

ORIGINAL RESEARCH ARTICLE

Use of the game-based learning platform KAHOOT! to facilitate learner engagement in Animal Science students

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Gamification of instructional activities is a useful approach that educators can use to promote more effective learning environments by increasing problem-solving, critical thinking and competence in the classroom. 'KAHOOT!' is an online multi-player real-time quiz game that allows students to measure learning in an engaging, immediate and entertaining manner. Lecturers can measure how well students absorb information and tailor their teaching to the next step or re-teach a concept after poor uptake by students. Seventy-two students participated in a 20-question survey about their experiences with 'KAHOOT!'. Engagement scores were correlated with assessment grades to measure if 'KAHOOT!' affected student learning and achievement. The survey was deemed statistically sound in reliability and validity testing, and a principal components analysis (PCA) revealed that the attributes were strongly linked. There was no relationship between engagement score and assessment grade, indicating that 'KAHOOT!' did not directly increase achievement. However, assessment of individual responses identified that students found it to be a positive social learning technology as it provided a fun, competitive and immersive end to a class. The benefits of fostering engagement, enjoyment and immersion within adult learning are especially important for maintaining a level of achievement within education to ensure that students are better equipped to deal with challenges and can turn a potential failure into an opportunity to improve their scholarship. The challenge provided by this study is to identify now how to measure the value of 'fun' activities in the tertiary classroom as a reinforcer for engagement, participation and learning.

Keywords: 'KAHOOT!'; gamification; online-learning tool; engagement; tertiary; learning; enjoyment

Introduction

Educational gamification is a technology-based method for increasing student engagement and motivation for learning (Simoes, Redondo, and Vilas 2003; Whitton 2007, 2011). In an educational setting, gamification has primarily been used to promote reflective learning in formative assessment tasks. Gamification has been shown to promote effective learning environments by increasing problem-solving (Whitton 2011), as well as improving critical thinking and competence in the classroom (Bicen and Kocakoyun 2017; Dellos 2015; Karaaslan and Budak 2012). In addition, it allows for reinvention and constant advances in educational technology (Moreno-Ger, Burgos, and Torrente 2009). The present study sought to assess student opinions and is the

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first to attempt the identification of a direct relationship between the use of a quiz-based game called 'KAHOOT!' and student's final grades.

Educational gamification tasks can require students to compete with each other while completing tasks related to course content. 'KAHOOT!' is a popular online multi-player real-time quiz package that allows students and lecturers to measure learning in an engaging, immediate, entertaining and anonymous manner (Bicen and Kocakoyun 2017; Cutri *et al.* 2016; 'KAHOOT!', 2015). It has been claimed that the application allows for an interaction between intrinsic motivation and external motivation; the built-in, naturally satisfying motivation to play a game to obtain an external reward such as kudos or praise from others (Özer and Bicen 2017). In comparison with a paper quiz and a physical 'clicker' arrangement, the use of 'KAHOOT!' was rated as being more engaging, exciting and competitive, with a slightly higher overall mean score within a cohort of first-year university information and technology (IT) students (Wang, Zhu, and Saetre 2016). Students reported 'satisfying' engagement across all types of gamification. They also preferred to use the platform utilising their own devices. In a similar study of 131 students enrolled in a pre-teaching course, 39% identified 'KAHOOT!' as the most preferred online platform for learning compared to other online options such as 'CLASSCRAFT©' (an adventure achievement-type game), 'CLASSDOJO©' (an animated communication and game application) and 'SOCRATIVE©' (a general quiz platform).

The built-in 'KAHOOT!' rating system allows students to 'rate' their experience of the quiz in a simple way. Cutri *et al.* (2016) measured the responses of 191 undergraduate chemistry students as 4.59/5 for 'fun', with the vast majority having a positive feeling (77%) and reported learning something (87%) while using the application. Also, 92% of the students would recommend the application. Students across three science cohorts reported the immediacy of feedback, interaction, fun and enjoyable environment as benefits of using 'KAHOOT!' but identified that Internet access is an issue for participation. Students preferred the quizzes being at the beginning or middle of the class and the reasons they gave were because of fatigue and lack of time to process the information presented in the class.

