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Winning Together: Using Game-Based Response Systems to Boost Perception of Learning

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ABSTRACT

The integration of game-based techniques, Internet, and mobile phone technology in teaching has been adapted recently in classes as a Game-based Classroom Response System (GCRS). Game-based technological tools can make the learning environment more appealing for students, increase their learning perception and level of engagement. This cross-sectional study explores student perception of learning using GCRS (Kahoot) in undergraduate Information Systems courses. This study also examines the simplicity of working with GCRS, the extent to which the technology motivates student engagement, and the extent to which different features of GCRS can trigger or facilitate student participation. The effects of students' grade, gender, ethnicity, and age are examined as moderator factors on the relationships between ability, motivation, trigger, and students' perception of learning. Two groups of Business students enrolled in one general business course, Introduction of Management Information Systems (MIS101) and one upper-level course, Business Data Telecommunication (MIS140) were selected as a convenience sample. The findings suggest that the ability, motivation, and trigger capabilities of the GCRS were the most important predictors for the students' perception of learning in MIS101. Also, ethnicity, grade, and age were found to have moderator effects on the relationship between ability and motivation, and the perception of learning in the MIS140 sample.

Keywords: *Game-based classroom response system; Persuasive technology; Student engagement; Achievement gap; Pedagogy*

INTRODUCTION

Classroom Response Systems (CSR) use technology to actively engage students in activities during lectures. The advent of the smartphone has enabled substantial expansion of in class engagement technologies. Today's CSR products include a diverse range of providers, including Turning Point, Poll Everywhere, Top Hat, Socrative, Clicker, and Kahoot. Mahon (2012) defined a classroom response system in the context of technology that facilitates the use of devices by instructors and students for transmission of in class questions or problems, and aggregation of responses for immediate feedback to students. Features of game-based learning such as competitive practices, immediate feedback, and classroom monitoring are supported by newer types of CRS. While the literature has consistently found that CRS can be of value in engaging students, less is known regarding the specific circumstances in which CRS can have the largest effects. In this study we explore the use of a CRS within the context of technical classes, specifically examining technical classes within a business school. Technical education often struggles with student engagement and diversity (Schroeder et al, 2010), and as such we propose that substantial value can be found through better understanding of how technology can improve student engagement in technical classes. The purpose of this study is to address the impact of one game-based CRS (Kahoot) as a persuasive technology to enhance students' perception of their own learning experience.

BACKGROUND AND RESEARCH QUESTIONS

This study was conducted in the College of Business Administration at a large public university in Northern California, USA. As a context for the analysis, an information systems class required for all business majors was included in our assessment. The class is designed as an introduction that addresses general learning objectives without requiring perquisite knowledge of, or interest, in the technical subject matter. Most of the participants in the class have limited background or interest in information systems. Historically, there has been a lack of student interest in the course. For the purposes of our analysis this introductory information systems class will be referred to as MIS 101.

Kahoot, a multiplatform, game-based CRS (see Figure 1) has several advantages compared to its competitors, the most important being that it is free and can run in a browser without installation. Kahoot, although new to most of the participants in the study was chosen as the platform. While some of them had used Clicker or Top Hat before, almost none of them had experience with Kahoot.

Most students in today's universities have access to the Internet, cell phones, laptops, and other electronic devices. In large lecture halls, it is difficult to monitor every student's screen, so they can check email, post on social media, or watch YouTube videos. Therefore, students are easily distracted in the classroom (Rice & Bunz 2006). Monitoring student attendance and participation in large classes are not easy tasks (Lander & Stoeckel 2012). To compensate for this challenge, the main strategies for using a CRS in this class were classroom monitoring, game-based learning, conducting assessments, collecting feedback, and engaging students.

In the context of our study examining the benefits of CRS in technical education we contrast the benefits of using CRS within a general technical class targeting a non-technical student audience and a skill-based technical class targeting students pursuing a technical major. To compare MIS101 students' perception of learning through Kahoot with that of students in a Management Information Systems (MIS) technical course a second class is included in our analysis. The upper division MIS course comprises of business students majoring in information systems and will hereafter be referred to as MIS 140. This class included approximately 50 students. Data were collected in Fall 2018.

Research Questions

This study was designed to examine the impact of Kahoot as a persuasive technology on students' perception of learning. The research questions that will be addressed in this study are as follows:

1. How do game-based classroom response systems (Kahoot) as a persuasive technology affect students' perception of their learning experience?

2. Do Gender, Age, Ethnicity, and Grade have moderator effects on the relationship between ability, motivation, trigger, and students' perception of learning?

3. Are there differences in perceptions of learning between students of a general population to a technical subject compared with specialized technical student populations?

