Integrating Lecture Capture and Clickers in the Economics Classroom via Bring Your Own Device

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Abstract

The purpose of this study was to investigate students' perspective of integrating Lecture Capture and instant response system in an Economics classroom based on a Bring Your Own Device approach. This class consisted of forty-two students. Qualitative interviews were used to collect the data, which was then analyzed using a thematic analysis. It was demonstrated by the results that incorporating portable devices and an instant response system in the classroom made the course more interactive. Not only did the interaction between students and teachers improve, but the students' attention and motivation were also increased throughout the duration of the class. The smart lecture capture system not only alleviated the teacher's problem of remedial teaching, but it also simplified the students' review for the benefit of those who were falling behind in their studies. This teaching environment was designed to foster discussion among students, and the curriculum was structured in such a way that they could take the initiative to learn and collaborate with each other to produce unexpected outcomes. However, when teachers use portable devices in the classroom, the stability and speed of the network are critical factors in determining the success or failure of teachers' instruction and students' learning.

Keywords: Bring Your Own Device, instant response system, Lecture Capture, Economics

1. Introduction

Past researchers have suggested that some students enter university with lofty aspirations and ideals, but they gradually lose their motivation, and some university instructors have begun to confess that they are losing their enthusiasm for teaching due to students' unwillingness to learn. This especially applies to economics courses, because economics is commonly perceived to be a heartless, cold, and highly mathematical discipline (Jones, 2014; Ruder, 2010; Mansaray, 2018). The aforementioned issue may appear to be complex, but it is only because students' motivation to learn is low and teachers are completely unaware of students' learning status because, in the traditional teaching method, the teacher was emphasized as the primary source of instruction, and students played a passive role, which made it difficult to maintain their attention. However, higher educational institutes are increasingly adopting a "learner-centered" approach, which involves encouraging students to participate in classroom discussions and emphasizes the need for teachers and students to interact in order to foster the latter's active learning spirit (Schreurs & Dumbraveanu, 2014). Since university campuses have become fully enabled and personal digital mobile devices (e.g., laptops, tablets, and smartphones) have become popular, teachers have been attempting to keep pace with the times as information technology has continued to evolve, and teachers' teaching behavior has shifted significantly compared to that of previous generations. The Instant Response System (IRS) is a useful tool for enhancing the effectiveness of classroom teaching and learning because it promotes students' active learning, increases classroom engagement, and facilitates teacher-student and peer interaction (Chien, Chang, & Chang, 2016).

Economics is one of the most challenging subjects for university students (Wulandari & Narmaditya, 2017) and, as a required course for management students in a number of related departments, it is also one of the most challenging subjects for business school students. Therefore, this study is based on the use of a student-portable mobile device in conjunction with a cloud-based instant response system and a cloud-based learning platform to facilitate teachers' instruction and students' learning, resulting in a win-win situation for both sets of participants. For teachers, they can immediately learn the feedback results of students' learning during the classroom teaching activities via the cloud-based instant response system, thereby enabling them to better understand students' learning status, adjust their teaching pace, and advance their professional development. Meanwhile, students can utilize the cloud-based learning platform to reinforce the modules they are unsure of in class, thereby increasing their motivation to learn and learning effectiveness.

The rapid development of advanced information and communication technology (ICT) has enabled IT to be integrated into teaching and learning at a new level (Buil, Catalán, & Martnez, 2017; Castillo-Manzano, Castro-Nuo, Sanz Daz, & Yiguez, 2016). In turn, this has enabled students to have a more diverse learning experience, thereby increasing their satisfaction with learning, and improving their learning outcomes. Many researchers have commented on the beneficial effect on students of this shift in teaching methods. In this context, maximizing the use of Internet resources and information technology products as tools to improve teaching outcomes in class is a critical issue in today's higher education. Hence, the purpose of this study was to investigate students' perspective of integrating Lecture Capture and instant response system in an Economics classroom based on a Bring Your Own Device approach.

2. Literature Review

2.1 Bring Your Own Device

Bring Your Own Device (BYOD) is a method of operation in which employees are able to enter the workplace and use their own mobile device and applications to process company information, and the evolution and application of bring-your-own-device (BYOD) in education have received a great deal of attention in recent years (Al-Okaily, 2013; Cheng, Guan, & Chau, 2016). In terms of school policy, the benefit of BYOD is that it saves money on purchasing equipment and maintenance costs. It did not increase students' burden at the teaching and learning levels because every student has a mobile device, and can be trained to learn independently. Since BYOD is student-centered, students are able to choose what and how they learn using their devices, which enables teachers to tailor the instruction to individual students' learning profiles, and create a more interactive, fun, and engaging learning environment for them. More importantly, researchers have discovered that BYOD improves students' creative thinking, problem-solving, and collaborative learning abilities (Dündar & Akçayr, 2014).

