Development and Acceptance Evaluation of Personalized Classroom Response System

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ABSTRACT

Learning technology greatly modifies traditional classroom teaching methods due to the continuous development and innovation of information technology and wireless network technology. The integration of an interactive response system in traditional classrooms can improve the interaction between teachers and students; the classroom response system (CRS) can store students' response data and save assessment time. However, the current application of CRS in practice exams has many disadvantages. For example, the traditional CRS used to allow students to input their responses using small remote transmitters that send signals to a receiver and wait for other classmates to complete their responses; moreover, the CRS cannot provide adaptive individuals' supplementary information. Therefore, the study aimed to develop a personalized interactive response system (IRS) to facilitate both teaching activities and personal learning assessment in a classroom setting; students are required to use mobile learning devices (i.e. tablets as interactive tools, a platform for instant assessment, and e-readers). Through the wireless network, pop quizzes, or learning activities can be performed to increase interactions between teachers and students and conduct remedial teaching instantly. The system can shorten waiting time for students and stimulate reflection of what they learn in practice exams, increase the readability of questions, and provide privacy when answering questions. The study recruited 6th graders of an elementary school as participants to investigate the usability and users' acceptance of the system. The results indicate the differences between the traditional CRS and the personalized IRS and recommend applicable learners based on the results of the cross verification between different personality preferences and users' acceptance. The collected feedback from the participants and teachers can be referred for further studies.

Keywords: *Acceptance Evaluation, Personalized Classroom, Response System*

INTRODUCTION

The personalized interactive response system (IRS) can provide instant automatic grading results different from the traditional classroom teaching method and offer instant individual remedial teaching different from the traditional classroom response system (CRS). In addition, the personalized IRS can completely save students' records of learning process, reduce teachers' time to do inductive analysis, and promote interaction between teachers and parents to understand students' academic performance. The study aimed to develop a personalized IRS that can improve teachers' efficiency and teaching convenience in a classroom setting and increase learners' immediate learning efficiency significantly in the process of assessment to stimulate reflection of what they learn in the problem solving process. The system retained the advantages of the interaction response system and improved the disadvantages of

the assessment process in the traditional CRS. For example, the traditional CRS used to allow students to input their responses using small remote transmitters that send signals to a receiver and wait for other classmates to complete their responses; moreover, the CRS cannot provide adaptive individuals' supplementary information. Participants of the study were required to use mobile learning devices (i.e. tablets as interactive tools, a platform for instant assessment and e-readers). Through the wireless network, pop quizzes or activities can be performed to increase interactions between teachers and students and conduct remedial teaching instantly.

The current CRS tools have given a new dimension to the field of education, but there are still many challenges to overcome. The study combined tablets with back-end application system to investigate issues with regard to informal computerized assessment and a mechanism for stimulating reflection of learning in a computer assisted learning environment. The following are challenges of the common computer assisted learning system.

- Shortening time to stimulate reflection: Most learners are too nervous to completely understand exam questions and mistakenly understand that they don't possess enough knowledge to answer those questions in assessment which result in inaccurate assessment outcomes that cannot reflect on learners' knowledge level. However, with appropriate stimuli and hints, learners can reflect what they learn previously and apply the knowledge to answer exam questions correctly to yield true assessment outcomes and help examinees understand their proficiency levels. The traditional CRS used to allow students to input their responses using small remote transmitters that send signals to a receiver and wait for other classmates to complete their responses that result in losing opportunities to stimulate students to reflect and learn from the test items.

- Readability of test items: The centralized display equipment (i.e. single projectors and slides) of a computerized assisted learning system may lead to difficulties of reading projection content because of environmental factors, such as sunlight or indoor lighting, in a general classroom setting (Yan, 2007). This situation may lower students' learning effectiveness and cause bias of evaluating students' performance. Learners answer incorrectly may result from poor hardware devices, not due to teaching methods or individuals' personality preferences. Therefore, the readability of test items is very important in a computerized assisted assessment.

- Answer with privacy: The current computerized assisted learning system can display all students' correct and incorrect answers that may lead to peer pressure and increase middle and lower learning students' anxiety and depression. According to Seligman's learned helplessness theory, if students are placed in a helpless and passive condition for a long time, what they learn is inability to change the status quo and take any constructive action (Maier, & Seligman, 1976). This situation has a negative impact on students' overall learning performance; therefore, the design of the system should address privacy as a consideration.