4. What are the most important factors that change students' perception of their learning experience?

Based on the Fogg behavioural model (Fogg 2009), persuasive technology such as Kahoot can change user attitudes and behaviour through persuasion and social influence. According to the model, motivation, ability, and well-timed triggers to complete tasks are three factors that could affect user's behaviour. We further explore this model in the theoretical framework section of this paper. The research hypotheses that will be tested in this study are as follows:

> H1-There is a positive relationship between Ability, Motivation, and Trigger and the student's perception of learning.
>
> H2-Gender, Age, Ethnicity, and Grade moderates the strength of relationship between ability, motivation, trigger, and the student's perception of learning.

LITERATURE REVIEW

Classroom Response System

According to Martyn (2007), CRS support some principles of game-based learning, such as competitive practices and scoreboard systems. The benefits of CRS are immediate response and display as well as data analytics for assessments and evaluations. Fies & Marshall (2006) discussed how appropriate pedagogy combined with a CRS can promote learning. Other studies such as Simpson & Oliver (2007) and Stowell & Nelson (2007) found that by creating an interactive and dynamic environment, CRS could make a class more fun and enjoyable for both students and instructors. On the other hand, Lander & Stoeckel (2012) reviewed the disadvantages of CRS. Based on their work, some of the issues that need consideration before applying a CRS in the classroom include the challenge of creating quality questions aligned with the learning objectives of the course, the potential unfamiliarity of instructors and students with the CRS interactive environment, and the potential for unstable Internet connections or disconnections.

Game-Based Learning

Our study extends to literature exploring gamification strategy and game-based learning design, and we build upon this literature in identifying our research questions. Huotari & Hamari (2012) defined gamification in the context of service enhancement and affordances for an experience that supports value creation for the user. In gamification, the game elements are applied in an unlikely context, such as education, health, management, or marketing and are designed to motivate a target audience to higher and more meaningful levels of engagement. The stimulating elements of gamification, such as immediate feedback, feeling of achievement, and challenge make it valuable in the field of education (Kapp 2012).

There are several studies that revealed the relationship between play and learning. Alexiou & Schippers (2018) in one of the more important in the context of this study, discussed how gaming technology can be blended with pedagogy and provide a unique opportunity for educators. Their study theoretically validates that game design elements and mechanics have an impact on user motivation and engagement and consequently learning. The role of player personality traits on learning outcomes is used as a moderator in the model which suggests the value of the game design process in pedagogical development. The context of our study also compares motivation and engagement effects of gaming technology across differing student groups and curriculum contexts.

The extant literature has examined the effects of gamification, in differing countries and the impact of game-based learning on student engagement and performance, cognitive success, and motivation has been discussed. Woo (2014) studied the learning motivation and related game characteristics in Taiwan applying Motivation, Volition, and Performance (MVP) theory (Keller

2008). This cultural analysis concluded that cognitive load and learning motivation simultaneously influence learning performance. In another study of game-based learning in China (Su 2016) the relationship of learning motivation, cognition load, and learning anxiety and their impact on achievement was explored. Su's findings indicate that game-based learning has a negative effect on learning anxiety and cognitive load. Similarly, learning anxiety and cognitive load have a negative effect on academic performance. Turan & Meral (2018) examined the effects of game-based and non-game-based online student response systems in Turkey and identified a relationship between student achievement, engagement, and exam anxiety levels. Khan, Ahmad, & Malik (2017) examined the impact of game-based learning on student engagement in the Pakistan Education System and found that gender had a moderating effect and that girls outperformed boys in terms of engagement and learning outcome. While our understanding of national and cultural effects of gamification is well advanced, our study seeks to expand this body of literature by examining the depth of subject matter expertise, and racial/ethnic differences on engagement outcomes, within a diverse sample within one country.

Educators around the world are trying different tools to make learning more attractive and joyful and at the same time, improve the learning effectiveness. However, many of studies have mainly emphasized the importance of pedagogy and how the game-based learning activities would apply in the course. Westera (2019) tried to improve the design methods for learning games, concluding that, that experience-based learning and learner motivation has to be taken into account when designing the games for learning.

Hamari, Koivisto & Sarsa (2014) demonstrated that gamification techniques can improve user engagement and enhance positive patterns in service use, like increasing user activity, social interaction, and productivity of actions. Because of these stimulating features, game-based response systems can be used as "persuasive technology" within the classroom environment. For changing or triggering the students' learning behaviour, they need to be motivated and at the same time be able to solve the challenges (Muntean 2011). Bicen and Kocakoyun (2018) declared that motivation is an important factor in student success and it should be considered in different learning designs such as gamification. A more effective learning process will be created if the gamified design with the element of motivation is added to learning spaces.

