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Applying Student Response System to Improve Accounting Learning Achievement of University Students in Thailand

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Abstract
Changes in university education have been proposed frequently to meet the demands of the new generation of students. According to the Thai 4.0 strategy, university education calls for technology-based education. Thus, this research investigates whether the Student Response System (SRS) effectively enhances student learning achievement in an Introductory Accounting class. Teaching accounting based on the SRS pedagogy and traditional pedagogy was examined in two groups for comparison. A total of 179 students from an international college in Thailand comprised the samples in this research. Of the 179 students, 81 students were assigned to the experimental group (EG), and 95 students were assigned to the control group. The EG intervention was conducted within a course comprising 15 lessons, with 2 lessons delivered every week and with each lesson lasting 90 minutes. Both groups participated in the pre-tests and post-tests, which assessed the students' fundamental knowledge and practical techniques. A paired sample t-test was then performed to examine the learning outcomes. A one-way analysis of covariance was performed to analyse the statistical differences of the data. Results indicated that the SRS pedagogy could effectively enhance students' accounting learning achievement, especially their practical techniques, in the Introductory Accounting class.

Keywords: *Student response system, accounting education, accounting learning achievement, Thai 4.0*

1. Introduction

Thai 4.0 is a strategy published by the Thai government in 2016. This strategy aims to provide Thailand with a high equality, high income and sustainable society. Technology-based capacity is one of the indicators of the Thai 4.0 strategy objectives. Wittayasin (2017) pointed out that education plays an important role in achieving the objectives of the Thai 4.0 strategy in the reform age. At present, Thai higher education faces the challenge of improving education quality, pedagogy innovation and technicalisation. Such challenge should be the focus of Thai universities. In particular, Thai universities urgently need to create a technology-based learning environment so as to improve education quality and develop students' sustainable competency which should help them in meeting the requirements of the new era (Wittayasin, 2017). Howieson (2003,

p.74) explained that future accountants "will take on the role of 'knowledge' workers" who are not only knowledgeable but also highly skilled so as to effectively apply themselves in a real business environment; for example, financial report knowledge refers to the knowledge of analysing financial statements and the techniques for communicating with clients. The challenge of accounting education is how to lead students towards meeting the requirements of the future business environment in terms of fundamental knowledge and practical techniques.

However, in a traditional accounting class, students play the passive role of recipients of knowledge; as such, the accounting learning achievement is affected by a non-interactive learning environment (Frick, Birt & Waters, 2017). Student boredom is common in such setting. Deveci (2016) indicated that boredom is often seen as one of the main factors that causes students' disengagement and their subsequent low learning outcomes. In addition, disengagement can impact the performance of teachers whose noncommunicational approach jeopardises students' academic results (Bebell & O'Dwyer, 2010). Therefore, student disengagement in traditional accounting education is directly risking their learning performance and results. The Student Response System (SRS) is the technology-based class interaction system that uses smart devices and the internet. Lecturers could use it to assign questions to students and receive their responses online immediately. This pedagogical innovation is able to readily engage students in an interactive learning environment and can therefore assist students in achieving their learning objectives (Cerqueiro & Harrison, 2019). The SRS could contribute to students' learning process and teachers' communicational teaching activities (Bebell & O'Dwyer, 2010); hence, it is expected to satisfy the requirements of accounting education. Although the extensive literature has shown that the SRS as a pedagogy could increase students' engagement during learning, its effectiveness in accounting achievement has rarely been discussed. Furthermore, the efficiency of the SRS in aiding students to gain fundamental accounting knowledge and practical techniques requires in-depth comparable discussion.

Therefore, the researchers of this work, as accounting lecturers of first-year university students, aim to explore how to teach accounting knowledge with an interactive and communicational approach and to effectively develop students' practical accounting techniques through innovative technology, such as the SRS, and thereby improve their accounting learning achievement. Most previous studies investigated the effects of such type of technology, including mobile learning and laptop learning, and their results were mainly about increasing student engagement, diversifying teaching methods and recognising the overall interesting quality of the technology. Hence, the academic effectiveness of the approaches has not been improved appropriately. The researchers of the current work expect to determine the overall effectiveness of technology and to compare its effects on two related sessions focused on accounting fundamental knowledge and practical accounting techniques. The results of this work could contribute to the development of accounting education. Thus, the SRS was adopted in this investigation to explore the above concerns.

