

Preliminary Study on Exploring Students' Perceptions of Instant Response Systems in Pre-Service Teacher Courses: University Level in Taiwan

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ABSTRACT

The purpose of this research focuses on the learning and teaching effectiveness of using web-based IRS in courses for pre-service teachers. This study was conducted to explore the students' perception and IRS instruction effect. The following question was investigated: how does the use of ZUVIO influence learners' perceptions, experience, and the quality of interactive instruction? Key findings revealed that ZUVIO enriched the quality of teaching and learning, with the highest influence reported on all types of assessment, including live and formative assessment, ongoing assessment, and self-assessment, as well as improved learning experience in content delivery, interaction, engagement, and motivation. These findings also suggest that the use of IRS is likely to minimize distractions, thereby improving the quality of teaching and learning beyond what is provided in conventional classrooms. Other factors that contributed to students' enhanced learning included the creation and integration of appropriate content in ZUVIO, providing students with timely feedback, and game-play strategies.

KEYWORDS

Instructional Quality, Interaction, Learning Experience and Achievement, Learning Platform, Motivation, Online Teaching, Pre-service Teacher Courses, Student Perception, Web-Based IRS, ZUVIO

INTRODUCTION

With the development of modern technologies, multimedia has been widely used in the teaching field, exerting a great influence on classroom teaching (Ding & Li, 2011; Neo & Neo, 2004). The students' learning styles have become more diverse to enhance both self-study and collaborative learning environment (Palloff & Pratt, 2005). Nowadays, learners become more active when they use digital devices in the classroom, and the classroom also becomes more interactive because of the online instructions (Gilakjani, Ismail & Ahmadi, 2011), and many alternative pedagogical approaches focusing on student-centered instruction that reverses the traditional classroom environment have shown significant concerns and have become more widely adopted in education (Su & Chen, 2018).

Obviously, technology is being increasingly integrated into teaching environments in view of enhancing students' engagement and motivation. In the past decade, several researches have been paid attention on teaching and learning in various educational context by using or implementing

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technologies to promote interactions between instructors and learners. Learners' engagements of classroom interaction play a crucial role in the classrooms. There are various technologies and digital instruments in recent years, interactive response system (IRS) is one of the common digital tools for teachers' employment in the classroom. An increasing number of studies concerning the application of such as new interactive response systems such as Socrative, Creatist, Clickers, Kahoot and ZUVIO have revealed that the IRS has positive effects for school teaching and learning (Heaslip, Donovan, & Culle, 2014; McDonough & Foote, 2015; Barr, 2017; Hung, 2017; Wang, 2017; Wang, 2018; Chang & Lin, 2019; Kent, 2019). Many relevant studies describe IRS implementations for various disciplines like physics, chemistry and the science fields (Chu, Lu, & Wann 2009; Lin, Liu & Chu, 2011), these studies have shown positive feedback after using IRSs, and students are more willing to interact with instructors and classmates, but the majority of studies on the application of IRSs have been limited to traditional IRS tools.

However, other studies have some issues that the disadvantages and inadequacies of traditional classroom interaction reflecting to the use of IRS. In higher education, active student participation is not always easy to implement because it is challenge to maintain learners' motivation and concentration over time when the lecture format is adopted in a large class of over 50 students (Chang, 2021). There are many factors determining students' active learning experience and engagement as well as the teachers' evaluation, assessment and teaching quality. The similar studies reported some barriers for using the online IRS such as lack of explanation regarding how to use this platform, the inability of the teachers to see the students' body language (Bakerson et al., 2015), the lack of an arranged schedule, repeatedly studying, disciplined as well as self-motivation (Sun, 2014). It means that teachers need to design or provide better nice facial expressions and more body language, good learning materials, and more learning instructions to create nice interaction and motivate the learners in participating in a class technology-integrated class. Furthermore, Nguyen (2021) argued that online platform is not effective for laboratory lessons as well as that it is not appropriate while submitting long answers, such as those to essay questions. Additionally, Rojabi's study on students' perception of online learning (2020) also reported other disadvantages for using online learning platform such as lack of interaction between students themselves and their educators as well, which leads to social isolation; lack of communication that usually leads to mental issue such as negative thoughts; and lack of self-motivation with bad time management. To that end, the use of IRS as an online learning tool is still in its infancy, especially in higher education.