Wang (2015) argued that by adding gamification to Student Response System (SRS) tools, students' level of motivation and engagement will increase. Licorish, George, Owen & Daniel (2017) in their initial observations during Information Science lecture sessions showed that over a two-year period, students' excitement to actively engage in lectures and their contribution to the learning environment increased via Kahoot. GCRS tools can improve students' interaction with their peers, motivate students who are not participating in class discussion (Wang 2015) and increase class attendance (Caldwell 2007). Some students in Kiili's (2005) study indicated that when games have a user-friendly, non-distracting interface and are not very complex, they can improve learning. Papastergiou (2009) noted that if games are appealing, accessible, useful, and of high quality from the students' point of view, the impact of GCRS will be higher. On the other hand, Randel, Morris, Wetzel & Whitehill (1992) found that students' performance did not significantly change when they were using CRS in comparison with traditional learning platforms. Interestingly, Sqire (2005) determined that high performing students did not like to play games as a practical learning tool.

Dichev & Dicheva (2017) studied the level of progress towards a systematic understanding of how to use gamification in educational contexts. The study revealed that gamification is an approach for encouraging learners' motivation and engagement. Their study posited that applying gamification to motivate student is appealing, however, currently there are no practical guidelines for how to do so in an efficient manner. Furthermore, the understanding of how to gamify an activity based on the specific education context is limited. Our study seeks to address this gap by providing specific guidelines to instructors regarding the circumstances in which we found increased student engagement through gamification. Our research extends our understanding of gamification by examining the interplay between curricular and demographic variation between classes, with the Fogg model (2002) for evaluating engagement.

In summary, the extant literature regarding the use of CRS has shown mixed results. In an effort to disentangle some of the conflicting findings regarding the use of CRS, our research design allows the comparison of classes targeted towards a general student audience, with students who represent a specialized audience. While the concept of gamification may take many different forms, the factors that allow for distributed student engagement through technology provide students with additional means to interact with peers and faculty. The overarching goal then is not merely for students to have more "fun" playing games in relation to the course material, it is for students to increase their engagement with the subject matter of the course. While many devices and applications may be used to engage students in gamified activities, our research focuses on the mobile application called "Kahoot".

The Kahoot Application

Kahoot is a game-based classroom response system (GCRS) that was introduced in 2013. As Bring Your Own Device (BYOD) and technology tools have become widespread in the modern classroom, CRS have shifted from Clickers or Zappers toward GCRS, such as Kahoot or Socrative (Wang 2015). Licorish, Owen, Daniel & George (2018) described the impact of Kahoot, as a game-based response system in a strategy and governance class in New Zealand. They concluded that Kahoot can improve the quality of student learning in the classroom and has effect on classroom dynamics, engagement, motivation, and improved learning experience. In another study in Turkey, Göksün & Gürsoy (2019) observed the positive impact of Kahoot-based instructional activities on academic achievement and student engagement.

With Kahoot, students can use their cell phone or tablet to open a web browser, connect to the Kahoot game landing page, enter the game PIN, and start answering questions in a game show-like situation. The instructor is the game show host, and the students are the competitors. The questions are displayed on the classroom screen with various graphical user-interfaces, music, and time limits. The instructor can control the pace of play. If students answer a question correctly, they will be awarded points, and students' points are displayed on the screen, which can be exciting for students.

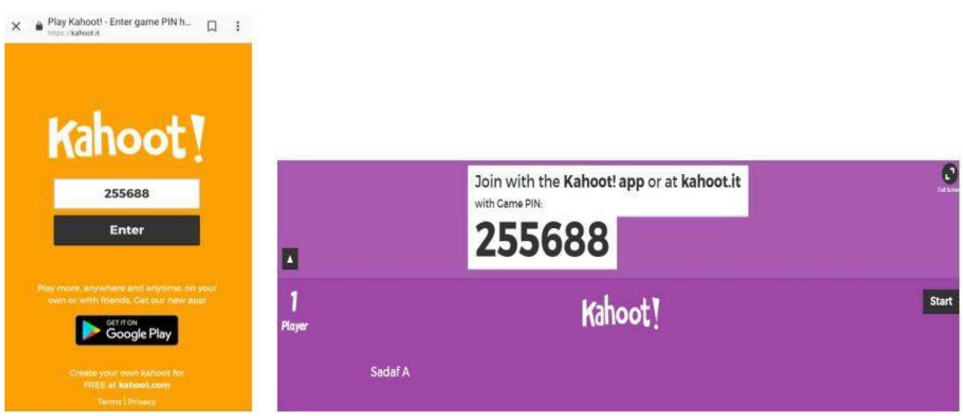

***Figure 1**:* Kahoot Application

THEORETICAL FRAMEWORK

Persuasive Technology

Fogg (2002) defined persuasive technology as technology that is designed to change user attitudes and behaviour through persuasion and social influence. Fogg (2009) explained that persuasive technologies are ubiquitous. People can experience them through the web, video games, mobile phone applications, and consumer electronic devices. Fogg introduced best practices for developing new digital experiences that can influence people and described an eight-step design process for creating successful persuasive technologies. He believed that the lack of three factors—motivation, ability, and a well-timed trigger to complete a task—may result in an unpleasant digital experience (Fogg 2009). Also, the lack of these three factors could prevent an audience from performing the target behaviour. In this study, the Fogg model was applied to the GCRS Kahoot and its student users.

