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EFFECT OF INTEGRATING A GAMIFIED INSTANT RESPONSE SYSTEM WITH A SMART LECTURE CAPTURE ON UNIVERSITY STUDENTS' MOTIVATION TO LEARN IN AN ECONOMICS CLASSROOM

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Abstract

The purpose of this study is to investigate learners' motivation when integrating a gamified instant response system (IRS) with a smart lecture capture in an Economics classroom at a university in Taiwan. One hundred and one students participated in an 18-week Economics I course consisting of three 1-hour sessions per week between academic years 2018 and 2019. The Motivated Strategies for Learning Questionnaire (MSLQ) was used to assess students' motivational orientation at the beginning and end of the semester. It is concluded that this instructional approach has the potential to both increase and decrease student anxiety and gamified IRS should take into account both intrinsic and extrinsic motivation.

Keywords: Gamification, Smart Lecture Capture, Learning Motivation, Economics

Introduction

To date, the vast majority of undergraduate students are members of Generation Z, which has a different way of learning than previous generations. They were raised in an advanced technological culture and are accustomed to online interactions and education. Generation Z has grown up in a culture that values online interactions and technological devices as modes of communication, engagement, and education. Generation Z places a higher premium on self-directed learning, immersive educational experiences, and technology-mediated instruction than previous generations did, and they rely on smart devices and social media more than previous generations did (Shatto & Erwin, 2017; Skinner, Sarpong, & White, 2018). As a result, it may be challenging to teach fundamental business courses to Generation Z in Taiwan using traditional lecture approaches. Instructors may face a challenge in the context of an Economics classroom due to the learning and working preferences of Generation Z undergraduate students.

To date, when it comes to increasing student learning in Taiwanese higher education institutions, one common in-

structional practice in active learning classrooms is for students to respond to instructor-posed questions using clickers. Clickers, alternatively referred to Instance Response System (IRS), are active learning tools that encourage the majority of students in a classroom to participate. Incorporating clickers into classrooms can be viewed as a form of gamification, as it engages students in active learning through fun and interactive activities akin to game shows. Gamification is the process of incorporating game mechanics into non-game situations in order to influence human behavior and improve their experiences. It enables teachers to simulate question-and-answer competitions in the classroom. While numerous gamification techniques based on various game mechanics have been shown to improve learning outcomes in applied contexts (Zichermann & Cunningham, 2011), educators need more rigorous empirical research to determine whether and how specific gamified instance response systems may affect learners' motivation. As Cain and Robinson (2008) discussed, clickers do not transform a classroom magically; their effectiveness is determined by how they are used.

Economics is one of the most difficult subjects for university students. According to Nepal and Rogerson (2020), the complexity of the subject of Economics, as well as the use of mathematical concepts, has left many university students perplexed about how to apply economic theory to real-life situations. Higher education is gradually incorporating technology and a variety of teaching methods to improve students' learning effectiveness in Economics-related subjects (Dubas, & Toledo, 2016; Wooten, Geerling, &Thomas, 2020). Recent technological advancements have developed the opportunity to record lectures so that learners in Economics classroom can replay them at their leisure on their electronic devices. Lecture capture systems can automatically capture audio, video, and other devices connected to the projector, such as visualizers, interactive whiteboards, or tablet PCs. Students can watch the recorded lecture as many times as they want, including PowerPoint slides and movie clips, and they can choose whether to watch over a high-speed or low-speed connection, as well as watch lectures on their own devices at their own pace.

Therefore, the purpose of this study is to investigate learners' motivation when integrating a gamified instant response system (IRS) with a smart lecture capture in an Economics classroom at a university in Taiwan. The structure of the study is as follows: (i) a theoretical and empirical background, (ii) a description of the methodological approach, (iii) the findings, and (iv) a conclusion, which will include a discussion of the findings, a description of the limitations of the study, and some recommendations for future research.