Some previous studies were conducted to measure the level of satisfaction on students' interaction as well as students' learning environment to evaluate motivation, interaction, learning outcomes, and assessment system. According to Fortune et al. (2011), the dimensions of technology-added or online learning cover learning environment, face to face, technology, learning, preferences, and collaboration. Meanwhile, Gray & DiLoreto (2016) confirm that course structure/organization, learner interaction, student engagement, instructor presence, and student satisfaction are the appropriate dimensions. To date, not many studies have made attempts to discuss the effectiveness of using ZUVIO to assist pre-service teachers training. Consequently, the purpose of this study was to integrate an interactive response system into a couple of pre-service teachers training courses and to explore whether the assistance of this digital tool could promote students' perception of learning motivation and engagement, whether it could influence their learning experience and how to facilitate a well-interactive designed learning environment. Considering the above explanations, hence, this study was conducted to explore the students' perception in pre-service teachers training courses, and to measure students' learning experience and teaching quality by using online IRS, ZUVIO.

Therefore, the study lasting for one semester (18 weeks) was conducted in a University located in northern Taiwan. Three courses were chosen as the sample. Based on the research background and rationale, the following research questions were investigated: (1) How does the use of ZUVIO influence learners' perceptions toward their learning motivation and engagement? (2) How does the use of ZUVIO influence students' learning experience? (3) How does the use of ZUVIO influence the quality of interactive instruction?

LITERATURE REVIEW

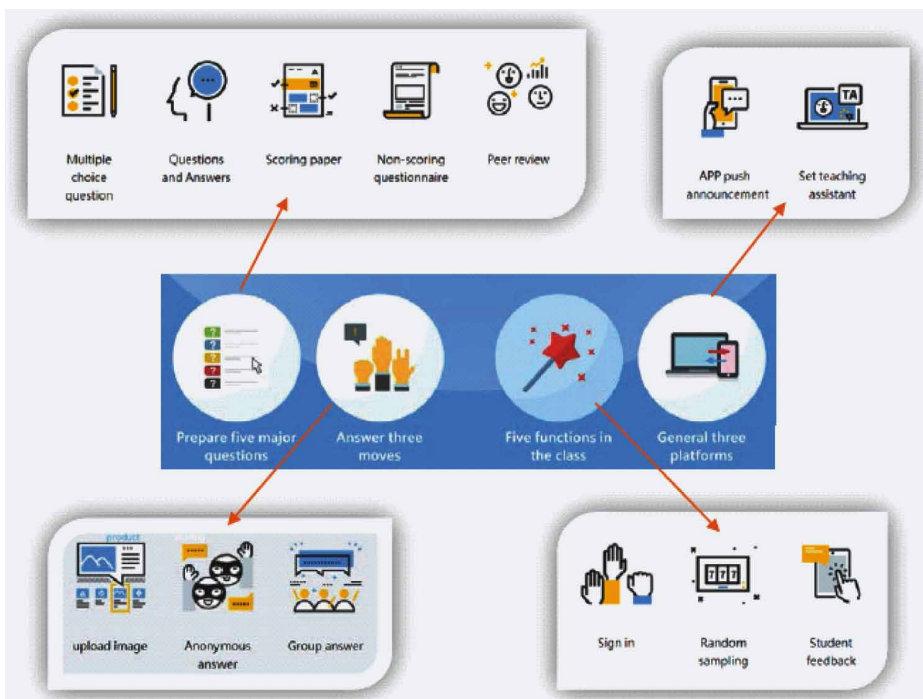
ZUVIO and Online Instant Response Instruction

As reported by Dorf (2019), educational technologies are classified into learning tools, educational resources, learning environments, as well as learning methods. Firstly, both digital and non-digital technologies used to promote learning through internet connection is defined as learning tools. Secondly, educational resources provide textbooks, tutorials, and other learning materials. Thirdly, providing the learners to learn both in conventional as well as in online learning management systems in various locations, contexts, and cultures is defined as a learning environment. Fourthly, exemplifying an action of the specific contents of a subject that may be properly understood by learners is defined as a learning method. For instance; drill and practice, memorization, collaborative learning, and competency-based learning. It can be concluded that the learners' experiences covering learner's perceptions, as well as learners' performances of the learning tools, educational resources, learning environment, and methods can be gained through educational technology.

