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Kahooting: Exploring the Impacts of Game-Based Learning on Bahrain Polytechnic Foundation Students in Information Technology (IT) Courses

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Abstract: Bahrain Polytechnic was established in 2008 (by Royal Decree No. 65 for the year 2008, Bahrain Polytechnic website) to supply the Bahraini economy with competent work-ready and enterprising Bahraini labour force to support the economic growth and diversification. Industries and international education institutions are consulted in designing and applying the methodology in all programmes which include Problem Based Learning and computer literacy. The development of computer literacy plays an important role in the learning process of undergraduate students in their foundation (orientation) year at the polytechnic. In order to effectively engage learners and enhance their computational skills, educators are required to explore motivational and constructive teaching methodologies that are prevalent with modern technology. This paper presents three case-studies examining the level of Bahraini learners' Information Technology in their foundation (orientation) year at Bahrain Polytechnic. The study explored the impact of Kahoot as a gamification or online game-based tool on learners' achievement and proficiency levels over four academic semesters. The intervention applied to improve learners' computational skills included a significant online game-based component. Students' academic achievement levels were investigated to identify the effectiveness of online game-based platforms in teaching Information Technology courses.

Keywords: Game-Based Learning, Foundation, Information Technology Courses, Motivation, Academic Achievement

1. INTRODUCTION

Technology is progressing continuously to transform didactic instruction into more active student-centered approaches with the opportunities that the Internet as well as computer technologies can provide. Nevertheless, educators still find it challenging to incorporate technological strategies in their teaching for a number of reasons, including: packed classrooms, reliance on didactic methods, unsuitable forms of assessments, unqualified teachers and students' lack of motivation (Teevno, 2011). In order to maintain learners' motivation and self-confidence as well as enhance students' competencies, new teaching and learning strategies need to be developed and adopted (Kangas, Siklander, Randolph, & Ruokamo, 2017). Employing Game-Based Learning is a contemporary method that can be used in Information Technology (IT) courses aiming to enhance students' skills and attributes. The aim of this paper is to identify the effectiveness of using Kahoot as a formative tool of Game-Based Learning to enhance students' achievement level in IT classes.

A. Game-based learning benefits

Technology plays a vital role in education by integrating new tools and online games to enhance the teaching and learning process (Kapp, 2012). The incorporation of Game-Based Learning in classrooms has the capacity to develop students' motivation to learn new skills (Shah & Foster, 2015). Tan, Ganapathy, and Singh (2018) stated that the learning materials, whether theoretical or practical, used in universities are hardly motivating. Thus, they exposed their undergraduate students to a Game-Based Learning platform (Kahoot), which they highlighted as having motivated and engaged their students in the learning process and fostered and reinforced practical and theoretical learning (ibid). This is in tandem with Martínez and García (2019) who implemented Malone's theory '*What makes things fun to*

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learn?' in designing educational rubrics to assess any kind of active teaching methods in diverse educational environments. Malone's (1980) intrinsic motivation instructions categorise three aspects that make learning fun. These are challenges, curiosity and fantasy. Martínez and García (2019) based their rubrics on the five most recurrent concepts in Malone's model, which are environment, design, fantasy, challenge and curiosity. They concluded that g Game-Based Learning promotes interaction among students, as well as cooperation and collaboration, while learning in an active environment. Martínez and García (2019) stressed the fact that "humans enjoy learning and are able to learn while enjoying." This supports the notion introduced by Debbita, Ganapathy and Manjet (2018) that play-based platforms are designed with a set of specific outcomes associated with the lessons' aims and objectives in any learning and teaching scenario, to motivate and offer virtual challenges to maximise the benefits that games could bring into learning. Recently, the number of teachers integrating Game-Based Learning in their teaching has increased noticeably, with the aim of entertaining students (Hwang, Wu, & Chen, 2012), changing their attitudes as well as their learning interests (Malone, 1980), improving their learning performance and academic achievement (Wang & Chen, 2010), improving their attendance, interaction with teachers (Wang, Zhu & Sætre, 2016), and their cognition and social processes (Yien, Hung, Hwang & Lin, 2011). Nevertheless, Yang (2012) found that online Game-Based Learning did not improve students' learning achievement, although it did develop their problem-solving skills.