Method

Research Design

This study was conducted in the Economics (I) course taught in the 2018 and 2019 academic years in order to understand the impact of using the gamified instant response and smart lecture capture (LC) system on the enhancement of university students' learning motivation, and the participants were students who took Economics I in the 2018 and 2019 academic years. They were taught Economics I for three hours per week for 18 weeks, using their mobile devices (cell phones or laptops) in conjunction with the Zuvio instant response system,

the school's intelligent teaching and learning recording system, and the cloud-based learning platform with gamified learning (IRS and rewards).

This research combined the use of portable devices and a cloud-based instant response system for teaching in the Fall semester of 2018 and the use of an interactive whiteboard in the Fall semester of 2019 in an intelligent classroom with the HiTeach interactive teaching system and the Zuvio instant response system (https://www.zuvio.com.tw/) for gamified response, which enabled the teachers to understand the learning status and response of each student in real time. Students could access the IES cloud learning platform at any time to watch classroom videos, and the teachers could use the course management function to see the number and duration of students' visits to better understand their learning status and hence, improve their teaching. Students' motivation was pre-tested in the second week of the first semester, followed by a post-test in the eighteenth week to ascertain whether the study's pedagogy had improved it or not. The differences in the improvement of students' motivation due to adding the gamified instant response and intelligent teaching and recording system were also compared using the post-test scores of academic year 2018 and the post-test scores of academic year 2019.

Figure 1. Interactive Learning and Innovation Teaching Center Facilities

The Zuvio instant response system and the CHUMoodle teaching platform were used in this study, as well as the teaching recording equipment in the school's Interactive Learning and Innovative Teaching Center and the recording equipment of the IES cloud-based learning platform (see Figure 2).

Teaching and Learning Context

The Interactive Learning and Innovation Teaching Center (see Figure 1) was the classroom for the Economics I course in this study. The intelligent teaching recording function of this teaching center, combined with the automatic human image tracking camera, enables teachers to record the entire teaching process for students to learn after class.

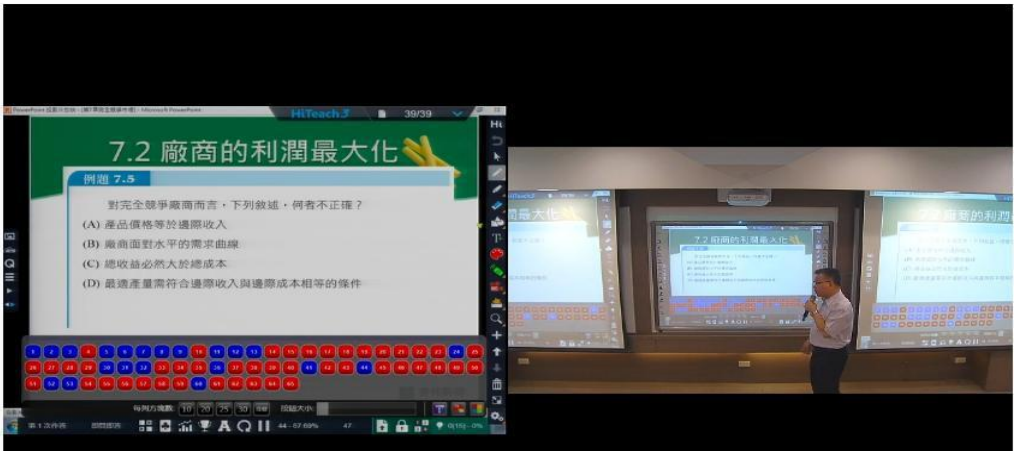

Figure 2. Example of lecture video recorded by the IES cloud learning platform

The school's CHUMoodle teaching platform and the Zuvio instant response system (see Figure 3) were used in this study to assist the teaching. The CHUMoodle teaching platform was used for course announcements, assignment submission, and assessment (total grades, assigned scores, attendance, and activity records). The Zuvio instant response system was used in conjunction with the mobile device app software for the teacher-student interaction system.