However, despite these educational benefits, BYOD also has drawbacks, such as a small screen size, short battery life, and a slow processing speed. Allowing students to access the Internet freely in the classroom is liable to distract them (Taneja, Fiore, & Fischer, 2015), and it will be challenging for teachers to change their traditional teaching methods and create a BYOD learning environment where students can use their own devices to learn.

Therefore, the success of BYOD will be determined by schools' policies, teachers' teaching beliefs, and students' willingness to use their devices for various learning activities, both inside and outside the classroom. As a result, the

portable devices used in this study are the mobile devices, such as cell phones and laptops, that the students brought to integrate into the course learning and interaction.

2.2 Using Lecture Capture in Higher Education

The use of Lecture Capture (LC) has been growing in the higher education sector. It refers to the digital multimedia recording of lectures in the classroom using audio, video, or a combination of the two, for later use by students (Lokuge Dona, Gregory, & Pechenkina, 2017), which, according to Vajoczki, Watt, Marquis, Liao, and Vine (2011), increases students' satisfaction, motivation and self-efficacy (Chester, Buntine, Hammond, & Atkinson, 2011). On the other hand, some researchers have demonstrated that LC has no significant effect on students' achievement (Leadbeater, Shuttleworth, Couperthwaite, & Nightingale, 2013) and it actually reduces their attendance (Traphagan, Kuscera, & Kishi, 2010). Given the ways in which information is received and assimilated, digital technology can be especially useful when designing constructivist learning environments. Students may find that watching LC is beneficial to gain knowledge from incomplete ideas after attending live lectures and to gradually grasp the means to solve complex problems (Banerjee; 2021; Caglayan & Ustunluoglu, 2020; Williams, Aguilar-Roca & O'Dowd, 2015).

2.3 Using Instant Response System in the Classroom

As instructional technology has continued to evolve over the past two decades, numerous researchers have examined the usage of instant response systems (commonly referred to as clickers or clicks) in higher education. Clickers are also alternatively referred to as Student Response Systems, Audience Response Systems, Personal Response Systems, instant response systems, Classroom Response Systems, and Electronic Voting Systems (Han & Finkelstein, 2013). While previous researchers have demonstrated that Clickers are also effective for improving teaching quality (Buil et al., 2017), in the early days of using instant response systems for instruction, in addition to having to carry heavy hardware (including the system, receiver, and carriers), the student's remote control had to be released and retrieved prior to and after class. The issues are as follows: (1) a traditional teacher-side system contained bulky hardware and required complex setup procedures; (2) a student-side system required the use of a specialized individual classroom remote control, resulting in inconvenient management, increased equipment and maintenance costs, and reduced flexibility in use, and (3) the traditional device was limited to designing simple questions (e.g., multiple choice and right/wrong closed questions) due to its simple structure.

The increasing popularity of smartphones and mobile networks in recent years has led to a substantial volume of research focused on the use of mobile learning in education (Buil et al., 2017; Castillo-Manzano, Castro-Nuo, SanzDaz, & Yiguez, 2016), especially cloud-based instant response systems, which, according to Kearney, Burden, and Rai (2015), appear to provide a novel platform and solution in combination with BYOD. Numerous instant response systems are emerging in higher education, including Kahoot, Plickers, Socrative, Zuvio, and Cloud ClassRoom, among others, with Zuvio being one of the most mature of these systems in the domestic market today.

The advantage of utilizing cloud-based instant response systems in the classroom is that they are more environmentally-friendly than traditional teaching methods due to eliminating paper-based classroom tests (Premuroso, Tong, & Beed, 2011). Additionally, the use of instant response systems can increase students' motivation and satisfaction with learning (Buil et al., 2017), which results in a more positive classroom experience (Han & Finkelstein, 2013). Incorporating instant response systems into lessons fosters students' interaction and engagement, improves their attendance and attention, increases their learning satisfaction and promotes their active engagement in collaborative learning (Blasco-Arcas, Buil, Hernández-Ortega, & Sese, 2013; Carnaghan, Edmonds, Lechner, & Olds, 2011; Keough, 2012).