B. Kahoot as a gaming environment

Kahoot (https://getkahoot.com/) is a game-based educational platform in which students and teachers interact and compete using theme-based games, which could be either quizzes, surveys or discussions (Debbita, Ganapathy & Manjet, 2018). However, it does not offer open-ended questions and it has a limit in both the character numbers for each question as well as the number of responses students can participate (Plump & LaRosa, 2017). The games are timed based on the teachers' preferences from 5 seconds to 120 seconds. Kahoot is counted as a response system which motivates students and engages them while playing and learning (Wang, Zhu & Sætre, 2016). Kahoot allows teachers to share their quizzes with others and even edit each other's quizzes (ibid). Learners can easily log into the game by using a numerical pin for the specified game and assigning nicknames to themselves. When the game is started by the teacher, students are expected to answer the questions correctly and faster than their peers in order to earn more points. The question and its options are viewed on the board while the students view the colours of the answers on their phones to choose from (See Figure 1). Kahoot offers a range of colours and music, which naturally motivates students and increases/strengthens their concentration (Plump & LaRosa, 2017). It provides immediate feedback which supports learners' metacognition and constructs new knowledge (ibid). Plump and LaRosa (2017) also identify many more advantages to Kahoot as listed below:

- It is free
- Easy for instructors to learn
- Simple process for students (no account registration or downloading of application)
- Compatible with smartphones, tablets, or computers
- Real-time results help instructors provide clarification when needed
- Music and colors add to student excitement and energy
- Increases student engagement
- Instructors can download, review, and save students' results
- Students can take quizzes multiple times
- Instructors can create quizzes, discussion questions, or surveys
- Instructors can adjust the response time.

2. METHODOLOGY

The purpose of this quantitative study was to investigate the effectiveness of online game-based platforms in teaching Information Technology courses and their impact on the level of students' academic achievement at the Bahrain Polytechnic. Bahrain Polytechnic was established in 2008 (by Royal Decree No. 65 for the year 2008, Bahrain Polytechnic website) to supply the Bahraini economy with competent work-ready and enterprising Bahraini labour force to support the economic growth and diversification. Industries and international education institutions are consulted in designing and applying the methodology in all programmes which include Problem Based Learning and computer literacy. Over a four-year period spread from 2015 to 2018, different batches of students, from a foundation programme at Bahrain Polytechnic, were enrolled in 15-week long IT foundation courses. These IT courses are offered every semester; therefore, the collated results for this study were accumulated on an annual basis. The IT courses comprised different learning outcomes that covered basically four modules, which are: Word Processing, PowerPoint, Spreadsheets, and online communication (Email + Internet). The learning outcomes of the courses were:

- Define common ICT terminology and describe how ICT is used throughout an organisation.

- Browse the Internet for information to meet the requirements of the module.
- Organise and manage email to enhance productivity.
- Produce a complex word-processed document to specifications.
- Enter and manipulate data using mathematical and logical formulas using standard spreadsheet functions.

3. RESEARCH DESIGN

Research design is a way or strategy to prepare the frame of the research for the purpose of obtaining valid data. In this study, the quasi-experimental design is used. According to Krishnan (2019), the most important feature that distinguishes quasi-experimental research is the absence of randomization. If randomization, or the control group is inconvenient or impractical, then the researcher can select from a range of more types of quasi-experimental designs. Miksza & Elpus (2018) stated that in education research, in particular, the use of randomization is commonly unachievable, unethical, or unacceptable for one or more of many possible reasons.

Since this study lacks the control group and randomization elements, the quasi-experimental design is adopted. There are different types of quasi-experimental research, the main types according to Cohen et al. (2010) include:

- The one-group pretest-post-test
- The non-equivalent control group design
- The time series design.

In this study, the time series type is used to observe the trend of students' achievement when introducing Kahoot as a formative assessment tool. Sinharay (2010) indicated that the time series research includes a measurement of data points on successive time points. This is being chosen according to Sinharay (2010) to understand the underlying context of data or to make predictions. On the other hand, White & Sabarwal (2014) pointed out that in time series analysis, the researchers tend to analyze changes in trends amongst outcomes before and after intervention. Therefore, for this study type, the time series research is adopted to understand the change in students' achievement in the context of gamification in education.

