Kahoot gamified technology use to assess student performance

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***Abstract*— The ubiquitous presence of Information and Communication Technologies (ICT) in educational settings presents both positive and negative benefits for Higher Education Institutes (HEIs) around the world. While ICTs offer innovative avenues for student engagement, they can also foster off-task behaviors which can affect their academic success. This study addresses this challenge by examining the potential of the Kahoot Gamified Student Response System (GSRS) in an Information Technology course at a higher education institution in the South Pacific. Using a quasi-experimental design, the study examines the correlation between Kahoot participation and student performance metrics. The findings indicate a moderate positive correlation, suggesting that increased Kahoot participation is associated with improved academic outcomes. Overall, the study adds to the growing body of literature on gamification in education particularly from South Pacific context, demonstrating its potential to mitigate off-task technology use during lectures and laboratory classes while enhancing student engagement and performance.**

Keywords— Gamification, Student Response Systems, Kahoot, Student Performance.

I. INTRODUCTION

The demand and use of Information and Communication Technologies (ICT) such as the internet, smartphones, tablets, and laptops have become a daily lifestyle of the modern world. Higher Education Institutes (HEI) are no exceptions, as 21st-century netizens are fond of technologies and are mostly engrossed with games and off-task technology during classes [1] [2] [3] [4]. Some of the examples of off-task technology use are browsing their social media accounts, instant messaging and playing virtual games. The use of these technologies is now increasingly prevalent and has permeated all aspects of human livelihood. A study by [5] revealed that undergraduate students used their ICTs in the classroom, where two-thirds of the time was spent on off-task technology use. Compared to a study by [6] revealed 42% of students' classroom time was spent on non-academic activities on their computing devices. In particular, for HEI classes in Pacific Universities, computer labs issues a severe concern for students' indulging in non-academic classroom activities during laboratory classes in Computer Science and Information System courses. Evidence from previous studies have revealed that off-task technology uses of computing devices in the classroom are linked with negative academic outcomes, lower scores in tests [7] [8] and lower overall grade point averages [9, 10].

Moreover, studies have revealed that non-academic technology use in classrooms leads to negative effects on student's learning and leads to distraction of nearby students [11-13]. As such, turning students' behaviour to our advantage as teachers by integrating the use of technologies in classes for learning and teaching purposes while mitigating their negative effects requires exploration. As such, it is essential to investigate the integration of ICT use in the classroom through emerging gamified Student Response System (SRS) technologies to engage students, motivate participation and possibly elevate academic performance. Researchers have revealed positive experiences such as an increase in interest, motivation, classroom participation[14-16]. Additionally, few studies revealed negative experiences such as fear of losing and losing interest when too many SRS sessions are conducted [17-19]. With dearth of literature from the field of gamification from South Pacific, there is no concrete evidence that clearly demonstrate efficacy of using gamification in HEIs. As such, this study aims to bridge the gap by examining the potential of the Kahoot Gamified Student Response System (GSRS).

Furthermore, the current study investigates the relationship of participation in Kahoot games sessions during laboratory classes with students' academic performance and engagement in the laboratory assessment component of the Information Technology first-year course. Given the aim of this study, the following two research questions were derived:

RQ1: To what extent does Kahoot GSRS enhance student motivation and engagement in weekly topics of an undergraduate course?

RQ2: Is there a correlation between the frequency of Kahoot session attendance and students meeting the participation benchmarks in weekly assessments?

The remaining section of this paper outlines a literature review on mobile learning, motivation and active learning, gamification, and gamified student responses system technologies. Followed by details of research methodology, then with results and discussion. Finally, presenting

conclusion while the ending provides details on limitations and future work.

II. Background

With the imminent use of ICT in higher education, studies mainly in the area of gamification technologies to enhance student learning by focusing on student motivation, classroom dynamics, student anxiety, student perception, teacher perception have contributed considerably to the domain of gamification through the use of Kahoot GSRS [16, 20-22]. In addition, Gamification is defined as process of applying game elements to non-game contexts [23-25] . One the most common variants of gamification is through the use of third-party SRS technology tools such as Clickers, Quizizz, Quizlet, Kahoot and many more. But the most gamified version of SRS is Kahoot, which has now embraced by academics in HEI.