Additionally, students can use instant response systems to determine which domain areas to focus on when they are learning to apply adaptive learning (Tong, 2012). Instant response systems can be used to enhance the learning experience, increase the challenge of additional course content, provide clear learning objectives and immediate feedback, encourage students to concentrate, increase their sense of control and enjoyment (Buil et al., 2017; Rana, Dwivedi, & AlKhowaiter, 2016), and cultivate a friendly competitive environment among them (Buil et al., 2017). Similarly, Kapp (2012) proposes that the playful aspects of instant response systems can be incorporated into the traditional classroom pedagogy (e.g., course design that provides students with rewards and feedback).

Buil et al. (2017) observe that, in addition to their potential benefits, instant response systems present challenges in terms of increased workload for teachers, increased cognitive load for learners, potential technical issues with platform or web-based systems that occasionally fail to function properly, and occasional class time delays. Instant response systems can be used to enforce or monitor attendance records, and their use can occasionally cause anxiety among students (e.g., worrying about the correct recording of grades and course grades, or being unsure of the correct recording of answers) (Caldwell, 2007).

3. Research Method

3.1 Curriculum Design and Implementation

This research took place during the first semester of the 2018 academic year, with three consecutive classes (50 minutes each) every Tuesday morning for a total of 18 weeks. The content of the course covered micro and macro-economics, with a focus on basic economics knowledge and applications. The topics related to the current week's lecture and the national exam questions were loaded on Zuvio, and the lecture began with students using their portable devices to access Zuvio and retrieve the practice questions from the previous lecture. The students interacted with Zuvio during the course by a combination of pre-designed questions and the quick-question-and-answer and random point draw functions of the system. Before the end of the class, students were given 10 minutes to reflect on the week's lesson and discuss any questions they had about the content. The instructor also gave them an assignment on Zuvio for the week's lesson, which was due within 24 hours and took about 15 minutes to complete, so that they would have a better understanding of the lesson and could check their level of familiarity with its contents.

Each lesson was recorded in the smart classroom, and each recording took no more than 50 minutes. The instructor answered questions online and was able to view the number of times each student had watched the recorded videos through the cloud-based learning platform, as well as use Zuvio's student management statistics to understand the status of the class and individuals' responses (e.g. number of responses, response rate, and correct response rate) and absenteeism, which could be downloaded. The students could view their performance (i.e. question response rate and class performance) and correct response rate (i.e. question correct rate and class ranking) immediately after the course, as well as check their absentee status at any time and use the subject history to view or review the wrong questions for the semester. In this way, the platform enabled the students to keep track of their learning status and areas that needed improvement, and the teacher to keep track of students' learning effectiveness.

Both Formative and Summative Assessments were used to evaluate the students' learning outcomes. The former was used to develop their self-assessment skills, while the latter helped to measure their overall learning status. The formative assessment was based on the response rate of the previous week's lecture at the beginning of each class, and the participation rate and response rate of the students in the classroom interaction to understand their learning status and revise the content and methods of the lecture. The summative assessment was based on the midterm and final examinations to understand the students' familiarity with economic knowledge. Therefore, the assessment results were immediately updated to students and teachers through Zuvio.

3.1.1 Teaching and Learning Context

The classroom for this study was the Interactive Learning and Innovation Teaching Center, in which instant response, cloud-based learning and other technologies are integrated (see Figure 1), and students are able to be the main characters in the classroom due to the concepts of team-oriented and problem-oriented learning. The interior of the center is designed with special chairs and movable quadrangular tables that can be adjusted for a group discussion in addition to a traditional classroom setting. The researcher's teaching school has been fully e-campus enabled, with wireless Internet access available throughout, and the Zuvio cloud-based instant response system, which is available to teachers for free for the duration of their career, has been integrated into the school's teaching platform (e-Campus).