Based on the factors defined in the Fogg behaviour model (FBM), in this study we used ability, motivation, and trigger as independent variables. Each of the three factors as defined in the Fogg Behavioural Model (FBM) are explained below.

In the FBM the construct of "Ability" is sometimes replaced by "Simplicity". Based on his model, if persuasion designers focus on the Simplicity of the target behaviour, they will increase its ability to be completed. Fogg (2009) defined Simplicity as "the minimally satisfying solution at the lowest cost." The elements of ability in the FBM are time, money, physical effort, brain cycles, social deviance (going against the norm), and non-routine tasks. Muntean (2011) described ability as a factor that influences the occurrence of a behaviour. A behaviour of even a highly motivated person cannot occur or change, without the ability to do so.

Regarding motivation, Fogg (2012) indicated that by motivating people, we can facilitate changes in their behaviour. During a keynote (March 2012) at the Health User Experience Design Conference he clarified that when motivation is high, you can get people to do hard things. He observed that three core motivators - sensation, anticipation, and belonging - are central to human experience. Each of these has two sides: pleasure/pain, hope/fear, and acceptance/rejection, respectively.

Motivation and ability may not be sufficient to determine a behaviour; a trigger may also need to occur (Muntean 2011). However, Fogg (2009) noted that users sometimes need an internal or external trigger, such as a ringing alarm, that functions as a signal or reminder to perform a target action at a certain moment. Fogg (2009) gave different names to triggers, such as cue, prompt, call to action, and request. There are three types of triggers described by Fogg: facilitators, signals, and sparks. In this regard designers should use the trigger type that best matches their target user's context.

METHODOLOGY

This study used a cross-sectional quantitative methodology (Creswell 2017) to investigate the extent to which differences in students' motivation and ability (Simplicity), as well as different types of triggers (Facilitators), are related to differences in students' perception of their learning experience. The research model is illustrated in Figure 2 below.

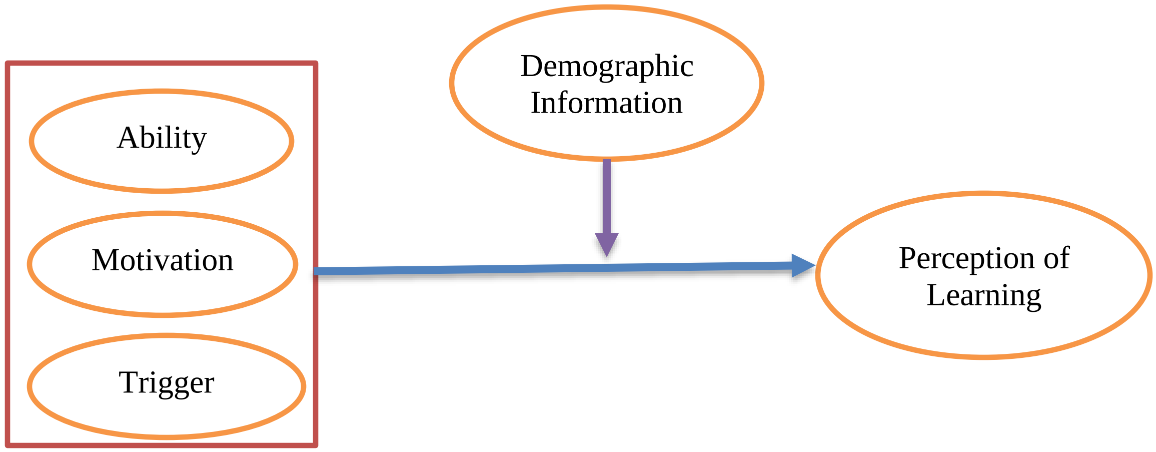

Figure 2: Research Model

Population and Sample

A convenience, non-probability-based sampling method was used in this research (Creswell 2017). The sample comprised two groups of business students who were enrolled in the Introduction to Information Systems (MIS101) course in Spring 2018 and who were enrolled in the Business Telecommunication (MIS 140) course in Fall 2018. MIS 140 is an upper-level course for the Management Information Systems concentration, while MIS 101 is the general Information Systems course that everyone in the College of Business must take. Students were enrolled at a large public university in northern California. The students in MIS 101 were business undergraduate students in different concentrations such as accounting, business, management, marketing, finance, management information systems, human resources, and entrepreneurship. These students comprised a general student population audience, compared with the MIS 140 students who represented a specialized student population.