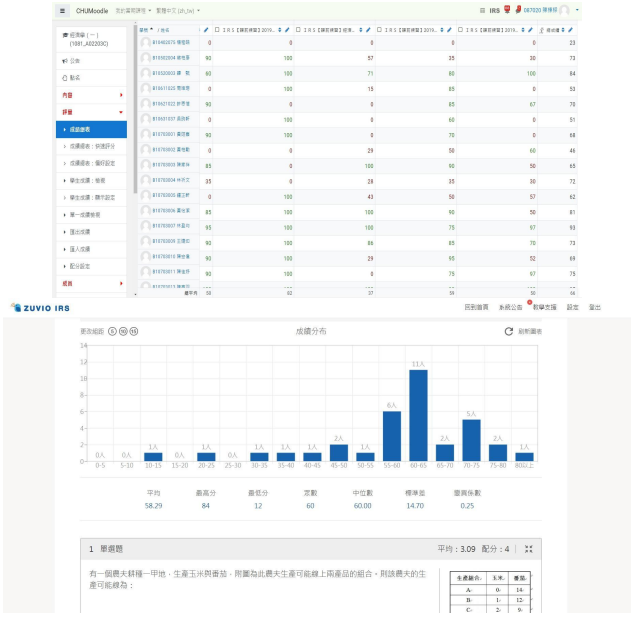

Figure 3. CHUMoodle teaching platform and Zuvio instant response system

Participants

The intelligent teaching and learning video classrooms of the Center for Interactive Learning and Innovative Teaching and Learning in the School of Management were used for this study, and the courses were imple-

mented from September 2018 to January 2019 for the 2018 academic year and from September 2019 to January 2020 for the 2019 academic year. The subjects of the study were the second-year economics (I) students in the School of Management. 42 students took economics (I) in the 2018 Fall semester and 59 students took economics (I) in the 2019 Fall semester.

Research Instrument

The instrument used to collect the data in this study was a questionnaire consisting of two parts: pedagogy and learning motivation scale. The pedagogical approach in the 2018 semester was taught using a portable device and a cloud-based instant response system, and the gamified instant response and smart LC system were used for teaching in the 2019 semester. The study also made use of the Motivated Strategies for a Learning Questionnaire (MSLQ) developed by Pintrich, Smith, Garcia, & McKeachie (1991) based on the social cognitive theory and the 31 questions of the MSLQ used in the study contained the following constructs: (1) intrinsic goal orientation, (2) extrinsic goal orientation, (3) task value, (4) beliefs about control over learning, (5) self-efficacy, and (6) test anxiety. Students were asked to score from "1=not at all like me" to "7=exactly like me" using a seven-point Likert scale. A high score on the scale meant that the student was highly motivated to learn.

Data Analysis

All the students enrolled in Economics I were subjected to a pre-test of motivation in the second week of the first semester of the 2018 and 2019 academic years, and a post-test was administered in the 18th week to understand their motivation scores. The quantitative data collected from the Zuvio instant response system and the motivation survey results were subjected to a narrative statistical analysis, reliability analysis, paired sample t-test, and independent sample t-test.

Results

The purpose of this study was to analyze the questionnaire data collected from 42 students in the 2018 Fall semester and 59 students in the 2019 Fall semester to determine if the integration of information and communication devices into teaching could enhance students' motivation to learn, and if there were differences in students' motivation to learn by different teaching methods. The results of the study are described below.

Reliability Analysis

The Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich, Smith, Garcia, & McKeachie (1991) based on the social cognitive theory was used for the purpose of this research. The MSLQ was translated and modified to fit the context of this study, and was evaluated and revised by experts in related field, so that the questionnaire has some content validity. The Cronbach's alpha coefficients were greater than 0.85 for both the 2018 and 2019 academic years, indicating that the scale has good internal consistency. The reliability of the scale can be seen in Table 1.