2. Research background

2.1 SRS adaptation

In 2015, Aljaloud et al. (2015) reviewed the literature about the use of the SRS as a pedagogy and showed that the SRS is known by various names, including classroom performance system (CPS), audience response system (ARS), personal response system (PRS), classroom communication system, electronic response system (ERS), electronic voting system (EVS), polling systems and clicker systems. Generally, the SRS is an interactive class system that lecturers can use to assign questions to students via an online platform and obtain students' responses immediately through mobile devices or clickers. The answers to each question can be collected and uploaded to the lecturer's account. Furthermore, students' responses can be summarised and automatically briefed in the system. The SRS has spread across higher education as a well-established student-centred learning technique in recent decades. Over the years, technologists have developed and refined the smart SRS technology by allowing students to key in their responses by using educational apps through wireless devices; examples include Socrative, Kahoot and iClicker (Zhao, 2019). The process of implementing this type of application in learning can be likened to playing a mobile game. Answering questions is similar to achieving game goals. Students are awarded points to compete with other students. This pedagogical innovation readily engages students with an interactive class environment that could assist students in achieving their learning outcomes efficiently (Cerqueiro & Harrison, 2019). Thus, Zhao (2019) and Cerqueiro and Harrison (2019) consistently contended that the SRS, as an amusing, competitive and interactive learning technology, can motivate students to think and respond actively.

2.2 SRS and the effects on learning performance

Numerous studies have discussed the SRS, including how it affects student engagement and how it benefits the learning process. Most previous educational experiments have been conducted in introductory university courses, such as Science, Law and Chemistry, with the use of the SRS in various devices and applications (Aljaloud et al., 2015). The most significant benefits highlighted in existing SRS research can be summarised in terms of improving interaction, student academic performance and engagement. Blasco–Arcas et al. (2012) established a conceptual framework to demonstrate that active interactions between students and instructors through the use of clickers, an SRS device, could facilitate class engagement and collaborative learning. Additionally, Blasco–Arcas et al. (2012) proposed that clickers enhance the interactions between students and between students and teachers. This point of view is line with that of Bebell and O'Dwyer (2010) who reported that an interactive teaching approach is helpful in conducting good quality lecture, which directly benefits students' learning achievement.

To explain how the SRS affects academic performance, Chen and Lan (2013) adopted SRS technology as an in-class assessment tool in a university introductory chemistry course and proved that the SRS affects students' learning performance in terms of their in-depth understanding, knowledge management and efficient learning. According to the experiments of Chen and Lan (2013) and Lantz and Stawiski (2014), including the SRS in the teaching routine could help students to maintain long-term memory, which is

important in achieving good learning results. Bojinova and Oigara (2011), Chen and Lan (2013), Hedgcock and Rouwenhorst (2014) and Johnson and Lillis (2010) all claimed that relative to the traditional pedagogy, the SRS increases students' desire to improve their learning outcomes because of its game-based quiz function which attracts students to identify their areas for improvement. By learning and being examined with the SRS, students feel active and become willing to overcome difficult questions.

In sum, the SRS has been implemented in different courses to increase students' engagement, interactivity and learning motivation, as well as advance their learning capacities in terms of their in-depth understanding, long-term memory and self-learning. These features contribute to students' learning performance. The conclusion of existing studies indicates that a high level of interactivity and engagement resulting from the use of the SRS (clickers) improves students' overall learning performance in some introductory university courses. Thus, attempting to qualify the effectiveness of the SRS in an introductory accounting course is a relevant task.

2.3 Accounting learning achievement

Accounting learning achievement means that students are able to contribute knowledge to the business environment sustainably. Sithole (2015) explained that accounting learning objectives need to be aligned with what employers or stakeholders expect. Abbasi (2013) classified accounting learning achievement into three types: practical techniques, skills and values, all of which are based on previous studies on the American Institute of Certified Public Accountants and International Accounting Education Standards Board. Practical technique is the functional ability in accounting, including the knowledge and ability to analyse financial reports and perform management accounting and audit. Skills refer to the cooperation and critical thinking competencies and are divided into four areas: communication skills, creative thinking and problem solving, teamwork and leadership and management of change. Values are the basis of technical competencies and skills that are linked to morals and ethics. Values include professionalism, conceptual foundation of ethics and ethical decision making.

