. Second, universities should adopt classroom response systems and encourage their academics to use these systems in their classes. Classroom responses systems, like Poll Everywhere, Socrative and Kahoot, are real-time interactive tools that can stimulate students' learning,

increase their participation and facilitate their responses in class. They are proved to be effective in enhancing students' learning experience in a subject.

There are three limitations in the current study. First, the conceptual framework of this study considers only six subject factors (subject contents, teaching materials, subject difficulties, subject workload, assessment design and subject usefulness). There may be other factors that can influence students' subject learning experience. Second, this study only covers one of the classroom response systems, Poll Everywhere. There are other classroom response systems with different functions, platforms and interfaces available in the market. Different classroom response systems may have different impacts on students' subject learning experience. Third, the sample for this study was university students major in marketing. This limits the generalizability of the study findings to university students major in other disciplines. Despite its limitations, the current study provides good insights into the factors determining university students' subject learning experience and the influences of classroom response systems on their subject learning experience. Future research may wish to extend the analysis to examine other subject factors and cover other classroom response systems. Also, future research may wish to explore the impact of using classroom response systems on other teaching and learning areas (e.g. teachers' teaching performance).

#### CONFLICT OF INTEREST

The authors declare no conflict of interest.

#### AUTHOR CONTRIBUTIONS

CC, SY and VL conducted the research; CC, SY and VL analyzed the data; CC wrote the paper; all authors had approved the final version.

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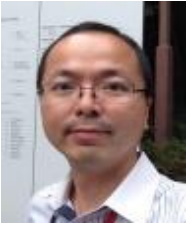
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