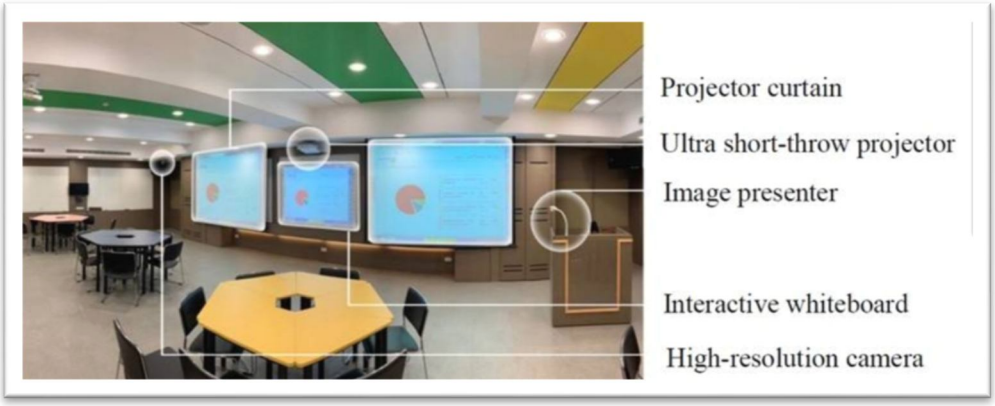

Fig. 1 Teaching and Learning Context

The upright information desk in the classroom enhances teachers' convenience, which reduces their burden and, hence, enhances the efficiency of the teaching applications. The interactive whiteboard is both a whiteboard and a computer screen, so that various computer operations can be performed directly on this interactive whiteboard. The teacher's lectures and computer software operations can be stored in the computer in real time, and the operation and lecture process can even be recorded and saved (see Figure 2). Three projectors are set up in the classroom so that students can clearly see the lecture materials from all angles. The teacher only needs to wear a sensor and can use the automatic tracking camera system to track the set targets and accurately lock them for recording purposes.

Figure 2: Teaching Facilities and Equipment

3.1.2 Cloud-based Instant Response System

With the popularity of smartphones and the rapid development of cloud technology, in order to meet the trend of a digitized teaching and learning environment, our school not only utilizes the established e-Campus e-learning platform and real-time learning alert service (i-Signal), but also integrates Zuvio, which not only provides teachers with functional support during teaching activities, but also helps them to keep track of students' learning status in real-time. Our school currently owns three systems: e-Campus, i-Signal, and Zuvio, but all three are integrated into e-Campus, making it very easy and convenient to use.

The cloud-based technology combined with mobile app software of the Zuvio system enables students and teachers to use it in the classroom based on their portable devices (e.g. smartphones, tablets, laptops, etc.) without having to rely on other hardware and remote controls. In addition, Zuvio provides a peer assessment of multiple-choice questions, quizzes, papers, and group reports, which enables teachers to choose questions that are appropriate for their course. In addition to multiple-choice or question-and-answer questions, teachers can also ask students to answer in the form of pictures, and establish anonymous responses to allow students to express their opinions freely. During the class, the teacher can use the roll call function to quickly complete the roll call and keep track of students' attendance. In the middle of the course, the teacher can use the random sampling function to increase the activity in the class, or the quick-question-and-answer function to assess individual students' current learning status. The feedback function enables students to actively ask questions or express their opinion via their cell phone, making the classroom a two-way communication environment for teacher-student interaction.

3.1.3 Cloud-based Learning Platform

Students can use the i-Learning system to review areas with which they are unfamiliar after class to ensure that the learning is effective. In a cloud smart classroom, teaching resources can be managed and integrated through the cloud material library, the curriculum can be organized in the cloud classroom, teachers can prepare lessons in the cloud, and teaching materials stored on the cloud learning platform can be accessed at any time (see Figure 3). The electronic notes left in the classroom and students' learning portfolios are also saved on the cloud learning platform. The electronic notes automatically recorded by the teacher in the smart classroom are automatically uploaded to the cloud learning platform and become teaching resources for students to read after class.

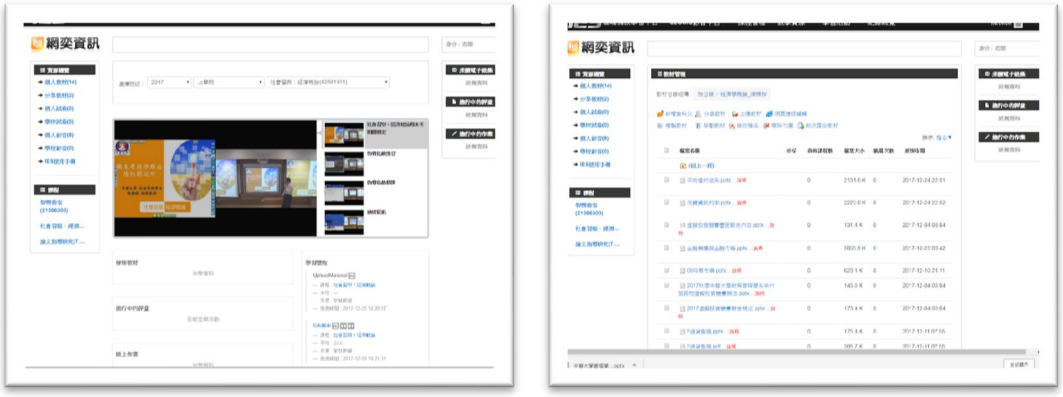

Figure 3 Cloud-based Learning Plateform

After the teaching activities are finished, the teaching records are automatically uploaded to the cloud for management. In addition, teachers can record and share the complete course through the recording system, so that students can review the course themselves through the cloud learning platform. In addition, students' personal learning history is completely recorded and analyzed on the cloud-based learning platform, enabling teachers to grasp the status of their revision after class (see Figure 4).