The game strategy used in these two classes was to ask students to read the assigned chapter for each class session, then listen to the lecture in the class and take a multiple-choice quiz on Kahoot to stabilize their learning. The instructor designed three different types of Kahoot quizzes that were playing for different purposes. For sessions in which the topic was continuous with that of the previous day, a Kahoot quiz was played at the beginning of the session to review the material from the previous session. Sometimes Kahoot quizzes were played in the middle of the session, if the instructor saw that students were distracted, or s/he wished to break the lecture into several intervals. Finally, Kahoot quizzes were sometimes played at the end of the session to summarize the day's material.

Data Collection and Response Rate

The tool for collecting data in this study was an online questionnaire administered via Google Forms. There were 30 Kahoot-related questions and 11 demographic questions such as gender, ethnicity, age, working, and study hours per week. Also, students were asked to write their up-to-date grade, however, because the data was collected before the final exam and project, it was not possible to add their final grade to the survey. Since, their understanding of the course material and performance might not only reflect on their grade, they were also asked to write about their perception of their learning experience. In addition, because the survey was anonymous, it was not possible to collect their final grades at the end of the semester and relate to the survey data. The survey questions for both semesters in Spring and Fall 2018 were the same.

Students took 5-10 minutes to fill out the questionnaire. The purpose of this study and the voluntary Kahoot survey was explained in the face-to-face class by the instructor. The link to the survey was provided to students in Canvas (Student Learning Management System) and by email. Participants were informed about the subject of the study and could ask any questions regarding the research. Their participation was voluntary, but students were offered extra credit if they filled out the survey. At the end of the semester, they were offered two different types of extra credit activities and they had an option to choose between them so that there would not be pressure to submit the survey. The survey results were anonymous. Students had to email the screenshot of their submission alert to get the credit. The data collection process took two weeks for each semester. Ninety-eight percent (108) of the 110 face-to-face registered students in the two different sections of MIS101 completed the online survey. One hundred percent of the 50 students registered in the MIS140 section took the survey. None of the students that participated in the survey attend both sections of MIS 101 and MIS 140.

Descriptive Sample Information

The demographic information of participants, including their course section, gender, age, ethnicity, class level, and major, as well as their status - an international/domestic student, full-time/part-time, and their study and working hours per week, are shown in Table 1 below.

As shown in the table:

- Most of the partricipants were male (69.0%);
- Most of the students were between 19-24 years old
- The three main ethnic groups represented were Asian (32.9%), white (30.4%), and Latino (18.4%).
- About 63% of participants were in their junior year
- 95.6% of the participants were full-time students
- The greatest proportion of students were following a finance concentration; the next most popular concentration was business administration (14.6%), with accounting third (12%)
- About 41% of students worked full time and 40% study between 6-10 hours during a week

***Table 1**: Demographic Information*

Demographic	Frequency	Percentage	Demographic	Frequency	Percentage
Gender			**Section**		
Female	49	31.0%	MIS101	108	68.4%
Male	109	69.0%	MIS140	50	31.6%
Ethnicity			**Class Level**		
American Indian	2	1.9%	Freshman	2	1.9%
Asian	29	26.9%	Sophomore	1	0.9%
African American	6	5.6%	Junior	81	75%
Latino	22	20.4%	Senior	24	2.2%
Pacific Islander	2	1.9%	**International/Domestic**		
White	31	28.7%	International	3	2.8%
Other	2	1.9%	Domestic	105	97.2%
I prefer not to respond	14	13%	**Full-time Student**		
Grade up to date			Yes	102	94.4%
A	16	10.1%	No	6	5.6%
A-	21	13.3%	**Age**		
B+	26	16.5%	19-24	100	63.3%
B	33	20.9%	25-30	30	19.0%
B-	10	6.3%	31-36	9	6.5%
C+	21	13.3%	37-42	5	3.7%
C	22	13.9%	Above 42	14	9.3%
C- or lower	9	5.7%	**Studying Hours per Week**		
Working Hours per Week			1-5 hours	44	27.8%
Don't have a job	37	23.4%	6-10 hours	65	41.1%
Less than 10 hours	8	5.1%	11-15 hours	32	20.3%
11-20 hours	48	30.4%	16-20 hours	8	5.1%
More than 20 hours	65	41.1%	Above 20	9	5.7%

Instrument Validity and Reliability

The validity of the instruments was examined using content validity analysis. For the content validity analysis, after extensive literature review and consulting with experts in the field, the main scales were designed for the factors of motivation, ability, trigger, and perception of learning experience. Fogg's (2009) study also provided a comprehensive and applicable guide for developing the scales. Several items of the motivation, ability, and trigger scales were adapted and modified from Bicen & Kocakoyun (2018), and Wang (2015). All four of these scales are based on a 5-point Likert scale with five anchors (1=strongly disagree to 5=strongly agree). To validate the use of these scales we reviewed the instrument with experts in the field to establish expert validity of our measures. Two experts from the School of Business at the large-size public university in northeast California and two experts from the College of Technology in Michigan reviewed the questionnaire and gave their professional opinions.