ZUVIO is an online teaching and learning platform designed by Xue-Yue Technology in 2013. It aims to improve teaching quality, increase students' learning motivation, and use digital educational system (Yan, 2021). Figure 1 shows the interface of ZUVIO platform. The features of ZUVIO are summarized as follows (ZUVIO, 2021):

1. **Course and account management system:** Teachers can offer different courses each semester and manage the enrollment of each course.
2. **Multimedia question system:** Teachers can develop multiple choices, open-ended questions, or group questions. In addition, figures can be included in the questions. Moreover, teachers can decide whether the individual student or the group should answer the questions. Students, could use digital devices, like smartphones, tablets, or computers, to answer questions immediately.

Figure 1. Instructional functions of ZUVIO



3. **Peer assessment system:** Teachers can create groups and students can conduct peer assessment. Meanwhile, grading rubrics and weighting can be set in the system. Besides, teachers can choose whether the students have to give comments. During the peer assessment, the system will update scores and rankings among individuals or groups.
4. **Grading system:** Teachers can observe the dynamic answer process, and receive the detailed data and figures. Students, on the other hand, can read the previous answering records to review the course.

Online learning tools and instruction become crucially important to higher education nowadays. Tsai (2018) predicts that online interactive learning system will exist in advance over the next two years. By the end of 2020, 41% of organizations expect to use it globally. Tsai's research covered a survey of 901 respondents from various organizations including small to medium-sized businesses and enterprises. Respondents came from a variety of industries, together with manufacturing, healthcare, non-profits, education, government, and finance. This research is somewhat limited for educational research, however, it provides a type of new learning environment and online response skills students will experience as they turn into the workplace in the future, instant response system is playing an important role in higher education teaching and learning.

The terms instant response system, classroom response system, classroom communication system, wireless response system, and interactive response system are used interchangeably. The term refers to a software/hardware system that allows instructors to easily get instant feedback from their students, using remote control devices and a portable receiver. The most common use instructions are as follows:

1. **Assessing student comprehension:** Accurately assessing student comprehension of material in the classroom has always been a challenge for educators. Methods historically used by instructors have included calling on a broad range of students to answer questions, having the entire class answer questions through visible means, or using volunteers. Although these methods have merit in moving toward a more active classroom learning environment, they all fail to truly give the instructor an accurate picture of how well or how poorly all students have grasped recently taught concepts." (Czekanski & Roux, 2008).
2. **Voting to engage students in knowledge construction:** Typically, a lecturer may ask students to vote in order to engage them later in discussion. "We advocate a model of CRS-based teaching that we call "question-driven instruction." In this model, posing questions via CRS does more than augment traditional instruction: it forms the very core of the instructional dynamic. Our primary in-class goal is not to lecture or present information. Rather, we seek to help students explore, organize, integrate, and extend their knowledge. Students receive their primary exposure to new material from textbooks, multimedia, and other out-of-class resources." (Beatty et al., 2006).
3. **Data gathering:** Lecturers can ask to students to fill in short questionnaires or just a single multiple choice question in order to create real data to process in order to illustrate a method or a theory.