The control variances for this research are as follows:

- Learning outcomes: The learning outcomes that are given to the experimental groups are the same over the years. The different learning outcomes are eliminated from this study.
- Modules: Over the study period, the experimental groups were tested on the same modules.
- Teaching hours: The experimental groups took two lessons in two hours and one lesson in one hour per week.
- Kahoot quizzes: The quizzes were administered to the experimental groups based on each module taken.
- Final test: Final tests or assessments were given to the experimental groups at the end of each module.

A comparison between Kahoot quizzes results and the module test results was conducted to identify discrepancies or patterns between batches over the four-year time period.

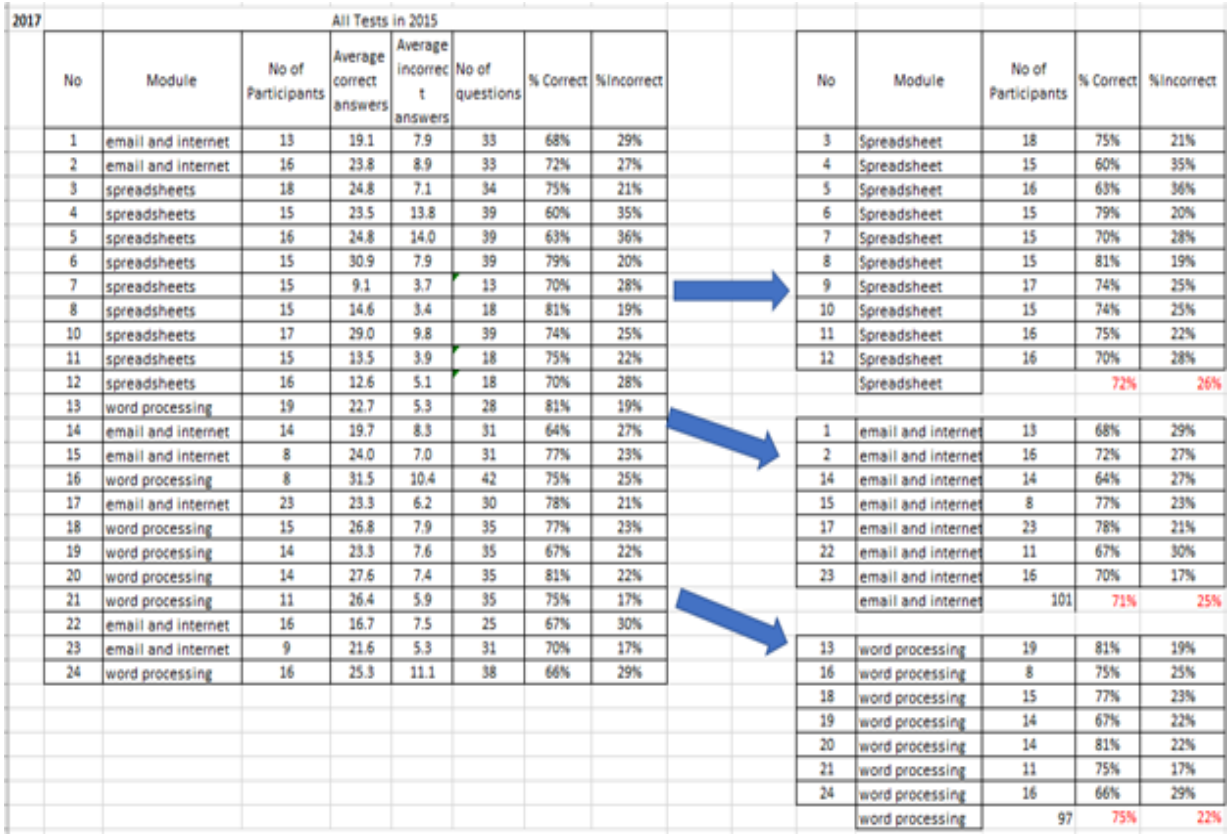
A. Sample of study

A total number of 800 students, who participated in Kahoot quizzes for IT courses during the four-year period, was the sample size of this study; while, the total number of Kahoot quizzes' attempts within the same period of time were 1489 attempts. The data was collected from both the final results of students in IT courses and from Kahoot's saved results between 2015 to 2018. A comparison between Kahoot quizzes results and IT foundation courses was conducted to identify the impact of the games on students' academic achievement over different periods of time, among the groups and cohorts of students at Bahrain Polytechnic. Each year there were different numbers of students studying IT courses in Foundation. In general, the average number of students who were registered in IT courses was 300 students per year. Moreover, all students in IT classes attended the same number of lessons every week. Consequently, the contents/material/teaching practices of the courses were coordinated to be covered similarly between course tutors. One of the agreed upon practices among tutors was the use of Kahoot quizzes, every week, as a formative assessment.

B. Data collection

The data was compiled from Kahoot quizzes results from the three main modules which were taught in IT courses. In addition to Kahoot, data was also obtained from the tests' results of each module of the IT courses. The modules are: Excel (Spreadsheet), Word Processing, and Email & Internet. The main aim of the courses was to equip students with the IT skills needed to enable them to undertake first year degree level study. Each module of the course took around 3 to 4 weeks to complete with one summative test at the end of each module. The materials for the courses were a blend of in-house resources posted