Fig. 4 Example of student screen and recorded videos on the learning platform

3.2 Participants

Forty-two students (9 females and 33 males) were enrolled in the Economics I course. One was from the Department of Electrical Engineering, one from the Department of Public Administration, and the remainder from the Department of Technology Management. 18 students who were selected from the Economics (I) course by purposeful sampling were interviewed for this study, after signing an agreement form that assured them of the confidentiality of their private information.

3.3 Data Collection and Analysis

Interviews were conducted and the duration of each interview was 40 to 60 minutes. The interview numbers were S for the individual in-depth interviews, and the numbers represented the order of the interviews; SA and SB represented the two focus group interviews, and the numbers represented the number of respondents. The interviewees consisted of 12 male students and 6 female students. The interviews were audio-recorded in order to ensure the authenticity of the study, and the audio-recorded data were listened to after the interviews, and then transcribed verbatim within 48 hours.

The data for this study were collected and analyzed simultaneously using a Thematic Analysis (TA) for interpretation purposes. The analytical steps proposed by Nowell, Norris, White, and Moules (2017) were adopted to confirm the reliability of the study. This involved converting the audio files of the interviews into verbatim transcripts before conducting the thematic analysis in six stages: (1) becoming familiar with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing the themes, (5) defining and naming the themes, and (6) writing a report. In cases where the researcher and the interviewer did not agree on the data analysis and summarization process, another

qualitative research expert (the third person in the research team) participated in the discussion and clarification. In this way, meaningful units were generated and common themes were formed by a continuously reading the text (Miles, Huberman, & Saldana, 2014).

4. Results and Discussion

Four themes and twelve meaningful units emerged from the analysis and summary of the findings, namely "revitalizing teaching activities," "changing learning attitudes," "resolving educational dilemmas," and "mutual recognition of effectiveness", which are explained in detail below.

4.1 Reviving Teaching Activities

The term "revitalized teaching activities" refers to the integration of economics instruction into the classroom via student-portable devices and an instant response system. Three significant components of revitalized teaching activities are "increased teacher-student interaction," "strong motivation to attend class," and "immediate response."

4.1.1 Increased Teacher-Student Interaction

The students reported that they had interacted more with the teacher during the course. Several of them stated, " We had to pay closer attention in class due to time constraints; otherwise, we would have missed it accidentally. Additionally, we were able to interact more with the teacher, which strengthened our understanding of economics and the learning effect." (SA2). Other students pointed out: "There was an increase in interaction, perhaps because we IRS answered words and the teacher saw the answer and then noticed some incorrect information or some problems with it, and then spoke out, or some students' responses were quite dissimilar, which increased the interaction." (3SB). This implied that the teacher could increase the interaction by eliciting immediate responses and discussion from students. Additionally, students stated that this method of teaching was more diverse, because it did not focus exclusively on the teacher during the lecture: "I believe we would have more interaction with the teacher, if a variety of elements was involved in the lecture." (S2)

4.1.2 Strong Motivation to Attend Class

The students perceived the class to be more spiritual due to the non-traditional teaching style; hence, they were more motivated to attend: "I believe it is possible to enhance the class, that is, the type of motivation to attend. There will definitely be an increase in spiritual participation with a combination of 3C products such as cell phones." (S3) Additionally, some students stated that the class would become more serious by incorporating information and communication devices into the classroom, not only in terms of increasing students' attendance, but also in enhancing the learning effect: "If we have to speak in class, it is more serious. We can gain some knowledge, such as the teacher's timely answer, which feels very good. In a similar way, it will be serious to listen to what the teacher is saying. The willingness to attend class will improve and so will the learning effect." (SB4)

4.1.3 Immediate Response

Historically, teachers usually directed their own performance, and the students acted as an audience watching a movie, with no involvement in the lesson. Not only does the use of an instant response system engage students, but it also requires an instant response: "In economics, we can use remote control with IRS to answer many questions. Because the feedback is not always enthusiastic, we can use IRS to answer so that the entire class can participate, to work out their own ideas." (S4) After receiving immediate feedback, the students can determine whether their responses are correct and can discuss them with the teacher immediately: "Because this class is not required to change to the next class to inquire, and IRS can change immediately upon learning of a problem, we can directly ask the teacher, which is more convenient" (S7).