Instructional Technology and Learner's Perception

A research on promoting active learning strategies for the college classroom found that students generally do not participate into the lectures about 40% of the whole class time (Meyers & Jones, 1993). Similarly, Brookfield (1990) points out the need for students to mull over the content, generate questions, share their ideas in order to learn; in other words, students need to be cognitively engaged during learning process. Another study about indicators of engagement broadly defines engagement as the willingness level of students in order to participate in learning tasks and the time they spend for the activities (Beer, Clark, & Jones, 2010). However, Fredricks, Blumenfeld, and Paris (2004) claim

that engagement comprises many related components such as emotions, behaviors and cognition of learners. Although Fredricks et al. (2004) give a categorization of engagement types, they suggest that the behaviors presented as indicators of each engagement type are interrelated.

To illustrate, when a student asks a question, which is an indicator of behavioral engagement, s/he also performs cognitively to prepare his/her question before asking. When students experience a learning environment in which good questions and questioning take place, they become aware of the importance of sharing the accountability of their own learning (Hunkins, 1995). Additionally, asking questions and questioning inevitably contribute to learning process (Walsh & Sattes, 2005). Asking questions also show that the student is attentive and motivated in contrast to being absent minded. In other words, it exactly shows that student is an active learner.

When shifting the focus from teaching to learning, many teachers seek strategies to increase students' active participation and involve them in the learning process. According to Bonnell and Eison (1991), active learning refers to involving students in doing things and thinking about the things they are doing. This broad definition has led to variations in meaning; active learning can refer to teaching methods or interactive instructions, educational applications by mobile learning or inquiry learning, learning activities by peer learning or class discussion or formative assessments and learning experiences or positive learning perceptions (Hung, 2017). In practice, when a more specific instructional design is tailored to support active learning, students' thinking improves during the learning process.

There are various technologies and digital instruments in recent years, interactive response system (IRS) is one of the common digital tools for teachers' employment in the classroom. In the past decade, several researches have been paid attention on teaching and learning in various educational context by using or implementing technologies to promote interactions between instructors and learners. As Chu & Yang (2017) describe, learner-centered education with Flipped learning is one of the applications that incorporate the IRS. Because students can work in groups and solve problems together with its IRS functions, the ZUVIO IRS can increase students' learning motivation by using its online peer assessment system (Wang 2016). Studies have valued new IRS usage in increasing student engagement and influencing positive student learning experiences (Heaslip, Donovan, & Culle, 2014; McDonough & Foote, 2015; Barr, 2017; Hung, 2017; Wang, 2017; Wang, 2018; Chang & Lin, 2019; Kent, 2019).

In higher education, active student participation is not always easy to implement because it is challenge to maintain learners' motivation and concentration over time when the lecture format is adopted in a large class of over 50 students (Chang, 2021). Lack of learning motivation can result in a negative learning atmosphere in the classroom and determine learning achievement (Chang & Lin, 2019). The lecture-based classes typically support some level of student involvement. Hand raising is a common method that teachers use to increase s student responsiveness (Chern, 2010), but it only provides some students with opportunities to ask questions and involve in discussions with the instructor within limited contact hours (Kent, 2019). Sometimes participation appears unbalanced when the instructor is in favor of certain students who are most willing to speak in the classroom, which gave the limited opportunities for the rest of students to respond in the interactive learning process (Chern, 2010). Some interactive instruction related research showed, students are hesitant to voice their ideas or ask questions, perhaps owing of the fear of making mistakes or embarrassing themselves in front of peers. They express reticence in classroom activities where instructors attempt to involve them during lectures (Shao & Gao, 2016). There are many factors determining students' active learning experience and engagement as well as the teachers' evaluation, assessment and teaching quality.

Hamilton (2015) confirms that instructional technology used by the teacher is more important than the equipment used. The purposes of the activities are to develop background knowledge, model an activity, to read, to demonstrate, to solve a problem, to explore, to review information, to respond to an idea, fee senses, as well as to engage students in critical thinking. Furthermore, identifying the learning objectives and providing the appropriate students' needs in learning is the most important

step in designing an online learning environment. The objectives provide all learning objectives, teaching strategies, learning activities, and assessments that are listed on the syllabus (Sewell et al., 2010). Sebastianelli (2015) confirms that learning material was the most important factor for both grasped learning and student satisfaction. Furthermore, teachers should know that what the student does is more important than what they do. To construct a meaningful and valuable user experience, the materials and learning activity in online learning platforms should be useful, usable, desirable, findable, accessible, credible as well as valuable (Dorf, 2019).