Four different constructs were developed in this study. In the following section, each construct is explained.

Ability

The ability (simplicity) scale in this study was intended to measure how easy or simple it is for students to work with Kahoot. In another words, how the simple setup of Kahoot can increase the ability of students to work with the technology. This scale included seven items. Where students indicated that the Kahoot application is easier to setup and use, the scale values are more positive; if they found the Kahoot application difficult to set up and hard to use, the direction tends to be negative. The Cronbach's alpha for this scale was 0.761. The Ability construct included the following items:

1. It is easy to use a cell phone to play a game
2. I like playing Kahoot because it is free (no charge)
3. Kahoot friendly user-interface increases my ability to interact with it
4. It is convenient that I don't need to install Kahoot app on my device
5. It is fun to compete against other students
6. I enjoy playing Kahoot
7. Playing Kahoot increases interest in the lesson in crowded classes

Trigger

The Trigger (facilitator) scale in this study was intended to measure the Kahoot's facilitator tools to attract students to engage in the class. This scale included seven items. If facilitator tools could engage more students in the class, the scale values were more positive and if they do not, the direction tends to be negative. The reliability test for the trigger scale returned the acceptable value of 0.723. The Trigger construct included the following items:

1. I like to see myself on the Kahoot Podium at the end of the game
2. I like to put funny avatar for my Kahoot nickname
3. The colour harmony of the buttons in the application is nice
4. Kahoot point-system makes me excited for playing it
5. I think my reputation in the classroom improves with the badges I win through Kahoot

Motivation

The motivation scale in this study was intended to measure the students' motivation for using Kahoot in the classroom. This scale included six items. When students were motivated to use Kahoot, the scale values are more positive; if they were not motivated, the direction tends to be negative. The reliability test for this scale was 0.872. The motivation construct included the following items:

1. Playing Kahoot decreases my stress for taking other quizzes (such as midterm and final exam)
2. My fear of taking exams decreases by playing Kahoot in class

3. Seeing the answer of the test immediately increases my motivation to focus
4. Playing Kahoot can increase my class attendance rate
5. Each question I correctly answer improves my self-confidence
6. Applications such as Kahoot allow me to practice time-management skills

Perception of Learning

The perception of learning experience scale included seven items and was intended to measure the student's perception of their learning via the mobile-based classroom response system. The Cronbach's alpha for this scale was 0.94. The students' perception of their learning experience construct included the following items:

1. Information can be recalled more easily thanks to Kahoot
2. Use of a learning method blended with a Kahoot help me to understand the lesson better
3. Playing Kahoot improves my learning
4. Kahoot enables active learning
5. Kahoot provides permanent learning in classroom activities
6. Playing Kahoot made me think more during the class
7. Playing Kahoot makes my learning process faster and easier

DATA ANALYSIS

Multiple linear regression was used to determine the strength and direction of the relationships between the motivation, ability, and trigger scales and students' perception of their learning experiences. Multiple linear regression was used to build a model and discover the best predictors for the students' perception of the learning experience; statistically insignificant variables were not included in the model. Scale reliability was examined using Cronbach's alpha. All statistical procedures were performed using SPSS (Version 25).

RESULTS AND DISCUSSION

To answer the study research questions and test the hypotheses three different types of analyses were conducted to see if there are differences between the results for MIS140 and MIS101. Data was analysed for:

1. both sections of MIS101 together,
2. the one section of MIS140, and
3. the combination of MIS101 and MIS140.

MIS101

Multiple linear regression was used to determine the best-fit models between the dependent and independent variables. In the analysis of both sections of MIS101, the R square value of 73.4% of the observed variability in students' perception of their learning experience is explained by the three independent variables. The R value of 0.827 indicates a good correlation between the observed value of the dependent variable and the predicted value based on the regression model. The observed value of 0.734 is sufficiently large to indicate that the linear regression model predicts the data variability well. The data shown in Table 2 indicates that the coefficients for ability, motivation, and trigger are not zero ($p<0.05$); therefore, the null hypothesis is rejected and there is a positive relationship between ability, motivation, trigger and the student's perception of learning. To check the strength of the linear relationship among independent variables, the tolerance (=1/VIF) was measured. For VIF>10, the independent variable is highly correlated with another independent variable. This suggests that multicollinearity was not an issue in this model.