A similar perspective was supported by Porter and Bui (2010) who summarised accounting student achievement into functional skills (practical techniques), general business skills and individual competency, which include personal interactive skills and managerial ability. However, they also found a gap between accounting graduates' performance and employer expectations. They reviewed employers' evaluations of graduates from accounting firms and showed that students' accounting learning achievement and academic performance gained from a university degree is highly positively related to their career performance as an accountant. Hence, the learning achievement achieved in the school period is important to accounting graduates.

Cherry and Reckers (1983) proposed that the conceptual knowledge and procedural principles covered in the introductory accounting curriculum are technically related to practical techniques and serve as the foundation of intermediate accounting and advanced accounting courses. Therefore, fundamental knowledge and practical techniques are vital qualifications of accounting graduates. Similarly, Poter and Bui (2010) and Cherry and Reckers (1983) pointed out that accounting learning achievement accumulates during the whole accounting learning process, from the introductory level to the advanced level;

hence, accounting educators need to integrate practical techniques into each level of accounting education and not merely in advanced accounting courses.

In the current work, the authors aim to apply the SRS pedagogy to introductory accounting education to examine students' learning achievement of fundamental knowledge and practical techniques.

3. Research Objectives

The research objectives of this study are 1) to identify and describe the effectiveness of the SRS in the accounting learning of college students by investigating its effects on learning performance and 2) to compare students' learning outcomes through the SRS and traditional accounting class in terms of fundamental knowledge and practical techniques.

4. Research Methodology

4.1 Sampling and data collection

The experiment was conducted in an international college of a private university in Bangkok, Thailand. A total of 176 Chinese international students aged 18–19 years participated in the research. The sample was randomly selected from first-year International Business and Accounting students who attended the university in August 2018. The subject of Introductory Accounting is generally offered to first-year students in the business college. According to the Thailand Qualification Framework for Higher Education (Office of the Higher Education Commission, 2009), students can move to the intermediate and advanced courses only if they pass the introductory accounting course.

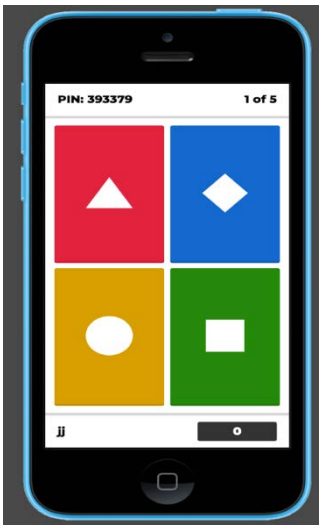
All the participants of this study grew up in the age of virtual technology and were beginners in learning accounting. Four classes were conducted and divided into two groups. The respondents of the two groups were assigned randomly along with their original enrolled classes. A total of 81 of the 176 students were assigned to the research intervention group (EG), and the remaining 95 were allocated to the control group (CG) that followed the traditional pedagogy. The two groups participated in the pre-tests and post-tests. The scores from the post-tests were compared with those from the pre-tests to determine any significant differences. The results of the post-tests from the two groups were compared in terms of fundamental knowledge and practical techniques to identify any significant differences.

4.2 Research intervention

The SRS approach was implemented in 15 lessons, with 2 lessons conducted in a week and with each lesson lasting 90 minutes. Kahoot!™ was applied as the SRS instrument in this research. The intervention was applied to four options quiz in Kahoot!™, as shown Figure 1. The students needed to use the Kahoot!™ app to respond to the quiz within the 10–120 seconds set by the lecturer. To motivate the students' participation in the class, the interface of the Kahoot!™ app showed options with designated colours and shapes (Figure 2). The students could not see the content of the questions and the options on their devices' screens.

Figure 1. Example of a quiz presented in Kahoot!™.

Figure 2. Interface of Kahoot!™ app on student's device.



The quiz design was based on the learning objectives of each lesson, which can be divided into two parts. The first part was fundamental knowledge, including the basic concepts and accounts; and the second part comprised the practical techniques that combined bookkeeping and financial statements. The procedure involved individual and group activities. Every student need to practice quizzes with the Kahoot!™ app in their own devices, which provide the real-time responses of their learning outcomes. For the group activities, the students were given a quiz list they created and were asked to discuss the answers with the group members in a limited time. Each group used only one device to respond to the quiz list with the Kahoot!™ app and compete with the other groups.