Another disadvantage in technology-integrated instruction is the inability of the teachers to see the students' body language. There is a missing nonverbal hint expression of confusion on a student's face, for example, or distracted doodling in a notebook that could help them measure understanding. In technology-added or online learning, the teachers need to take extension time to assess students from the beginning (Bakerson et al., 2015). Another cause of failure in this kind learning environments is the lack of an arranged schedule, repeatedly studying, disciplined as well as self-motivation (Sun, 2014). It means that teachers need to design or provide better nice facial expressions and more body language, good learning materials, and more learning instructions to create nice interaction and motivate the learners in participating in a class technology-integrated class. For teachers' perspective, how to integrate technology into a classroom to enhance students' engagement, how to increase their learning motivation (Aljaloud, Gromki, Billingsley, & Kwan, 2015), how to improve their learning experience in content delivery and interaction, how to facilitate learning environment and how to promote teaching quality, should all be considered, while using IRS supported instruction.

METHODOLOGY

Participants

The participants, instruments, and procedure of the study are introduced in this section. Three pre-service teacher core courses (course ID: J024, 4942 and 8184) participated in this study lasting a semester for 18 weeks. In total, 206 Taiwanese college students are pre-service teachers from 3 core training courses in the Department of Education for quantitative analysis.

Five students were randomly selected from each core courses, total 15 students were interviewed after final exam and provided qualitative comments regarding the use of IRS in the instant response learning experience and instruction quality analysis.

Instruments

In this study, for examining the learning achievement, the student's t-test was used to compare the two types classes' mid-term and final exam scores for 2 periods in the semester. In addition, for examining the quality of instruction, a five-point questionnaire (one being the lowest and five being the highest) was distributed to measure students' attitudes toward Instant Response Instruction by using ZUVIO.

The questionnaire, the Course Satisfaction Survey, a survey evaluating courses as part of the Research Development Center of the University, provides students with an opportunity to self-evaluate their learning perception and to examine the quality of course they took in the current semester. This Course Satisfaction Survey used in this study included 20 questions and covered four categories: motivation (items 1 to 5), interaction (items 6 to 10), learning outcomes (items 11 to 15), and assessment system (items 16 to 20), each question is counted from 0 to 5 points. The interview was designed with an open-ended question to collect qualitative data on the use of the IRS, the series of questions is: "What are the advantages and disadvantages of using the IRS in the classroom?" including 7 advantage questions and 5 disadvantage questions. From the analyzed Course Satisfaction Survey, the reliability test was carried out using the Cronbach's alpha method in 2015 by University Research Development Center, reported the Cronbach's alpha value obtained was 0.901. As the value is greater than 0.7, it can be concluded that the data is reliable.

Procedure

Before midterm exam, the first-nine-week class of each course was designed as the control period/group, which was given the traditional teaching instructions. The other nine-week class was designed as the experimental one, which had to complete the IRS tasks assigned by the teacher and use assessment, voting, peer-review functions in ZUVIO. The same professor taught all 3 core courses, and the students in both classes were sophomores and juniors with no ZUVIO learning experience.

Data Collection

For examining the learning achievement, data was collected from students' midterm and final exam results, after mid-term exam and final exam in the semester. For analyzing the overall quality of instruction and learning experience, data was collected from Course Satisfaction Survey, in the end of university semester. And the semi-structured interviews were conducted in the end of university semester, focusing on students' personal learning experience, qualitative data was collected from interview to understand the strengths and weaknesses of using the IRS in the classroom.

RESULTS AND DISCUSSIONS

Learning Achievement

According to the unified both students' midterm and final exam results in three courses for the semester, the experimental group and the control group differed significantly in the scores ($p = .000 < .05$) with regard to the use of instant response instruction strategy (please see the following Achievement T-Test Output Table).