4.2 Changing Learning Attitudes

Students will no longer learn passively, but happily and actively because of the positive teaching environment and the integration of information and communication technology into the economics curriculum, as well as the increased opportunities for mutual learning among students as a result of changes to the teaching environment and teaching methods. Three significant components comprise the change in learning behavior: "learning readiness," "collaborative learning," and "active learning."

4.2.1 Learning Readiness

This classroom featured two projection screens and an electronic whiteboard, as well as an excellent view of the classroom, which the students believed made it easier to comprehend the class content than the traditional blackboard: "Because it has three large screens, you can see it more clearly, but it still depends on the course. For example, economics is an excellent fit, because the writing on the blackboard is sometimes difficult to read, but also easier to understand. Additionally, it is more comprehensible." (SB3) Some students also stated that the classroom was more comfortable and conducive to learning: "It's not bad because they're all quite comfortable up to class. This classroom is quite beautiful, up to class is more relaxed than comfortable, conducive to learning." (S8) Furthermore, it was more convenient for discussions: "If we sit next to our own students, we can refer to certain points in the topic; therefore, I believe it is preferable to be in this classroom because it is more convenient for a class discussion." (S7).

4.2.2 Collaborative Learning

"Students could collaborate due to the classroom's movable quadrangle tables, the adjustment of the classroom to a group discussion mode, and the formation of a small group of six students in the class." (SA3). "Students will cooperate in the division of labor as lot of questions may be assigned on the class's words " (S5) The students could discuss them first and then verify them with the teacher's response. "If we do not understand something, we can ask the other side and then discuss it until we believe we have the answer and then verify it with the teacher's testimony that the answer does not match what we believe." (S9). The students could more easily absorb the course content with this arrangement of the teaching context. "If it is a round table, you will be heard by the people at that table. You will be able to answer questions and participate in discussions when everyone is heard." (S8).

4.2.3 Active Learning

In active learning, students are not only required to participate and respond to questions in class, but also to take the initiative to learn what they do not understand after class. Although these students indicated that they may not have understood some parts of the class, they said they would be willing to review the sections with which they were unfamiliar following the class due to the recording system: "If the teacher uses this platform, it means that, even if I am unable to understand something in class, I can return and examine the historical records and whatever else is available, which will motivate me to attend."(S5). The students believed that it was critical to maintain a class record because the recording and instant response system would capture all the questions answered in the class, enabling them to actively learn at any time: "I prefer digital because a recording is made of students answering questions, and if I am unsure or forget something, I can refer to the record; the record is still extremely important. Additionally, the instant response system increases students' participation in class. It is convenient, in the sense that your position can be displayed or not." (S4)

4.3 Resolving Educational Dilemmas

Introverted students who find it difficult to communicate can interact with the teacher via the instant response system, and those students who are falling behind in their learning can also use the recording system for remedial teaching to circumvent the problems associated with traditional lecture teaching. As a solution to learning difficulties, active learning consists of three significant components: "easily reviewed," "attention focused," and "assists introverted students."

4.3.1 Easily Reviewed

This course is easy to learn because it makes use of a smart recording system in which the instructor records the entire course and uploads it to the cloud learning platform following the course. The students also stated that this could resolve the issue of curriculum bridging: " If I am unable to bridge to the next class because I did not attend class today, I can watch it after class." (S7) Occasionally, even if a portion of the course content is missing, it can be reviewed via the teaching video: "Due to the fact that I fell asleep in the traditional class and did not pay attention to the teacher, I may have missed the lecture, as was the case with E, there is a video I can use to review it and there will be additional information to learn." (S3) Since the smart LC system enables repetitive learning, students perceive numerous advantages: "IES has a recording and playback function, which allows you to watch it over and over again until it becomes better. I believe that digital learning has a plethora of advantages." (S4)

4.3.2 Attention Focused

It is possible for students to focus their attention because the instant response system enables teachers to increase interaction with them. Teachers can teach the course at any time via the instant response system and student dialogue,

which not only makes the course livelier, but also requires students to concentrate on the course "I believe this is a very good way to go..... I don't believe this is a good way to indicate that you're not paying attention in class or that you'd like to sleep or something, but..... it increases the level of concentration that everyone has in class." Some students even believed that they may all want to sleep in class without an immediate feedback system: "I believe it is beneficial because it makes falling asleep relatively difficult; if we simply kept thinking without answers to questions, no IRS, and no remote control, we may all fall asleep." Also, after students respond to the question, teachers can use the immediate feedback system to draw points on different responses from students to express their views, which not only helps the students to maintain their concentration, but also extends their learning power: "Then, using the IRS to draw questions, first from the answer inside draw points, the time will be seriously extended, so that students will be a little more serious." (S2).