Table 1. Reliability analysis table of the Motivation to Learn Scale

Instruction Method	Variables	Cronbach's α
Without Gamification (2018 academic year)	Pre-Test	0.851
	Post Test	0.927
Gamification (2019 academic year)	Pre-Test	0.965
	Post Test	0.957

Analysis of the differences in learning motivation before and after learning

The ability of the gamified instant response and the smart LC system to enhance students' learning motivation was investigated by comparing the mean of the paired sample t-test. It was found that, although the students' learning motivation was higher in the post-test than it had been in the pre-test, it had not reached a significant level of variance (intrinsic goal motivation t-value of -0.706, extrinsic goal motivation t-value of -1.357, task value t-value of -0.623, learning belief t-value of -0.1.475, self-efficacy t-value of -1.098, and test anxiety t-value of -0.830). The results of each component of learning motivation before and after learning are shown in Figure 4.

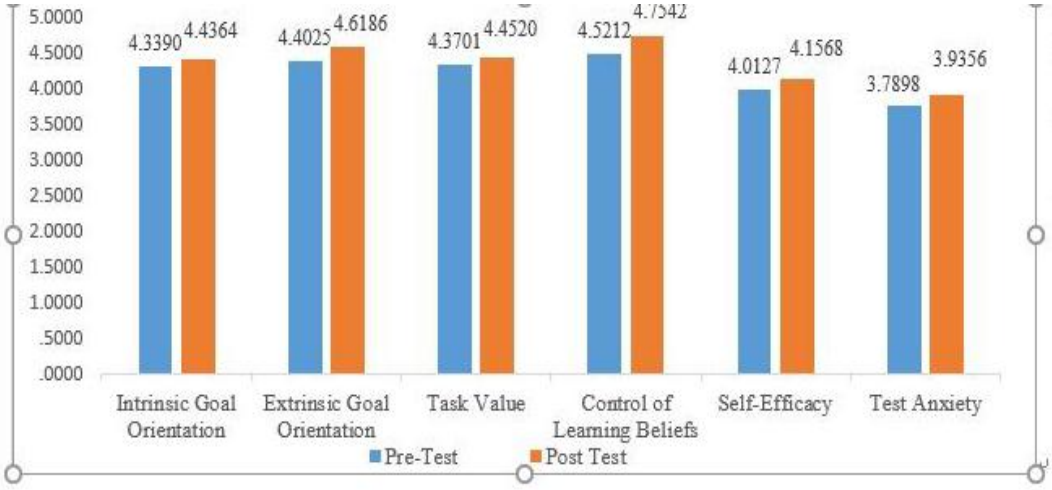

Figure 4. Differences in students' learning motivation before and after the study

Analysis of the differences in students' learning motivation by different teaching methods

After comparing the results of the independent samples of the mean method, it was found that there was no significant difference in students' learning engagement, the six components of learning motivation, and the learning effectiveness between the teaching methods of using the instant response and intelligent teaching recording system and the teaching method of adding gamified learning. The analysis of the differences in students' learning motivation by teaching methods can be seen in Table 2.

Table 2. Summary of the differences in students' motivation for learning by different teaching methods

Constructs of Learning Motivation	Instruction	Numbers	Mean	SD	*t* value
Intrinsic Goal Orientation	Without Gamification	42	4.232	0.936	-0.909
	Gamification	59	4.436	1.223	
Extrinsic Goal Orientation	Without Gamification	42	4.786	0.903	0.718
	Gamification	59	4.619	1.300	
Task Value	Without Gamification	42	4.512	0.805	0.298
	Gamification	59	4.452	1.212	
Beliefs About Control Over Learning	Without Gamification	42	4.976	0.857	1.409
	Gamification	59	4.754	1.269	
Self-Efficacy	Without Gamification	42	3.890	0.872	-1.347
	Gamification	59	4.157	1.052	
Test Anxiety	Without Gamification	42	4.267	1.081	1.500
	Gamification	59	3.936	1.102	

Note: * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

Analysis of different teaching methods used to enhance students' motivation to learn

In addition to using the interactive learning and innovative teaching center and classroom equipment, a gamified instant response and intelligent teaching and recording system were used to conduct the teaching activities. CHUMoodle was also used to publish the students' learning results so that they could keep track of their progress in real time. The students were asked to choose the teaching method that they believed could enhance their motivation to learn from the six teaching methods above in order to determine if these methods were acceptable to them. Participants are able to choose more than one of the choices provided (see Figure 5). The majority of the students believed that "CHUMoodle can view their grades in real time" would help them to learn more effectively.