on a Virtual Learning platform (Moodle) and ICDL (International Computer Driving License) course contents. In addition, Kahoot quizzes were given to students as formative tests during the teaching time of the modules. The extracted data from Kahoot was organized and classified based on the following categories: Module, the number of participants, Average or percentage of correct/incorrect answers, the number of questions, and date of the quiz. A snapshot of a sample of the raw data collected for 2015 is shown in Figure 1.



2017 — All Tests in 2015

No	Module	No of Participants	Average correct answers	Average incorrect answers	No of questions	% Correct	%Incorrect
1	email and internet	13	19.1	7.9	33	68%	29%
2	email and internet	16	23.8	8.9	33	72%	27%
3	spreadsheets	18	24.8	7.1	34	75%	21%
4	spreadsheets	15	23.5	13.8	39	60%	35%
5	spreadsheets	16	24.8	14.0	39	63%	36%
6	spreadsheets	15	30.9	7.9	39	79%	20%
7	spreadsheets	15	9.1	3.7	13	70%	28%
8	spreadsheets	15	14.6	3.4	18	81%	19%
10	spreadsheets	17	29.0	9.8	39	74%	25%
11	spreadsheets	15	13.5	3.9	18	75%	22%
12	spreadsheets	16	12.6	5.1	18	70%	28%
13	word processing	19	22.7	5.3	28	81%	19%
14	email and internet	14	19.7	8.3	31	64%	27%
15	email and internet	8	24.0	7.0	31	77%	23%
16	word processing	8	31.5	10.4	42	75%	25%
17	email and internet	23	23.3	6.2	30	78%	21%
18	word processing	15	26.8	7.9	35	77%	23%
19	word processing	14	23.3	7.6	35	67%	22%
20	word processing	14	27.6	7.4	35	81%	22%
21	word processing	11	26.4	5.9	35	75%	17%
22	email and internet	16	16.7	7.5	25	67%	30%
23	email and internet	9	21.6	5.3	31	70%	17%
24	word processing	16	25.3	11.1	38	66%	29%

No	Module	No of Participants	% Correct	%Incorrect
3	Spreadsheet	18	75%	21%
4	Spreadsheet	15	60%	35%
5	Spreadsheet	16	63%	36%
6	Spreadsheet	15	79%	20%
7	Spreadsheet	15	70%	28%
8	Spreadsheet	15	81%	19%
9	Spreadsheet	17	74%	25%
10	Spreadsheet	15	74%	25%
11	Spreadsheet	16	75%	22%
12	Spreadsheet	16	70%	28%
	Spreadsheet		72%	26%
1	email and internet	13	68%	29%
2	email and internet	16	72%	27%
14	email and internet	14	64%	27%
15	email and internet	8	77%	23%
17	email and internet	23	78%	21%
22	email and internet	11	67%	30%
23	email and internet	16	70%	17%
	email and internet	101	71%	25%
13	word processing	19	81%	19%
16	word processing	8	75%	25%
18	word processing	15	77%	23%
19	word processing	14	67%	22%
20	word processing	14	81%	22%
21	word processing	11	75%	17%
24	word processing	16	66%	29%
	word processing	97	75%	22%

Figure 1. Sample of raw data showing extracted data from Kahoot classified and based on the appropriate categories (Spreadsheet, Email+Internet and Word Processing) for 2015.