4.3.3 Assisting Introverted Students

The instructor has the option of announcing the respondent's name when questions are answered via the instant response system, and all questions are answered via a self-portable device. The students stated that, by responding to questions via the instant feedback system, introverted students can express opinions that they are usually afraid to express: "Because if we talk about interacting with teachers, it may be of great assistance to those who are more introverted, in that they can express opinions they are usually afraid to express." (S4) Additionally, the instant response system is extremely convenient because the answer is only visible to the teacher. This method is beneficial for increasing the effectiveness of the learning because "If the teacher had asked us for the words, some students may have been too embarrassed to speak, but the IRS directly calls us to answer, which is quite convenient, and the answer is only visible to the teacher, I believe the learning effect this way is quite positive." (S4).

4.4 Mutual Recognition of Effectiveness

While the system is not without flaws, it does represent a departure from traditional teaching methods. While the numerous benefits of integrating ICT into the curriculum were revealed during the students' interviews, they also revealed some challenges associated with student learning, teacher instruction, and system equipment. "Multi-tasking", "limited functionality", and "system stability" are the three significant components of effectiveness.

4.4.1 Multi-Tasking

Multitasking refers to the fact that students will unintentionally play online games or read messages on their portable devices during the learning process due to advanced information and communication technology. Numerous students stated that they are compelled to read and respond to messages when their cell phones receive them: "It's natural to become distracted and constantly want to slide the phone, put it on the table and look at it, and then respond if someone lines me." (S1). "Distractions such as playing with your phone or reading are common." (S9) However, the students confirmed that the traditional lecture-based teaching method was reversed and combined with the self-portable device-based teaching method: "I believe the entire endeavor is worthwhile, but I also believe it is easy to become distracted." (SA4). Additionally, some students stated that they waited for other students to answer questions before sliding their phone: "I'd like to slide the phone and play the electric guitar, because occasionally, there would be free time to play after answering questions." (SB4)

4.4.2 Limited Functionality

The limited functionality is divided into two categories: one is due to the instant response system's limitations, and the other is due to some teachers' unfamiliarity with the system, which impairs their teaching fluency. It is inconvenient to respond because this is a course in economics, and some of the economics courses cover computational topics, and the students' portable devices are cell phones: The respondents believed that the instant response system, IRS, has a limited number of functions, despite its convenience. Along with the limited capabilities of the system, some of the factors included teachers' unfamiliarity with the instant feedback system, which led students to believe that they would use it exclusively for roll call and order: "If some teachers are unsure of how to use it, they will simply use it for call roll and to ask a few simple questions." (S2); "One of our teachers was genuinely unsure how to use the IRS, so we assisted him."(S5)

4.4.3 System Stability

The stability of the system refers to the use of portable devices and real-time response systems to transform the traditional lecture teaching. The instant response system and the network system are both examples of unstable systems. The students occasionally responded that they were unable to answer the questions due to the system's instability:

"When the IRS is activated, I occasionally receive no response, preventing me from quickly responding to the teacher's questions." (S2). While the majority of students use the school network, when multiple people use it concurrently, the speed of the network suffers: "There are times when I am unable to connect to it, so I believe that the network speed is critical for the class and will, therefore, have a negative impact on it." (S6). Furthermore, the interruption will affect the learning: "The teacher's time is not constrained, but the network is a little slow, so that you only have two seconds left when you click into it. I believe that the aspects of the school network are easily broken."(S5)

5. Discussion, Conclusions, and Recommendations

5.1 Discussion

5.1.1 Instructional Activities

The findings of this study indicate that the incorporation of portable devices and an instant response system into the curriculum can increase students' motivation to attend classes, as well as improve their interaction with the teacher and facilitate immediate responses and discussions of class questions. It is obvious that this method of instruction not only increases students' willingness to attend classes, but it also has a positive effect on their learning outcomes. Additionally, it was discovered during the study that incorporating an instant response system into the teaching did not affect the progress of the lesson as long as the teacher planned the class content ahead of time, designed it to be interactive with the students, and interacted with the students every ten minutes. As S9 stated: "Using electronics means that the teacher speaks more frequently because writing on the blackboard is slower, but you learn more. I am able to acquire additional knowledge this way." Therefore, as long as the teacher prepares the lesson first and fully integrates the instant response system into the curriculum, not only can the teacher be reactive in teaching, but students will also be willing to enter the classroom to learn, which increases their learning effectiveness. Many instructors worked with the Center for Teacher Professional Development; however, some students stated that a few professors may have been concerned about using a virtual medium in this study. According to previous research, teachers' lack of familiarity with devices adds to the pressures associated with classroom management and security (Liu et al., 2014). To adapt to online teaching, schools should consider ways to motivate educators to embrace new technology.