A key question our research addresses is whether differences were observed between demographic groups represented in our study. To accomplish this comparison we conducted multiple steps of analysis. To measure the moderator effects of gender, grade, ethnicity, and age, first their centralized (Standardized) values were examined. The standardized values of the moderator factors were saved and the interaction of these factors with the independent variables of ability, motivation, and trigger were calculated. When adding more factors, the model did not improve. Based on the adjusted R squared value, the moderator factors did not enhance the model. Students' gender, grade, ethnicity, and age do not have moderator effects or direct effects on the relationship of ability, motivation, or trigger with the perception of learning.

Table 2: *MIS 101 Sample Result*

	Hypothesis 1	**Hypothesis 2**			
		Age	**Ethnicity**	**Grade**	**Gender**
Ability	0.242*** (0.000)	0.088 (0.000)	0.090 (0.000)	0.088 (0.000)	0.092 (0.000)
Motivation	0.527*** (0.000)	0.447 (0.000)	0.481 (0.000)	0.468 (0.000)	0.474 (0.000)
Trigger	0.20** (0.006)	2.32 (0.043)	2.60 (0.122)	2.482 (0.069)	2.405 (0.051)
R^2	0.734***	0.718	0.708	0.705	0.723

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

MIS140

The results for MIS140 demonstrated differences. After running the multivariable linear regression, only the coefficients of ability and motivation were not zero (P<0.05) and statistically significant. The observed value of 0.762 is sufficiently large to indicate that the linear regression model predicts the data variability well. The results are shown in Table 3 below.

Unlike MIS101, in this upper-division course, grade, ethnicity, and age were found to have moderator effects on the relationship of ability, motivation, trigger, and the perception of learning. The adjusted R squared value upon adding the new predictors improves the model more than would be expected by chance.

The results in Table 3 below demonstrate the coefficients of ethnicity as a moderator variable. Ethnicity, age, and grade have an impact on the relationship of ability and motivation and the perception of learning. Trigger is not statistically significant.

Among the four different moderator variables, gender did not have an effect and the effect of ethnicity improves the model more than grade and age.

Table 3: *MIS 140 Sample Result*

	Hypothesis 1	Hypothesis 2			
		Age	Ethnicity	Grade	Gender
Ability	0.348*** (0.001)	0.395*** (0.000)	0.350** (0.000)	0.368** (0.004)	0.092** (0.015)
Motivation	0.560*** (0.000)	0.500** (0.001)	0.671*** (0.000)	0.608*** (0.000)	0.327 (0.084)
Trigger	0.059 (0.579)	0.107 (0.418)	0.03 (0.775)	0.042 (0.7)	0.166 (0.285)
R^2	0.762***	0.831***	0.814***	0.841***	0.810***

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

Combination of MIS101 and MIS140

In the analysis of the combination of the MIS101 and MIS140 courses, a multivariable linear regression model was built for perception of learning as a dependent variable. Based on the obtained R square value, 74.3% of the observed variability in students' perception of their learning experience is explained by the three independent variables as shown in Table 4. The coefficient for ability, motivation, and trigger are not zero, indicating that they contribute significantly to the model (p<0.05).

Table 4: *Combined MIS 140 and MIS 101 Sample Result*

	Hypothesis 1	Hypothesis 2			
		Age	Ethnicity	Grade	Gender
Ability	0.274*** (0.001)	0.287*** (0.000)	0.268*** (0.000)	0.251*** (0.000)	0.272*** (0.000)
Motivation	0.540*** (0.000)	0.508*** (0.000)	0.567*** (0.000)	0.568*** (0.000)	0.531*** (0.000)
Trigger	0.152** (0.01)	0.186** (0.003)	0.147* (0.014)	0.140* (0.018)	0.154* (0.014)
R^2	0.743***	0.757***	0.765***	0.763***	0.748***

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

The moderator effects of ethnicity, grade, and age for MIS140 as an upper-division course for students in the MIS concentration were different than their effects for MIS101 as a general course for all business students. These results suggest that students who are enrolled in the technology-based concentration may have a different perspective on the effects of Kahoot on their learning. In other words, for the specialized student population there was a positive effect on motivation, whereas for the general student population there was no effect. Based on different results for two different courses, it can be concluded that the subject (how much it is technology related) and the major of students (whether the student is enrolled in a technology related degree program) will affect the perception of their learning.

Persuasive Technology theory predicts that technology may be used as a mechanism to change perceptions and behaviours. Our research demonstrates that CRS technology may be deployed as a mechanism to improve engagement within specialized technical courses. Of potential importance the improvement was positively mediated by ethnicity, indicating that the positive effects of CRS were even more prominent within an underrepresented population within technology (Tapia 2006). The demographic makeup of our participating students, described in Table 1, highlights the diversity of participants in our study. Extant research has found that racial demographics, such as African American and Hispanics are underrepresented in technology professions (Trauth 2017). In evaluating the moderating effect of ethnicity these underrepresented racial and ethnic groups were included in the analysis. While future research regarding the characteristics of CRS that are associated with boosting engagement in the populations included in our analysis, our research suggests that CRS may be a tool to help boost engagement in underrepresented groups studying specialized technology skills.