C. Data analysis

The statistical data analysis tool Regression Analysis was used to deduce the significant relationship between the independent variable (Kahoot quizzes) and the dependent variable (students average test scores), since it depicts the strength of impact of the independent variables, which are the Kahoot quizzes on the dependent variable which are the students' average test scores.

Regression statistical analysis is a tool that can be used to predict the dependent variable when the independent variables are known.

4. FINDINGS

Secondary data which comprised of the assessment data of students who took the four different IT courses between 2015 to 2018 was extracted and complied. A sample of this raw data is shown in Figure 1. The left-hand side shows the raw form of the data extracted, which is made up of the Modules, number of participants, Average correct answers, Average incorrect answers % Correct and % incorrect. The data was then categorized into the main 3 modules as Spreadsheet (SS), Word Processing (WP) and Email+Internet (E+I). The data was analyzed using regression analysis and plot in Excel and is displayed in tables and figures.

Table 1. Summary of data indicating average scores (in percentages) obtained by students in all the four IT courses over a four-year period.

	Spreadsheet	Word Processing	Email + Internet
2015	66	60	69
2016	68	56	67
2017	72	75	71
2018	67	60	70

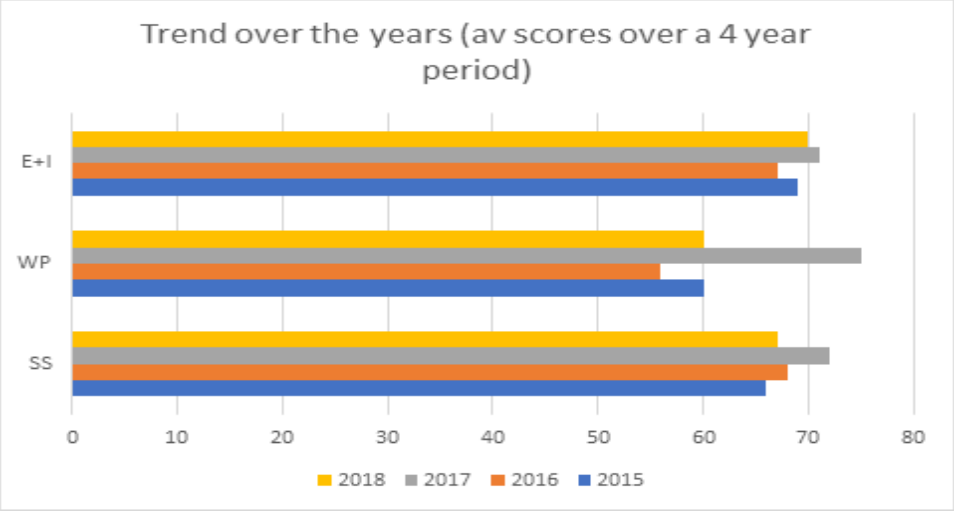


Figure 2. Comparison among students' average scores in the various IT courses over the 4 years period.