The CG did not take any intervention instructions and received regular accounting teaching. In addition, the knowledge, content and learning objectives of each lesson were the same as those in the EG class.

4.3 Measures

The pre-tests and post-tests were applied to examine students' performance. The CG and EG participated in the pre-test before the research and accepted the post-test following the treatment. The question design of the pre- and post-tests is based on the introductory accounting of IFRS (Weygandt, J. J., Kimmel, P. D., & Kieso, D. E., 2012). Firstly, a paired sample t-test was used to compare the mean differences of the tests to analyse the details of the learning outcomes. Secondly, one-way analysis of covariance (ANCOVA) was conducted to interpret the differences in the post-tests of the CG and EG by eliminating the effects of the pre-tests.

5. Results

5.1 Paired Sample T-Test

The paired sample t-test was applied to examine the details of the learning outcomes. The learning outcomes were divided into four sections in the pre-test and posttest, and the overall score was 100. These four sections were basic concepts, accounts, bookkeeping and financial statements. The sections of the basic concepts and accounts were tested for fundamental knowledge; bookkeeping and financial statements were assessed in line with practical techniques. Table 1 shows the summary of the results of the paired sample t-tests of the CG and EG. The EG showed better learning outcomes than the CG in all sections, especially the bookkeeping and financial statements.

The mean of the sections of bookkeeping (M of EG = 28.62, M of CG = 18.23) and financial statements (M of EG = 31.05, M of CG = 22.58) showed a more significant difference than that of the basic concepts (M of EG = 14.74, M of CG = 13.04) and accounts (M of EG = 9.37, M of CG = 8.03). This result indicated that the SRS pedagogy was more effective in students' learning of practical techniques than in their learning of fundamental knowledge in the introductory accounting class.

Table 1. Summary of results of paired sample t-test

Outcome	Group	Pretest		Posttest			95% CI for Mean Difference		t	df	Sig. (2-tailed)
		M	SD	M	SD	n					
Basic Concepts	CG	2.21	3.07	13.04	3.32	95	-11.71	-9.95	-24.45***	94	.000
	EG	1.44	2.55	14.74	2.38	81	-14.052	-12.54	-35.00***	80	.000
Accounts	CG	1.26	1.75	8.03	2.03	95	-7.346	-6.19	-23.24***	94	.000
	EG	.98	1.65	9.37	1.24	81	-8.814	-7.976	-39.86***	80	.000
Bookkeeping	CG	1.18	2.44	18.23	7.91	95	-18.70	-15.40	-20.52***	94	.000
	EG	1.62	2.795	28.62	5.20	81	-28.304	-25.69	-41.19***	80	.000
Financial Statements	CG	.16	.87	22.58	12.98	95	-25.10	-19.73	-16.59***	94	.000
	EG	.25	1.09	31.05	10.88	81	-33.215	-28.39	-25.40***	80	.000

5.2 Analysis of Covariance (ANCOVA)

A total of 176 students from the EG and CG took the pre-test. The initial testing of the homogeneity of the regression coefficients showed no significant differences in the pre-tests ($F = 1.129$, $P = 0.289 > 0.05$). This result showed that both groups had the same level of introductory accounting competency. Moreover, the homogeneity of the regression coefficients between groups and the pre-test did not present any significant difference after eliminating the effect of the pre-test on the post-test ($P = 0.954$). In addition, the P-value of Levene's test of equality of error variances was 0.136, which was higher than 0.05; hence, the null hypothesis was not rejected. This result meets the requirement of implementing one-way ANCOVA. The results of the advanced one-way ANCOVA are presented in Table 2 and indicated a significant effect on the posttest due to the treatment of one group with the SRS as the pedagogy ($F = 71.577$, $P = 0.000 < 0.05$).

Table 2. Summary of results of one-way ANCOVA for the two tests

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	20999.912[a]	2	10499.956	36.170	.000
Intercept	471367.458	1	471367.458	1623.761	.000
Pre_test	42.916	1	42.916	.148	.701
Group	20778.304	1	20778.304	71.577	.000
Error	50220.810	173	290.294		
Total	982597.000	176			
Corrected Total	71220.722	175			

a. R Squared = .295 (Adjusted R Squared = .287)

The significant differences in the posttest results of the two groups are shown in Table 3. The EG showed a higher mean score than the CG, with the difference being equal to 21.86, which explained the effect of using the SRS in introductory accounting courses.