In addition, the study aimed to develop a personalized IRS and investigate three dimensions, perceived usefulness, perceived ease-of-use, and satisfaction, of the personalized IRS applied in the Technology Acceptance Model. The results of cross verification of learning styles and users' acceptance indicated applicable learners and provided feedback from educators and system developers for further studies.

LITERATURE REVIEW

Previous studies showed that the application of the classroom response system (CRS) has other names, such as Personal Response System (PRS) and Electronic Voting System (EVS); the systems require individuals to input their responses using small remote transmitters that send signals to a receiver of the computer and then instantly present statistical results for analyzing learning situation. Cutts, Carbone, and van Haaster (2004) developed three different experimental activities to show that the EVS can enhance the consensus among students and that the company staff and students all agree that the EVS is more practical and beneficial than the traditional method. Moreover, the application of the EVS in a classroom setting can effectively promote students to provide learning feedback (Cutts, Carbone, &van Haaster, 2004). Many educational theories are based on the interactive relationships between teachers and students; however, the traditional lecture method is not conducive to the interactive relationships because students are unable or unwilling to express their opinions. The adoption of the EVS in courses allows students to respond to their teachers' instruction and questions that can alleviate barriers to the interactive relationships and increase learning effectiveness (Cutts & Kennedy, 2005). The PRS has an anonymous function helpful to increase students' participation in classroom activities and stimulate students to reflect on what they learn (Fan & van Blink, 2006). Another study pointed out that the system can rapidly collect multiple choice responses and display

participants' results so that the system is a useful tool to promote classroom discussion (Purchase, Mitchell, & Ounis, 2004). The CRS is a good interactive technology that saves students' learning records for future references of course design; the participants agreed that the technology prompt them to remain cautious and receive instant feedback on the course.

Ganger and Jackson (2003) adopted wireless PDAs as research tools and found that the use of wireless PDAs can improve the learning environment, allow students to have interactive relationships with teachers, and provide a solution of examination tools for a large course. In addition, the results indicated that the appropriate design of the optimized graphical user interface of the PDA screen can minimize tutorial which is also necessary. Researches indicated that the students who use PDAs pay full attention to the course topic that is also the moment that they lose their concentration in traditional lecture courses, and teachers replied that using PDAs as teaching tools can solve many difficulties in the classroom (Jackson, Ganger, Bridge, & Ginsburg, 2005). Some studies proposed the application of the Mobile Lecture Interaction (MLI) allows students to use personal mobile devices to ask anonymous questions and vote for questions proposed by other students so that their questions and the mostly asked questions are immediately displayed to teachers. In addition, the application of MLI in speech can increase interactions between the speaker and audience applicable for distance education to have interactive relationships between teachers and students in distant locations (Costa, Ojala, & Korhonen, 2008).

Learning styles originated from the German psychological research on cognitive style in the 1970s. McDermott & Beitman (1984) indicated that learning style is a unique way of learning demonstrated in the learning process, which includes observable strategies from problem solving and decision-making behavior. Learning styles are personal characteristics in the nature of biological development and various ways of learning that help individuals learn better. Therefore, the proposed system in the study can record learners' problem solving strategies when encountering problems, problem solving time, reflection time, and waiting time as important indicators of evaluating learning effectiveness. In addition to psychological based learning styles, the study adopted the Myers-Briggs Type Indicator (MBTI), a psychological and behavioral science-based instrument developed by Myers and Briggs, to measure individuals' personality preferences. Myers & McCaulley (1985) pointed out that individuals who have different psychological personality differences favor different majors when studying in college and selecting occupations. Personality differences and individuals' learning interests have a great impact on academic achievement. Therefore, the adoption of the MBTI instrument in education facilitates individuals to understand their personality differences and encourage educators to adapt their instruction to effectively increase teaching effectiveness.

RESEARCH METHOD

The study started with the system design and literature review to understand previous and present technical and application issues of the classroom response system, propose the system design, discuss characteristics of educational application of CRS in previous studies, investigate research questions, and conduct the experimental activity. The participants were recruited to participate in the experimental activities, take the MBTI instrument to understand their personality preferences, and fill out the Technology Acceptance Model survey. The researchers collected data from the results of the MBTI instrument, the TAM survey, and students' records in the tablets.