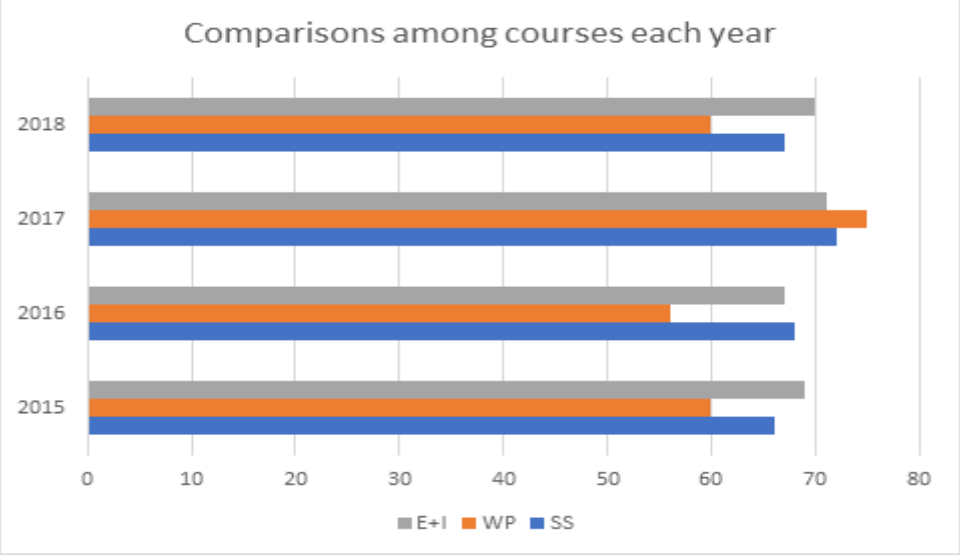


Figure 3. Comparison among the average test scores (of the IT-based courses) in each of the tests in one year.

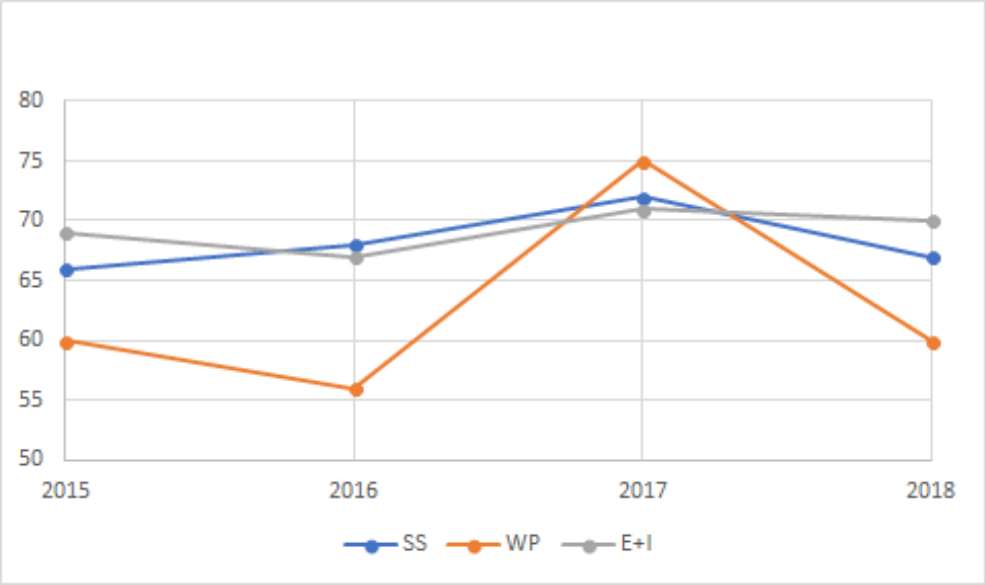


Figure 4. Trend observed in students' average test scores in the various IT courses over the four-year period

A. Students average scores in Courses

Between 2015 and 2018, students' average assessment scores that were obtained in the three courses clearly indicated a steady increase. There was evidence of significant improvement in test scores as a result of the impact of Game-Based Learning on students' learning. Analysed data from students' average scores in the three courses shows a positive impact of Game-Based Learning on students' learning.

Figure 1 shows a sturdy increase in students' average scores in Spreadsheet (SS) over the three-year period (between 2015 – 2017). However, there appeared to be a slight dip in 2018 test scores compared to the previous year (2017), which may be attributed to certain factors as discussed in the limitations section below.

In the Word Processing (WP) course, students' assessment data clearly indicated that there was generally an increase in the average test scores over the four years. However, the students' average test scores in Word Processing showed a slight dip between 2015 and 2016. In spite of that, there was a very highly significant increase in average test scores in Word Processing from 2016 to 2017, again slightly dipping in 2018.

With regards to the course in Email and Internet (E+I), students' average assessment scores indicated a steady increase over the four-year period. Between 2015 and 2016, there was however a slight dip, which may be attributed to other factors.