SUMMARY OF RESULTS

Research Question 1: How do game-based classroom response systems (Kahoot) as a persuasive technology affect students' perception of their learning experience?

According to the Fogg behavioural model, lack of three factors - ability, motivation, and a well-timed trigger to complete the task - may prevent users from performing the target behaviour. In this study these three factors in relationship with the game-based classroom response system (Kahoot) were examined. The data showed that Kahoot can affect students' perception of their learning.

Research Question 2: Do Gender, Age, Ethnicity, and Grade have moderator effects on the relationship between ability, motivation, trigger, and students' perception of learning?

The moderator effects of gender, age, ethnicity, and grade on the relationship of ability, motivation, trigger, and students' perception of learning were studied. The analysis revealed a difference between the MIS 101 and MIS 140 groups of students. This result was not part of our hypothesis and the hypotheses were not supported. Based on the limitations of the study such as the sample size of MIS 101 and MIS 140, more investigation will be needed in the future. Although, there is no control on every single factor that might have effect on these two different groups, one speculation is that students who are enrolled in MIS 140 (upper-level technology-related concentration) may have different behaviour towards Kahoot (technology-based system) than MIS 101 (general course) due to their familiarity with technology.

Research Question 3: Are there differences in perceptions of learning between students of a general population to a technical subject compared with specialized technical student populations?

This study demonstrated the differences in perceptions of learning between students in a general population to a subject compared with a specialized student population. While these differences are observed in our data, further analysis may be required to identify the different factors that could have an impact on differences in learning perceptions.

Research Question 4: What are the most important factors that change students' perception of their learning experience?

The most important factors that change students' perception of their learning experience in MIS 101 were slightly different than MIS 140. All three independent factors, ability, motivation, and trigger had an impact on the students' perception of learning among MIS 101 students. However, only ability and motivation were effective on the perception of learning among MIS 140 students. Students in the technical population did not perceive the triggers included in the CRS as increasing the perception of learning. This could indicate that for technical courses the benefits of CRS may be less related to the novelty of classroom technology, and more related to the content that is provided through the CRS tool.

LIMITATIONS AND FUTURE RESEARCH

We acknowledge that this is only a preliminary study, which has several limitations that are worth considering for future studies. Using a bigger sample with a greater variety of students in different majors and courses may affect the results of this study. The number of students in MIS140 was half of the number of students in MIS101. Having an equal sample for different courses may change the result of our analysis.

The impact of the independent variables on the students' perception of their learning experience in this study may also be different among different course subjects and students who are using Kahoot. We examined the extent to which students' gender, age group, and ethnicity affect the relationships between the ability, motivation, trigger factors and the students' perception of their learning experience and found that there were differences indicating greater levels of engagement for some underrepresented populations studying in areas of technology professions. Future research could further examine how underrepresented populations perceive learning and engage in coursework through CRS as an intervention to possibly boost enrolment in technical programs. Future research could also examine the theoretical constructs associated with technology workforce development that may be influenced by CRS technologies. The influence of differences in students' levels of study and work hours per week as a moderator variable is worth examining in a future study. Certainly, there may also be different factors that affect how Kahoot impacts students' perception of their learning experience. With increasing use of technology to boost student engagement, further analysis of the boundaries of technology benefits would be of value to both teaching faculty and students.

The data for this study were collected in the in-person class. Future research could examine the effects of GCRS tools in the online/hybrid classes and identify if students perceive the technology differently. In the online mode classes, there is an option to play Kahoot by sharing the screen and students log-in to the game with their phone or tablet and submit their answer. Further research could also compare the variety of GCRS tools that are available. Finally, this study did not compare the use of GCRS tools in the classroom with the traditional learning methods. It would be worthwhile in the future to compare the learning experience perceptions of students using Kahoot in class with those of students using only traditional learning techniques.

CONTRIBUTIONS AND CONCLUSION

Our findings suggest that GCRS tools can make a difference in student engagement and motivations. Our study empirically validates the Fogg Behavioural Model and suggests that instructors can improve perceived learning by using technology in class. However, in technical classes geared towards technical students, the value of GCRS may be less related to the novelty of the technical experience, and more focused on the value of the content that is presented within the tool. While previous research has demonstrated that cultural factors contribute to the perception of gamification among students, our research further clarifies the effects of GCRS by demonstrating the difference in results between general interest and technical classes. The results are especially valuable in improving the perceived learning within technical classes. Our results also demonstrate the possibility that GCRS tools may provide one means by which to better engage populations that are currently underrepresented in technical careers. While the positive effects of GCRS have been largely recognized in the literature, our work helps to clarify the conditions by which these emerging technology tools may be successfully implemented to boost student engagement.

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