According to Wang and Tahir [20], various studies have been carried out on the use of Kahoot Gamified Student Response System (GSRS) and student performance worldwide. However, there is still doubts about effectiveness of using Kahoot GSRS [21]. Additionally, studies have focused on performance of students using specific assessment and compared it statistically with traditional learning [26-28]. In contrast, some studies did not get improved learning effect compared to paper quiz and other SRS [29-32] when they used Kahoot. There was no study which explored student performance with engagement with an array of assessments, as such this creates a research opportunity to be explored using predictive methods. Furthermore, to our knowledge, there has not been any study on the use of Kahoot GSRS in HEI in the South Pacific, thus creating another potential research opportunity to contribute to current literature on Kahoot GSRS from the South Pacific context.

III. Methodology

The study utilizes quasi-experimental method through the use of quantitative student performance data to explore the effectiveness of Kahoot GSRS on students' performance and participation in the first-year undergraduate course. A quasi-experiment is when randomized experiments are not useful due to practical constraints [33] and is useful for testing the causal consequences of treatments through self-selection [34]. As such Kahoot sessions were planned for natural environment like ongoing class activity. The study provides the detail analysis of student performance data of first year undergraduate course after Kahoot sessions on selected weekly topical assessments.

The University of the South Pacific (USP) is a regional multi-campus university and higher education institution collectively owned by its 12 member countries, see Figure 1. Each member country has a campus, whereas Fiji houses its main campus in Suva, with two other campuses in Lautoka and Labasa. With the emergence of flexible learning, students from regional campuses can take up courses in online and blended modes, whereas face-to-face mode courses are only delivered through the main campus. USP uses USPNet technology, which connects all campuses through a Satellite system for live video conferencing sessions with their respective course lecturers. The regional campuses students comprise 39% (12, 519) and the main campus 61% (19, 581) of the USP population [35].

A. Setting

The course chosen for this study is a first-year undergraduate course titled Communications and Information Literacy. It is a 14-week semester-based compulsory course offered through blended mode at the main campus and online mode through all regional campuses. Students registered through blended mode are required to take up mandatory weekly 2 hours laboratory support sessions, whereas online mode students are offered non-mandatory support 2 hours laboratory support sessions at their respective regional campuses. The primary aim of the course is to ensure all incoming students to degree programmes develop knowledge and competence in Information and Communications Technology (ICT) skills and Research skills [36]. The course comprises an array of assessments, formative assessments consisting of thirteen weekly topic assessments, online review quizzes and assignments, and e-portfolio activities as summative assessments. As there are no lectures in the course, therefore the weekly laboratory support sessions are an important aspect of the course where in the first hour, the tutor goes over the weekly topic with the students, and in the second hour, the students get to work on the laboratory activities. Finally, the participants for this study were students enrolled in online mode from the USP Lautoka campus.

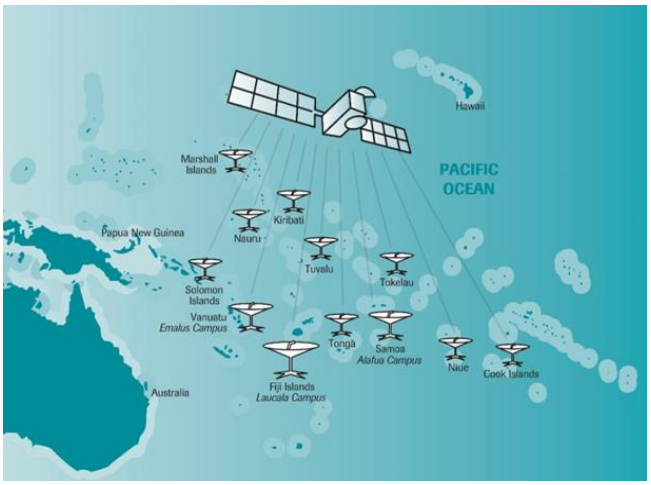

Fig. 1. Member countries of USP connected through USPNet.