B. Comparisons between the average scores of each of the assessments in each year

In 2015, the average score of the Email and Internet course was the highest followed by the score for the Spreadsheet and then the Word Processing courses. In 2016, the average scores obtained were slightly higher in Spreadsheet, slightly lower in Word Processing and slightly lower in Email + Internet. In 2017, the average scores were significantly higher, especially in Word Processing. In 2018, there was a decline in Spreadsheet and Word Processing test scores except for Email + Internet test score which was the same as in the previous year.

Table 2a. Regression Statistics obtained for comparing average test scores

	Regression Statistics					
	2015-2016	**2015-2017**	**2015-2018**	**2016-2017**	**2016-2018**	**2017-2018**
Multiple R	0.917662935	0.995871	0.999321651	0.94994789	0.9313674	0.998538
R Squared	0.842105263	0.991758	0.998643761	0.90240023	0.868017	0.997079
Adjusted R Squared	-3	-3	-3	-3	-3	-3
Standard error	2.57185226	0.588348	0.238667185	2.94174202	3.420896	0.159111
Observations	1		1	1	1	1

Table 2b. Regression Statistical data (ANOVA) indicating degrees of freedom, obtained for comparing average test scores between 2 years (e.g. 2015-2016… 2017-2018).

2015-2016: ANOVA				
	df	SS	MS	F
Regression	3	35.36842105	11.78947368	5.33333333
Residual	1	6.631578947	6.631578947	
Total	4	42.00000000		
2015-2017: ANOVA				
	df	SS	MS	F
Regression	3	41.65384615	13.88461548	120.333333
Residual	1	0.346153846	0.346153846	
Total	4	42.00000000		
2015-2018: ANOVA				
	df	SS	MS	F
Regression	3	41.94303797	13.98101256	736.3333333
Residual	1	0.056962025	0.056962025	
Total	4	42.00000000		
2016-2017: ANOVA				
	df	SS	MS	F
Regression	3	80.01282051	26.67094017	9.245925933
Residual	1	8.653846154	8.653846154	
Total	4	88.66666667		
2016-2018: ANOVA				
	df	SS	MS	F
Regression	3	76.96413502	25.65471167	6.57670801
Residual	1	11.70253165	11.70253165	
Total	4	88.66666667		
2017-2018: ANOVA				
	df	SS	MS	F
Regression	3	8.641350211	2.880450070	341.333333
Residual	1	0.025316456	0.025316456	
Total	4	8.666666667		

Table 2c. Regression Statistical data indicating coefficient of variables, tStat and P-values, obtained for comparing average test scores between 2 years (e.g. 2015-2016… 207-2018).

2015-2016	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept						
X Variable 1						
X Variable 2	24.7894737	17.4750317	1.4185653	0.390905	-197.251856	246.830804
X Variable 3	0.63157895	0.27348171	2.3094011	0.260147	-2.84333561	4.10649350
2015-2017	**Coefficients**	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept						
X Variable 1						
X Variable 2	224.307692	14.5265519	15.441221	0.041171	39.7303498	408.885035
X Variable 3	-2.19230769	0.19985202	-10.969655	0.057875	-4.73166833	0.34705294
2015-2018	**Coefficients**	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept						
X Variable 1						
X Variable 2	6.39873418	2.16397394	2.9569368	0.207610	-21.0971617	33.8946301
X Variable 3	0.89240506	0.03288704	27.135463	0.023450	0.47453559	1.31027454
2016-2017	**Coefficients**	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept						
X Variable 1						
X Variable 2	284.461539	72.6327595	3.9164358	0.159150	-638.425174	1207.34825
X Variable 3	-3.03846154	0.99926008	-3.0407114	0.202272	-15.7352647	9.65834164
2016-2018	**Coefficients**	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept						
X Variable 1						
X Variable 2	-15.7151899	31.0169598	-0.5066644	0.701448	-409.823031	378.392652
X Variable 3	1.20886076	0.47138092	2.5645093	0.236697	-4.78060167	7.19832319
2017-2018	**Coefficients**	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept						
X Variable 1						
X Variable 2	99.2658228	1.44264929	68.808007	0.009252	80.9352255	117.596420
X Variable 3	-0.40506329	0.02192469	-18.475209	0.034425	-0.68364294	-0.12648364

The Regression Analysis data obtained (from Tables 2a - 2c) showed that the R squared (Coefficient of Determinant) values in all cases was closer to 1, after comparing scores. This is an indication that the predictor variables (influence of gaming) directly had an impact on the final test scores (outcome variable) of students' assessments, since Regression Analysis measures the strength or correlation between the dependent and independent variables.