Overall Instant Response Instruction Quality and Learning Experience

The Course Satisfaction Survey provides students with an opportunity to evaluate the course, to show their learning experience or satisfaction in four categories: motivation, interaction, learning outcomes, and assessment system, each question is counted from 0 to 5 points. The descriptive statistics output is as following table, it shows students' high satisfactions on motivation, interaction, learning outcomes, and assessment system, the teaching effectiveness looks very well.

Table 1. Students' midterm and final exam results in three courses

<i>T-Test Output</i>						
One-Sample Statistics						
	N	Mean	Std. Deviation	Std. Error Mean		
MT_score	206	76.990	20.848	1.453		
F_score	206	82.078	18.147	1.264		
One-Sample Test						
	Test Value = 0				95% Confidence Interval of the Difference	
	t	df	Sig(2-tailed)	Mean Dif	Lower	Upper
MT_score	53.003	205	.000	76.990	74.126	79.854
F_score	64.915	205	.000	82.078	79.585	84.571

Table 2. Course Satisfaction Survey Descriptive Statistics

<i>Course Satisfaction Survey Descriptive Statistics Output</i>							
CourseID	Valid	Sample	Motivation	Interaction	Outcomes	Assessment	Total
J024	77	83	23.0	22.8	22.9	22.8	91.5
4942	59	61	23.0	22.9	22.9	23.0	91.8
8184	59	62	22.9	22.9	23.0	22.8	91.6

Lecturing and Engagement From Instructor's Viewpoint

When lecturing as an exposition teaching method, it is the best way to share a huge amount of information in a short time. The purposes of lectures are as follows. Lecture method allows instructor to show willingness for the content, to scrutinize and enrich the content with his/her deep knowledge, to get students to connect new information with their existing knowledge, to finish the lesson in a shorter period of time, to connect with students and to demonstrate the style of expert approach.

On the other hand, lecture method has some disadvantages. Passive learning is one of the important flaws of lecturing method. As opposed to student-centered teaching methods such as learning by doing model for designing constructivist learning environments and so on, lecturing method is teacher-centered, in which students passively listen to the instructor. However, instructor cannot be sure whether student is really cognitively engaged or not. In this case, the instructor felt on the downsides of the lecture method as lower interaction, boring learning atmosphere and classroom management problems due to waning student interest and attention. The way of communication in lecturing is hardly bilateral; that is, most of the time during lectures, instructor transmits the information and students are required to listen to instructor.

Personal Learning Experience With IRS

The qualitative data was collected by using an open-ended question interview to collect personal learning experience qualitatively on the use of IRS, ZUVIO. Five students were randomly selected from each core courses, total 15 students were interviewed after final exam and provided qualitative comments regarding the use of IRS in the instant response learning experience and instruction quality analysis to understand the strengths and weaknesses of using the IRS in the classroom. In the students' responses to the qualitative questions on the advantages and disadvantages of using IRS in the classroom, they listed the following advantages:

1. The IRS enhances interactivity in the class, students were more involved, attentive, and participative;
2. Students received better and more timely feedback by using IRS;
3. The IRS was fun to use in the class, and reduced the distract;
4. students can vote anonymously using the IRS;
5. The IRS is easy to use;
6. The use of the IRS adds technology components to the class;
7. The IRS promotes learning; and
8. The use of the IRS helps instructors to understand the students' level of understanding so that they can explain concepts to the students better.

Interactivity is one of the most highly cited benefits of the IRS. Students highlighted that the use of the IRS increased their involvement in the class, helped to promote more class participation, allowed them to get immediate feedback, and enabled them to assess their understanding relative to those of the other students. Anonymity is one of the advantages provided by the IRS. With the IRS,

every student has the chance to answer every question without being embarrassed if his or her answer is wrong. The anonymity feature of the IRS increases students' willingness to participate in the class. Fun is another benefit of using the IRS system. As the students stated, "the IRS complements the lectures," "introduces activities during the lectures," and "makes the lectures more interesting." The IRS uses BYOD idea as remote control; therefore, the IRS is fairly easy to use and operate. Also, since the design of the courses were technology-integrated, students realized the benefit of using advanced technology, such as the IRS in the class. Students also believed that with the help of the IRS, the instructor was able to explain course materials better. Overall, they felt that the use of the IRS in the class promoted interactivity and learning.