B. Selected Assessment Descriptions

The assessments selected for this study were weekly topical assessments Topics 4, 5, 7, 10 and 11, as shown in Figure 2. Topics 4 and 5 were from the Information Technology (IT) of the UU100 course, while Topics 7, 8 and 9 were from Information Literacy (IL) component. The Kahoot games were in weeks 4, 5, 6, 10 and 11, respectively, during the semester. IT component enabled students to attain the required IT skills as a university student, while the IL component covered the required Research Skills. UU100 is a complete coursework course with no final exam; therefore, the weekly topics are tested in assignments and e-portfolio activities that students complete as a summative assessment.

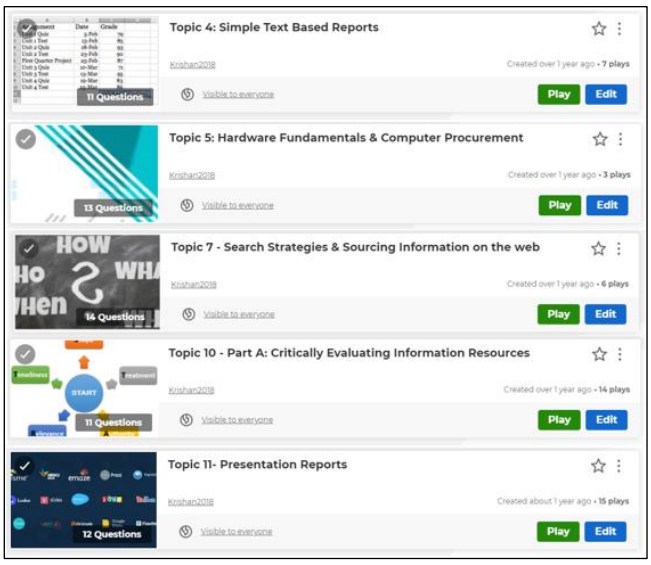

Fig. 2. Kahoot Quizzes.

C. *Kahoot GSRS quiz setup*

The online quizzes were set up using Kahoot free account, where a total of 50 participants is required per session. A premium Kahoot account enables teachers to create three different types of games: Survey – multiple choice type questions focused at collecting student opinions without assigning points; Quiz – multiple choice type and true and false type questions with a correct answer, provides points; Discussion – similar to survey but with a single question. After each question, Kahoot processes a distribution chart of solutions for teachers to review and provide feedback to students if majority of the answers were incorrect before moving to the next question. The system also provides the scoreboard of students and top five scores with student nicknames and at the end shows the podium of best players. Kahoot allows students to either use their personal devices or any computing device. For this study, since the UU100 classes were in computer labs, students were given the flexibility of using their own personal device or simply the computer in front of them. To start, the teacher projects the Kahoot quiz on projector with game pin and link with instructions to join the quiz after choosing a personal nickname. All Kahoot game sessions were quizzes only.

D. *Demographics*

The distribution of participants (N=101) in this study was by gender, minimum of eight topical assessments submitted out of thirteen required and number of Kahoot sessions attended by the participants. Majority of the participants were female (79%) and 21% of the participants were male. Followed by 33% of the participants meet the minimum passing requirement of the course and submitted more than eight topical assessments, 22% were in the category of 80% to 99% of attaining minimum eight topical assessments, while 46% were below 80% of attaining minimum eight topical assessments. Moreover, 35% of students did not participate in any Kahoot session and submitted weekly topical assessment, while 14%, 8%, 20%, 16% and 8% attempted five, four, three, two and one Kahoot sessions, respectively.

E. *Data collection and analysis*

The study focused on student performance data, the minimum eight laboratory submissions requirement of students who participated in Kahoot sessions and also submitted their weekly topical assessment. The Kahoot sessions were conducted in weeks 4, 5, 6, 10 and 11, respectively, during the semester. The attendance record of students was used as evidence to match their weekly topical assessment submissions. Table 1 shows a breakdown of the sample dataset. Passing requirements for the UU100 course is the completion of 8 out of 13 weekly topical assessments. Therefore, Table 1 highlights gender where female is coded as 1 and males as 0. Variable depicting number of Kahoot sessions is denoted by Kahoot participation, while a minimum of 8 out of 13 weekly topics is denoted by performance variable where 8 out of 13 (8/13 =100%) weekly assessment is a minimum requirement to pass the course. Each weekly laboratory assessment is worth 3.5%, comprising of lesson notes with built-in reinforcement quizzes and the assessment which is based on the topic delivered in that particular week. Students are given time after attending the non-mandatory face-to-face support session to complete their lesson notes and required assessment for the week before the deadline, which is usually on weekly Sundays. The analysis was done using IBM-SPSS version 25 with statistical analysis comprising Cronbach Alpha, Kolmogorov-Smirnov, Shapiro-Wilk, Spearman's correlation and Linear Regression tests.