SYSTEM DESIGN

In addition to learning content, the most important part of the personalized IRS is devices for mobile learning. The integration of mobile learning devices (i.e. tablets) in education allows teachers to conduct pop quizzes and interactive activities and promote students to answer questions immediately. The interactive assessment technology of tablets includes multiple wireless networks; a base station coordinates the activities of the multiple wireless networks and a plurality of mobile devices (i.e. tablets). The system has two subsystems, the classroom management system for teachers and the instant feedback system for students, in the Server-Client mode. Teacher use tablets to lecture course content, interact with students' devices, and display teaching materials on the whiteboard; students use tablets for classroom learning assessment. The classroom management system is for teachers to understand students' learning process and manage classroom activities. Teachers use their personal computers to remote control students' devices. With the roll call system (the first one from the left on Figure 1), students who attend the class can be recognized immediately simply by entering their student IDs. Teachers select the desired type of assessment in the assessment mode that displays pop quizzes, exams, test items, and content for testing (the second one from the left on Figure 1). The answer mode of students instantly receives test items sent by teachers. Teachers can check students' records to understand their learning activities and records of using the system (the third one from the left and the rightmost one on Figure 1) and display all students' answers anonymously. The platform can instantly display

each individual's answer to increase teaching convenience and effectiveness; students' learning records are saved in the personalized IRS for students and their parents to check and review.

Figure 1. The screenshots of the roll call, posed question, and students' learning process.

Students use the tablets for learning and assessment. The system provides supplementary information to assist students to be familiar with objectives and learning records that help them understand their learning process. Students enter their IDs for attendance and take an assessment test when turning on the tablets. Then, students instantly receive the multiple choice items (see the first one from the left on Figure 2) from the teachers. Reading the questions on the tablets increase the readability in comparison with the tradition CRS using a single projector to display test items so that students can feel comfort in reading each test item without turning off the light. Students are able to modify their answers before pressing the button, "send", receive instant feedback to check whether their answer is correct or incorrect (see the second one from the left on Figure 2), and read test results and supplementary information to review and further understand the learning objectives (see the rightmost one on Figure 2).

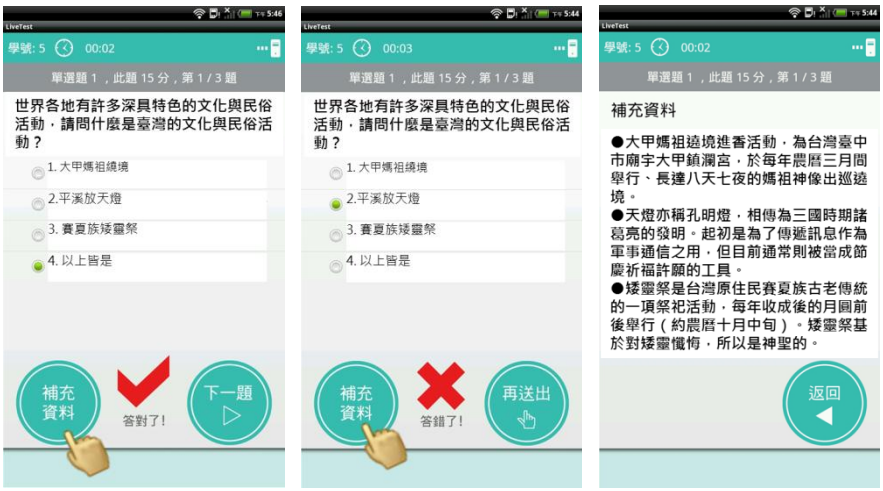

Figure 2. Check the correct answer and supplementary information and the score.

RESULTS AND DISCUSSION

The study performed the t-test to investigate differences of the personalized IRS applied in the TAM. The TAM survey items use 5-point Likert scale, and "3" indicates neutral. Therefore, the study set a critical value of 3.5 that determined the assigned value of each survey item above 3.5 indicated a positive perception on the dimensions of the TAM. The mean values of the three dimensions, ease of usefulness, ease of learning, and satisfaction, are all above 4.82; the meal value of the overall performance is above 4.85; the three dimensions and the overall performance of the personalized IRS reached the significant level ($p=.000<.001$), indicating that the participants had a significant perception on the personalized IRS applied in the TAM. The results are shown in Table 1.