Table 3. Results of effects of group factor

Group				
Dependent Variable: Post_test				
Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Control group	61.911[a]	1.749	58.458	65.363
Experimental group	83.747[a]	1.895	80.007	87.487

a. Covariates appearing in the model are evaluated at the following values: Pre_test = 4.57.

Consistent with the previous literature, the students who received the SRS pedagogy showed better learning performance than those who received the traditional accounting lectures; hence, the SRS pedagogy is effective in students' learning of fundamental knowledge and practical techniques in introductory accounting (Chen and Lan et. al, 2013).

6. Discussion

By comparing exam scores, this research examined whether the SRS as a technological pedagogy would help university students to improve their accounting learning achievement effectively in terms of fundamental knowledge and practical techniques. The students who learned introductory accounting within the SRS showed better learning of practical techniques than the students who participated in the traditional accounting lecture. The results of the paired sample t-test showed the different mean scores of the four question sections, which included basic concepts, accounts, bookkeeping and financial statement, to analyse the specific learning outcomes related to technical competency.

The summarised interpretation of one-way ANCOVA showed the group factor's effect on the increasing scores in the post-test whilst eliminating the pre-test interaction effect. Strong evidence proves that the SRS effectively affects accounting students' learning achievement. Furthermore, the research uncovered that the SRS as a pedagogy was more effective in students' enhancement of practical techniques than in their improvement of their fundamental knowledge in introductory accounting. In other words, the SRS can contribute to university accounting education in terms of improving learning achievement, especially in the aspect of practical techniques.

Some of the findings of this work are consistent with those of previous studies. Aljaloud et al. (2015) identified SRSs that help students to increase interactive learning, academic performance and engagement in learning activities. Blasco–Arcas et al. (2012) established a framework to show that better learning performance resulting from the use of clickers is positively affected by collaborative learning and engagement. They found that the SRS improves accounting students' learning achievement; the same was highlighted in the current research. The effectiveness levels of the specific modules (fundamental knowledge and practical techniques) of the SRS were also compared in this work to address the gap in previous studies.

7. Conclusion

This research shows that the SRS as a pedagogy is effective in improving the accounting learning achievement of university students, particularly their learning of practical techniques. Hence, the SRS is most efficient when introducing in-depth technical knowledge and applications to students. This finding supports those by Chen and Lan (2013) and Lantz and Stawiski (2014) who showed that the SRS helps students to have long-term memory and in-depth understanding. Consistent with the suggestion of Bojinova and Oigara (2011), Chen and Lan (2013), Hedgcock and Rouwenhorst (2014) and Johnson and Lillis (2010), this work finds that the SRS motivates students to identify their areas for improvement in their learning process. This study also highlights the distance of the post-test scores in the aspects of fundamental knowledge and practical techniques. The results of this work can be used to not only help students to find the distance between learning objectives and self-performance and apply accounting recording procedures but also encourage them to find solutions to difficult problems.

The variables of this research are limited. Further study could examine which factors may moderate the learning outcomes of the SRS pedagogy and investigate the causation between variables. For example, it could measure the variables that would

moderately affect accounting (or other disciplines) students' performance in terms of technology acceptance, learning attitudes, student age, teacher's preference and so on. Moreover, further study could explore whether the SRS is effective in other accounting students' achievement, including communication competency and managerial competency, neither of which were included in this work. With the upcoming Thai 4.0 era, technology-based pedagogy is essential for assisting students in the future. The determinants of measuring student learning achievement in the new era need to be discussed and explored further.

The experiment and sampling were conducted in one university only. Hence, future work could assess the generalisability of the findings to other universities or disciplines. The sample in our work does not wholly represent Thai universities. Another limitation is that student engagement scale was not covered in this work despite the previous literature's emphasis on the moderating effect of engagement or interactivity on the adoption of SRSs (Coates, 2005; Krause & Coates, 2008; Ng, 2012; Prensky, 2001; Bowers & Kumar, 2015). Nevertheless, this project aimed to investigate the effectiveness of the SRS and compare its performance with that of the traditional pedagogy in improving student accounting competency in specific learning outcomes. If engagement has such a significant impact on students' learning performance, then it should also be tested.

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