IV. RESULTS

The data analysis was done using IBM SPSS version 25 with an array of statistical analyses. Following steps were used to analyze the student performance quantitative data: Step 1: Data compilation, Step 2: Normality test, Step 3: Correlation analysis, Step 4: Hypothesis testing, Step 5: Designing a Prediction Model using Linear Regression.

In Step 1, the relevant needed data, such as the number of Kahoot sessions attended by students as student participation and students meeting the minimum weekly topical assessment criteria of 8 out of 13, were compiled into Microsoft Excel. Step 2 involved normality test conducted using Kolmogorov-Smirnov and Shapiro-Wilk tests; results show that data were not normally distributed at p-value = 0.000 < 0.05, Table 2.

In Step 3, the association between two variables number of Kahoot sessions attended (Kahoot participation) and a minimum of 8 weekly assessments out of 13 (performance) completed during the semester was tested using the Spearman's correlation test. There is a moderate correlation between Kahoot participation and performance of 0.614, further proving the hypothesis developed in Step 4 to determine if these associations were significant, as highlighted in Table 3. The null hypothesis (H0) was developed to verify that there is no significant association between Kahoot participation and performance. Since the p-value = 0.000 < 0.05, the null hypothesis is rejected, thus, concluding that there is a significant association between Kahoot participation and performance.

In the last step, a Linear Regression (LR) was developed to find a model that could predict the performance variable, which is a minimum requirement to pass the course and predict a causal relationship between the Kahoot participation and performance variable. The LR modeling shows an adjusted R2 = 0.392, which indicates that 39.2% of the variance in the performance variable could be explained by

the factor Kahoot participation (see Table 4). Table 5 provides ANOVA, which indicates a significant effect of the predictor Kahoot participation on the dependent variable performance at p-value = 0.00 < 0.05, indicating that, generally, the formulated LR model statistically significantly predicts the performance variable.

Additionally, Table 6, outlines the regression test, showing a summary of a predictive factor in terms of coefficients, B, for the obtained variable from the regression analysis. The findings reveal that the variable Kahoot participation poses a significant positive effect on students' overall performance in weekly assessment submissions (i.e. p=0.000<0.05). The predictive model constructed is as follows:

$$Y = 44.284 + 12.435 * \text{Kahoot Participation} \quad (1)$$

The model indicates that for every additional unit in Kahoot Participation, we can expect performance to increase by an average of 12.435. It can also be inferred from the model that if a student has Kahoot participation equal to zero, then his/her participation according to performance variable can be at most 44.284 per cent, resulting in 3 weekly topical assessments submitted out of the required eight weekly topical assessments. The constant in the regression model is due to the fact that students who do not participate in Kahoot sessions in the course can still participate in weekly assessments.

TABLE I. KAHOOT PARTICIPATION DATASET

Participant ID	Gender	Kahoot Participation	Performance
1039	1	3	100.00
1040	1	2	84.62
1041	1	3	92.31
1042	1	3	92.31
1043	0	0	0.00
1044	1	0	100.00
1045	1	0	38.46
1046	1	3	100.00
1047	1	2	92.31
1048	1	0	7.69
1049	1	5	69.23
1050	1	3	69.23

TABLE II. TEST OF NORMALITY

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	*Df*	*Sig.*	*Statistic*	*Df*	*Sig.*
Kahoot Participation	0.213	101	0.000	0.860	101	0.000
Performance	0.222	101	0.000	0.796	101	0.000