5.1.2 Student Education

The findings of this study indicated that incorporating a smart LC system and an instant response system into the course not only increased students' enjoyment of learning, but also their anticipation of the class. As S3 stated "When you compare your class to others, it becomes more enjoyable to discuss the economics teacher's methods. Students are actually happy to learn as long as teachers design the course content and utilize information and communication technologies to assist their teaching." Additionally, it was discovered during the research that the teaching environment does not consist of a traditional lecture hall, but rather six students seated at a round table. When the questions were opened via the instant response system, the students engaged in an active discussion and worked cooperatively to find the best answers, achieving a cooperative learning effect. All the lectures were recorded using an intelligent recording system, which enabled students who were falling behind in their learning to review the lessons via instructional videos. This study not only alleviates students' reluctance to learn, but also addresses the issue of remedial teaching for teachers.

5.1.3 System and Apparatus

The findings of this study indicated that the teaching equipment and network system were the primary sources of students' dissatisfaction with this teaching method. However, a few students were forced to turn their faces to listen to the lecture during the teacher's lecture and then back to the table when using the instant response system, causing some disruption. As S6 put it, "It is extremely convenient to respond to questions by name, but the IRS is occasionally unreliable and cannot be connected." Additionally, there is an issue with the distribution and speed of the school network because, if the course utilizes the instant response system, the entire class will be connected at the same time, causing the network to run slowly, which impairs teachers' teaching and students' learning.

5.2 Conclusion

After implementing the experimental course, it was concluded that incorporating the portable device and instant response system had made the class more engaging. The students had interacted well with the teacher, and their attention and motivation to learn had increased during the class. Not only did the intelligent LC system address the teacher's problem of remedial teaching, but it was also easier for students to review the lesson, which was beneficial for those falling behind in their learning. The teaching environment is designed to foster students' discussions, and the

curriculum is structured in a way that enables students to take the initiative to learn and collaborate with each other, resulting in unexpected outcomes. On the other hand, the teaching system and network system are critical factors of successful teaching and learning. It generally appears that combining the use of portable devices and cloud-based instant response systems with LC can result in a teaching method that is a win-win for both teachers and students. The LC, Clickers, and Bring Your Own Device (BYOD) approaches used in this study may provide critical guidance for students learning in a paperless context. Additional research could examine instructors' perspectives and assist schools in preparing for the sustainability of paperless environment by using technology in higher education.

5.3 Recommendations

Based on the findings of this study, some specific recommendations can be proposed for the reference of schools, teachers, and subsequent researchers who are interested in this topic.

5.3.1 Recommendations for Schools

1. Universities should provide workshops on smart LC systems and instant response systems, so that instructors can make good use of information and communication devices in the curriculum.
2. Schools should review the wireless network equipment on campus, especially in the teaching area, so that students' lessons can run smoothly.
3. While the instant response system has currently been integrated with the internal teaching platform, the smart LC system has not; hence, students need to enter another platform to watch the teaching videos after class. Therefore, these learning management systems need to be integrated in individual schools.

5.3.2 Suggestions for Teachers

1. The integration of an instant response system in the curriculum has been accepted by most students as being able to improve their willingness to attend class and increase their interaction with the teacher; hence, it is recommended that teachers make good use of this system.
2. Smart LC not only solves teachers' problems in remedial teaching, but also helps students to review the lesson after class via teaching videos.
3. The appropriate use of the instant response system will not affect the teaching progress. Teachers are recommended to first plan the content of the lesson and establish the course topics to make the teaching process smoother.
4. University students are familiar with 3C products, and are willing to use their portable devices to interact with teachers, but the speed of the network often has a negative effect on this process. Therefore, it is recommended that teachers should interact with students from time to time and pay attention to their learning status when designing the course.

5.3.3 Suggestions for Further Research

1. This study was conducted in an Economics classroom. Future researchers can base their study on different courses to understand if the integration of information and communication devices into different subjects has the same results.
2. This study was conducted with students as the target population. It is suggested that subsequent researchers could interview instructors to explore their view of the integration of ICT into teaching.
3. The target population of this study was undergraduate students, because they are familiar with 3C products. It is suggested that subsequent researchers could use graduate students as the study population to determine if older students have a different opinion of the benefits of utilizing portable devices in their courses.

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