On the other hand, the main disadvantages of the IRS that were identified by the students are as follows:

1. Sometimes the IRS do not function properly due to an unstable internet connection;
2. Question types are limited to multiple choice questions and true/false questions;
3. Some students do not take voting seriously; and
4. Voting using IRS takes up class time.

The above identified disadvantages are concerned with technology, instructional design, and students' attitudes. First, the IRS is a new technology and has room for technological improvement and advancement. For example, when wireless network is unstable, students' responses sometimes could not be detected and received through the internet. The cloud database was not able to receive more than one concurrent response. Second, the IRS can only capture quantitative data, thus limiting the responses to multiple-choice or true-false questions. Third, since using the wireless handheld device, the smart phone or the tablet, was fun to the students, some of them did not take it seriously—by clicking multiple times on purpose, by clicking on answers that were obviously incorrect, or by clicking on answers that were out of the range/choices given. Students also raised concerns relating to instructional design. For example, the following questions should be considered when designing instruction. How much class time should be allocated to voting? What types of questions are appropriate for use with the IRS? And will the use of the IRS disrupt the pace and flow of the class?

CONCLUSION AND IMPLICATIONS

The advantages and disadvantages identified by the students not only provide a more comprehensive picture and understanding of using the ZUVIO in the classroom, but also provide additional information that is useful to educators planning to implement the IRS. These qualitative comments highlight a number of pedagogical and curriculum issues that are valuable to educators:

1. Interactivity has long been considered one of main pedagogical issues in the classroom, especially for large classes and technology-related courses. The results of this study suggest that the IRS is an effective way to improve interactivity in the classroom. The students' comments also indicate that interactivity promotes learning.
2. The success of using the IRS in the classroom also suggests that technology components should be part of the curriculum design for classes related to technology. For example, adoption of a state-of-art technology can improve students' interests and motivation in learning the course materials. In this study, the IRS was successfully utilized in 3 designed classes, which is a technically oriented course.
3. Technology should be working. Not only must the technology be easy to use, it must also be useful and working properly. A technology that is not working properly can create frustrations

and disrupt the learning process. For example, the internet connection should be checked before the class to ensure that it's on and stable.

4. Instructors need to integrate the IRS seamlessly into the curriculum design. Although the IRS is an effective way for enhancing classroom interactivity, it may disrupt the pace and flow of the lecture if it is not implemented with care. Instructors need to design the questions carefully to complement the lectures. When designing the instruction, instructors also need to consider when to introduce the questions, what questions to ask, and how much class time to allocate. Instructors should also be flexible to adjust the pace of lecturing based on the students' responses gathered using the IRS.

Besides, the implementation of Instant Response Instruction by ZUVIO in courses had effective and positive feedback from the Taiwanese college students. According to the results of the questionnaire, students' learning motivation has been enhanced. Moreover, they were willing to apply what they have learned interactively. The student-centered approach guided the students to be more active in the classroom, and the designed curriculum also created an interactive learning atmosphere. In addition, with the use of ZUVIO online peer assessment platform, students could work with others on the Internet. Based on the results of the questionnaire, students could listen to their team members' ideas and try to reach a consensus. They paid more attention to the group presentation because they can grade their classmates.

This study has several implications:

1. Using IRS helps students' learning skills and collaborative skills.
2. Multiple-grading methods increase students' involvement in the class. Students feel positive when they can grade their peers.
3. Combing ZUVIO's peer assessment system with the group presentation creates an interactive classroom.

The limitations of the study were that only three courses participated in this study. The results would be more valid if there were more participants. Besides, if the study lasted longer, students' learning motivation and learning behavior could be observed more clearly. In the future, more teaching approaches could be implemented with multimedia to create interactive and student-centered classrooms.

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