TABLE III. CORRELATION BETWEEN VARIABLES

			Kahoot Participation	Performance
Spearman's rho	*Kahoot Participation*	Correlation Coefficient	1.000	**0.614****
		Sig. (2-tailed)	.	.000
		N	101	101
	Performance	Correlation Coefficient	**0.614****	1.000
		Sig. (2-tailed)	.000	.
		N	101	101

TABLE IV. MODEL SUMMARY

R	R-Square	Adjusted R-Square	Std. Error of the Estimate
.631[a]	.398	.392	27.757

TABLE V. ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	50410.027	1	50410.027	65.428	.0000
Residual	76275.778	99	770.462		

TABLE VI. LINEAR REGRESSION

Model	Unstandardized Coefficients		Standard Coefficients		
	B	Std. Error	Beta	t	Sig.
(constant)	44.284	4.133		10.715	.000
Kahoot Participation	12.435	1.537	.631	8.089	.000

V. DISCUSSION

The prime aim of the study was to investigate the effectiveness of using Kahoot GSRS on student participation and performance in the first-year undergraduate course in higher education in the South Pacific. This Information Technology course is a mandatory course that all incoming students are required to complete. The proposed LR model had a predictor variable called Kahoot participation, indicating the number of times a student participated in a Kahoot session. On the other hand, the dependent variable was overall student performance, i.e. meeting the minimum passing laboratory submission requirement. The Kahoot participation predictor was selected for this study, as it was considered the frequently examined factor of student performance [37-39]. In our case, the student's overall performance in the laboratory component is a formative assessment of an online course.

Based on the quantitative findings, the study demonstrates a moderate positive correlation between Kahoot participation and performance variables. This indicates that as the number of Kahoot participation increases, then the performance variable also increases, resulting in students meeting the minimum passing requirement of the Information Technology course. To increase the low Kahoot participation to moderate, the students need to attend the face-to-face sessions more, which is conducted by the respective tutor of the course. In

addition, if there is maximum Kahoot participation, then students also meet the minimum laboratory requirements of the course; ultimately, this increases student engagement in the course. As indicated earlier, the selected course was offered in an online mode, where face-to-face laboratory sessions were provided as additional non-mandatory support for all students.

Due to the geographical distribution of students enrolled in the Information Technology course at USP Lautoka campus, it is often difficult for all students to attend the non-mandatory laboratory support sessions, which can be considered as a limitation of the study. With the introduction of remote teaching at USP, the concept of Kahoot GSRS can also be embraced in online classes. This could be further explored in future studies. Additionally, 35% of students did not participate in any Kahoot sessions, while majority of the participants were female students. Otherwise, gender could have been considered as another predictor of student performance. The recent initiative of USP to provide free tablet PCs to first-year full-time students and the availability of computer laboratories for student use and Wi-Fi access at all USP campuses and centres in twelve member countries could further create more avenues of using Kahoot GSRS in online classes.

Finally, our study has contributed to the growing literature on student performance on the use of Kahoot GSRS with a variety of assessments, as shown in Figure 2. A total of five Kahoot sessions were conducted on selected weeks, considering the wear-off effect by [19]. The proposed research questions are thoroughly discussed above, where, based on the findings, it can be concluded that Kahoot sessions increase student engagement and performance in the course.

VI. Conclusion

This paper presents a simple LR predictive model illustrating the effect of using Kahoot GSRS in an Information Technology in HEI in the South Pacific. The findings revealed an insight into LR predictive model development. Considering the frequency variable (Kahoot participation) as the frequently used measure for student performance from other studies. The predictor (Kahoot participation) shows a moderate positive relationship with the dependent variable (performance), indicating as Kahoot participation increases, student performance also increases in the course. The nature of the selected course had a weekly laboratory component, which is quite similar to other STEM disciplines, such as biology, chemistry, physics, mathematics and computer science. USP is made up of twelve member countries with students from various cultural backgrounds and different learning styles. Future studies should use Kahoot in STEM disciplines to improve the proposed model. Finally, this study had several limitations; as a result, the findings cannot be generalized to other disciplines. First, the sample size was limited, with many female participants. Second, only five Kahoot sessions were conducted in selected weeks during face-to-face sessions, and future studies can consider more Kahoot sessions and extend the Kahoot sessions in remote online classes.

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