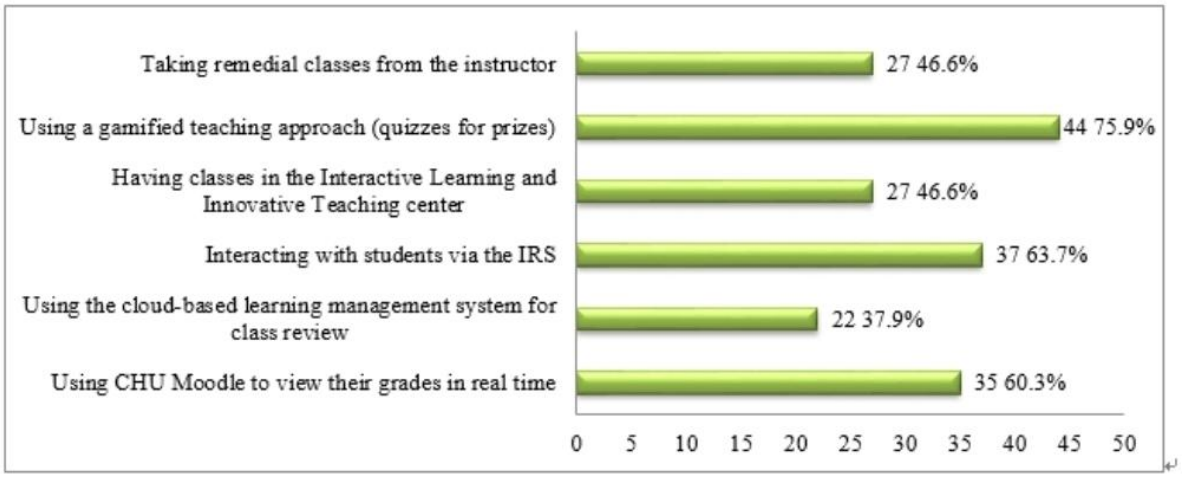

Figure 5. Statistical chart of pedagogical methods to enhance students' motivation to learn

Based on the results of the above analysis, the majority of the students believed that CHUMoodle's can help them to view their grades in real time would help them to stay motivated. More than 60% of them believed that the three teaching methods that could improve their motivation were gamified learning (i.e. quizzing for prizes), using the IRS instant response system to interact with them, and using CHUMoodle to see their grades in real time. If teachers used information and communication devices to integrate innovative interactive teaching into the curriculum, it would improve students' motivation and willingness to learn.

Student feedback

An open-ended question-and-answer format was used at the end of the course to better understand the students' motivation for using this novel approach. It was found by analyzing their responses to the questions that the game increased the students' willingness to learn, the reward motivated them to concentrate, the IRS encouraged them to speak up, the intelligent recording helped them to learn, and the innovative teaching created a win-win situation for both teachers and students.

Therefore, according to this study, the game increased students' willingness to learn, the reward made them concentrate, and the students took quizzes using the IRS instant response device. It was also said that "The quiz activity makes people discuss seriously," implying that the quiz method enables students to actively discuss their learning. The integration of a game-like reward system (e.g. quiz for gifts) not only made the course more interesting for the students, as they stated, "It was fun" and "It was very participatory and had more opportunities for practice," but it also enabled some students to "take the course seriously because of the reward" and "the reward system made more people listen to the course," indicating that the reward system enabled some students to "take the course seriously because of the reward."