5. DISCUSSION

The findings of the study show that the use of a Game-Based Learning platform (Kahoot) positively affected the participants' achievement and competency levels in the different course modules, albeit with some significant caveats.

In terms of the participants' results, the average of the test scores between 2015 and 2018 shows a development in students' IT skills. This might be due to the implementation of Game-Based Learning as a

motivating tool for achieving goals in non-entertainment contexts; as, Kahoot has made learning more fun and engaging which is supported by behavioral learning theories (Kim, Roh & Cho, 2016). These results were corroborated by (Dichev, Dicheva, Angelova & Agre, 2015; Shah & Foster, 2015; Teevno, 2011). Another reason could be derived from the real-time progress feedback that Kahoot provided as a motivating gaming tool, which increases the sense of competition amongst students and fits closely with what Plum and LaRosa (2017) experienced. The rankings, scores and competition Kahoot offers could be a factor influencing the participants' progress.

Aligned with the cognitive learning theories, students' improved learning performance levels could be due to the supplement of Kahoot as a Game-Based Learning tool, which also fits closely with McNeal's (2016) findings. Students' cognitive engagement through their observations, interactions and reactions in the game could have developed their academic aptitude and achievement levels in the course (Byun & Loh, 2015).

Despite the progress of the majority of the participants in most of the modules, this positive result is tempered to some extent by a slight dip in the Email and Internet as well as Word Processing tests between 2015 and 2016 and another one in the Spreadsheet test in 2018. This may be due to metacognitive reasons particularly skills which are self-regulatory enabling students to comprehend content subjects more thoroughly and to be more competent learners as found by Nietfeld (2019). According to Nietfeld (2019), Self-Regulated Learning (SRL) should be integrated in online game-based designs, as it incorporates emotional and motivational aspects as well as using cognitive and metacognitive aspects in controlling the learning process.

Throughout these processes in Game-Based Learning, some learners may choose to engage, disengage or do both throughout the game, which could have affected the results in the study. Another reason that could justify the decreases in some of the test scores as well as the decline in some modules' averages could be due to the variation in students' motivation.

6. LIMITATIONS OF THE STUDY

While a number of insights have been provided in this study, some limitations have been remarked that need to be addressed in future research. Firstly, the study lacks the control group, thus, a comparison between two different groups of students is not available. In fact, the comparison of information was obtained from the measurement of data points on successive time points. It is worthwhile in future research to use the experiment method where data from an experimental group is compared with data from a control group. Randomization is also not applicable since the quasi-experimental design is adopted. Secondly, students were selected based on the course subject which is in this case the IT foundation course.

This study, therefore, is limited to students in the foundation programme enrolled in the compulsory IT course. This excludes foundation students enrolled but exempted from IT due to passing the IT placement test. Finally, Kahoot quizzes were conducted based on coordination between tutors teaching the course; however, in rare occasions, some tutors may have opted to postpone or cancel a Kahoot quiz. This might have affected the overall accumulated scores for the particular cancelled quizzes. Another limitation of this study is the type of Kahoot quizzes that were used in the course which are mainly multiple-choice questions and some true and false. It is advisable to use different types of questions in further research to assess a wider range of learners' performances and differences.

7. CONCLUSIONS

The purpose of this study was to investigate the effectiveness of online game-based platforms in teaching IT courses and its impact on the level of students' achievement. In terms of the impact of Kahoot quizzes, the results of this study show that there is a strong effect of Kahoot as a Game-Based Learning tool on students' final results in the IT courses. Moreover, the difference in improvement in the three modules as well as in the batches demonstrated that Game-Based Learning has the potential to enhance students' IT level as well as to promote learning. As educators and teachers, we anticipate more innovative Game-Based Learning tools to be developed and used in order to develop students' talents, critical and problem-solving skills, engagement and motivation. Educators are urged to invest in the immense potential these tools offer in the teaching and learning process or, as Ghazal and Singh (2016) put it, 'It is time to make a smart move and join the game'.

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