Table 1. t-test of the personalized IRS in the TAM

Dimension	Mean	Std. Deviation	t-value
Ease of usefulness	4.87	.18990	69.690***
Ease of learning	4.82	.38146	33.737***
Satisfaction	4.85	.24625	53.662***
Overall perception	4.8535	.22312	42.893***

*p<.05 ** p<.01 *** p<.001

The study adopted the MBTI instrument to measure the participants' personality preferences and identify their differences. The personality preferences are Extraversion (E), Introversion (I), intuition (I), Sensing (S), Feeling (F), Thinking (T), Perceiving (P), and Judging (J). The results of the t-test reveal that the extroverts and introverts demonstrated a significant difference in the perception on ease of learning (see upper part of Table 2), indicating that the extroverts and introverts had a stronger perception on ease of learning in the TAM than the other participants in the personalized IRS. The results of the t-test reveal that the participants with a preference of Judging (J) or Perceiving (P) demonstrated a significant differences in the perception on satisfaction (see lower part of Table 2), indicating that the participants with a preference of Judging (J) had a stronger perception on the personalized IRS than those with a preference of Perceiving (P). In addition, the results reveal that the participants with a preference of Thinking (T) or Feeling (F) and those with a preference of Sensing (S) or Intuition (N) did not demonstrate any difference in dimensions of the TAM.

Table 2. Independent samples test of different MBTI learning style.

	Levene's Test for Equality of Variances		t-test for Equality of Means					
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Independent samples test of the participants with a preference for Extraverts (E) and Introverts (I)								
Ease of usefulness	.013	.910	1.335	48	.188	.07119	-.03604	.17842
Ease of learning	32.523**	.000	2.393*	25.732	.024	.25481	.03584	.47377
Satisfaction	.459	.501	-.501	48	.619	-.03516	-.17640	.10608
Independent samples test of the participants with a preference for Judging (J) or Perceiving (P)								
Ease of usefulness	8.866*	.005	1.363	11.590	.199	.12093	-.07313	.31500
Ease of learning	7.726*	.008	1.311	11.553	.215	.23543	-.15738	.62824
Satisfaction	4.597*	.037	2.490*	12.295	.028	.24788	.03156	.46420

CONCLUSION

The study conducted the experiment that required the participants to experience the personalized IRS and the traditional CRS. The participants' response time of test items in the both systems was recorded as objective evaluation indicators; their personality preferences measured by the MBTI instrument and the results of the TAM that adopted the USE survey were subjective self-perceived evaluation indicators. The objective and subjective evaluation indicators were used to discuss the effects of the overall performance of the personalized IRS. The objective evaluation indicators, the response time of the both systems, show that the participants' response time of the test items in the personalized IRS is shorter than that in the traditional CRS. The participants that used the personalized IRS can review and reflect on the supplementary materials and didn't need to wait for the others to complete their responses so that the participants could use the class time effectively and efficiently. However, the participants' 2nd response time was longer than the 1st response time when using the personalized IRS for the reason that the participants might spend time on combining the prior knowledge with the supplementary materials before answering the same test item again which may need a further verification. The subjective evaluation indicators, the participants' personality preferences, show that the extraverts had a stronger perception on ease of learning that reached a significant level than the introverts did, consistent with the characteristic that the extraverts don't like tedious issues. In addition, the participants with a preference of judging had a stronger perception on satisfaction that reached a significant level than those with a preference of perceiving did, indicating that the participants with a preference of judging were satisfied with the goal-oriented instruction in the personalized IRS. However, the participants with a preference of Thinking (T) or Feeling (F) and those with a preference of Sensing (S) or Intuition (N) did not perceive any difference in dimensions of ease of usefulness, ease of learning, and satisfaction in the TAM. The subjective evaluation indicators, the results of the USE survey, indicate that the participants had a positive perception on the personalized IRS applied in the TAM that reached a significant level; the values of the three dimensions and the overall performance are above 4.8 out of 5. The qualitative feedback indicate that the anonymous function of the personalized IRS, the supplementary materials, the 2nd opportunity to answer questions, the clear and interesting displayed view of learning content, and the novel impression of the assessment activities increased the participants' learning motivation.

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