In terms of the instant response system, it encouraged the students to be "more active in answering ques-

tions" and some of them remarked that "people should be more courageous in speaking up for answers." Others pointed out that "There will be a video recording, so we can go back and watch it again," and "It is good to use video recording so that people who don't know how to do it can go home and review it after class," thereby indicating that the intelligent teaching recording system used in this study enabled the students to practice after class. The majority of the students chose answers like "Because it is more active than other courses," "Because it is more interactive than other classes," "I think this is a good way to teach, because it is interactive and not one-way teaching," and "I am willing to spend time on economic learning," indicating that innovative teaching can help students to learn more effectively. In addition, they found that innovative teaching increased their motivation to learn, while also increasing their willingness to devote time to the course, resulting in a win-win situation for themselves and their teachers.

Discussion and Conclusion

Despite the lack of statistically significant results in this study, students value the use of gamified IRS and LC and would recommend it in future classes, according to perception survey data. More than 60% of students thought that gamified learning (quiz and gift), interacting with them via the IRS instant response system, and viewing their grades in real time via the school's Moodle system improved their motivation. They also believed that gamified learning increased their desire to learn, that the reward system encouraged them to focus on the course, that the IRS kept track of their class attendance encouraged them to speak up more, and that smart lecture capture aided a post-class review. Previous research suggest that gamification must respond to the inner call of the players in order to achieve deep engagement and high satisfaction (Nicholson, 2012); however, meaningful gamified IRS should not only emphasize intrinsic elements but also focus on extrinsic elements (eg. Prizes given after quizzes). Participants were given prizes (i.e. a US$3 voucher from the school bookstore) for raising their hands and correctly answering the IRS questions. Prizes for IRS-listed qizes were awarded at random during each class session. It appears that reward-based gamification may be suitable in this learning context. The findings of this study suggest that gamified IRS should take into account both intrinsic and extrinsic motivation.

One of the most advantageous features of an IRS is that it allows students to provide feedback without fear of public embarrassment. Rather than relying on the most vocal students to draw conclusions, the faculty member receives a far more accurate picture of class sentiment. Most importantly, the IRS's anonymous feature ensures that viewpoints that might not otherwise be expressed during class discussions are heard.

Students, on the other hand, expressed concern that if the clickers were timed, they would feel rushed and as if they were not understanding the material as well as the rest of the class. If clicker points were awarded based on question accuracy rather than simply attempting to answer the question, their anxiety would rise. It is recommended that instructors encourage active audience participation, allow students enough time to respond to ques-

tions, and allow time between questions for discussion.

By using lecture capture, students can overcome their fear of learning in live lectures. The recording is stored securely and captured remotely, and a link to it is created almost instantly in chronological order within the relevant unit in the learning management system and made available to students. Students can watch the recordings as many times as they want, including PowerPoint slides and movie clips, and they can choose whether to watch over a high-speed or low-speed connection. This reduction in anxiety associated with Economics education is critical, as student well-being is becoming increasingly important. As a result, the current study suggests that lecture capture could be a useful tool for creating a friendly learning environment.

In addition, the students predicted that the use of portable devices in the classroom would result in crashes and system instability, which would have a negative impact on their learning. The growing number of IRS users puts a strain on the servers, causing web service operations to slow or even stop; in particular, the COVID-19 pandemic has created extraordinary challenges in online teaching. IRS providers' platforms must be stable under high, even stressful loads in order to retain and increase the number of regular users. Furthermore, since the curriculum uses portable devices to answer questions, some students may inadvertently enter the online game mode or read communication software messages; therefore, it is essential for teachers to pay attention to students' learning status at all times.

It is concluded that this instructional approach has the potential to both increase and decrease student anxiety, and the implementation of LC and gamified IRS questions is important. While many gamification techniques based on different game mechanics have been shown to improve learning outcomes in applied contexts (Zichermann & Cunningham, 2011), educators require more rigorous empirical research to determine whether and how specific gamified intstant response systems may affect learner motivation. The institutional and cultural contexts in which this research was conducted limit the investigation's findings. When attempting to apply these methods and findings to a new context, researchers should consider the study's specific constraints, the type of gamification approach used, the type of IRS, the types of recordings of lectures, and the teachers' and learners' familiarity with the facility. Some of the study's findings may not be applicable to other disciplines or generations of students.

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