When a 'KAHOOT!' quiz is presented at the end of a lecture, students have the opportunity to gauge how well they have learnt new concepts and applied existing content and can assess and progress through their failures anonymously (Icard 2014). In addition, to promote engagement, there is a measure of competition between students as they can compare their answers with others (Cutri *et al.* 2016), and assess their progress against their previous performances (Icard 2014). Retention and consistent engagement of students across a 12-week short course increased with consistent use of 'KAHOOT!' as a formative assessment tool (Fotaris *et al.* 2016). For a comprehensive guide on the use of 'KAHOOT!' see Ren and Wagner (2016).

These gamified platforms offer some other useful features to educators. They allow lecturers to measure how well students (as a group) learn and apply information and can also be used to reinforce correct answers by the provision of points and verbal praise whereby they can move to the next learning step (Cutri *et al.* 2016). The platforms also offer detailed information for a quiz about how quickly and accurately a question was answered. Some quiz platforms offer detailed information about how quickly and accurately a question was answered by students. This information identifies material that the students have not mastered, and this affords lecturers with an opportunity to either correct at the time, reteach and direct students to look at the topics again during independent study or modify the delivery of information in future classes (Cutri *et al.* 2016; Dellos 2015).

Table 1. Learning engagement factor, with description (Ismail and Mohammad 2017; Whitton 2011).

Factor	Description	Example of survey question see note below
Challenge	The motivation to undertake the activity; Clarity as to what it involves A perception that the task is achievable	- I wanted to complete the activity - I wanted to explore all the options available to me - The goal of the activity was not clear* - I knew what I had to do to complete the activity - I felt that I could achieve the goal of the activity - I found the activity frustrating
Control	The fairness of the activity, the level of choice over types of action available in the environment, and the speed and transparency of feedback	- The types of task were too limited* - I could not tell what effect my actions had
Immersion	The extent to which the individual is absorbed in the activity	- I felt excited during the activity - I felt absorbed in the activity
Interest	The intrinsic interest of the individual in the activity or subject matter	- I found the activity boring* - The activity was aesthetically pleasing
Purpose	The perceived value of the activity for learning, whether it is seen as being worthwhile in the context of study.	- The activity was pointless* - I was given feedback at appropriate time - The activity was worthwhile

Note: Example questions from Whitton (2007, p. 153) of which correlated in her PCA analysis (note the negative phrasing marked with asterisks) covering each of the elements.

Recent studies have measured the use of ‘KAHOOT!’ in the classroom as a learning and engagement tool using a survey design centred on five aspects of engagement: challenge, control, immersion, interest and purpose of the game (Ismail and Mohammad 2017; Whitton 2011). Table 1 defines these factors (Ismail and Mohammad 2017; Whitton 2007, 2011) that are expanded from the elements of flow theory (Whitton 2011). Researchers have discussed the importance of each of these elements (e.g. Malone 1980), which has resulted in how students engage with an activity. It is not the event, but the subjective measure of the interaction by the individual with the activity. Therefore, it is necessary to conduct a survey to measure engagement from an individual’s point of view such as with the Likert-style 42-question survey iteratively developed and tested as statistically reliable and valid by Whitton (2007). Whitton’s survey was piloted by 33 adult participants playing online non-educational games and participating in a survey and face-to-face interviews about their experience for 12 participants.

The following is a description of each element and how it ‘fits’ in the measurement of engagement using gamification.

Challenge

Elements of ‘challenge’ relate to the achievement of goals that have uncertain outcomes, such as the multiple-option endings of traditional gaming (Malone

1980). The challenge of 'KAHOOT!' is to answer questions with multiple opposing answers while also competing against other students to gain the top score (Wang, Zhu, and Saetre 2016) by answering correctly and quickly (Fotaris *et al.* 2016). To ensure the 'challenge' of the game is motivating the students, the task or requirement must be perceived as achievable, requiring careful administration from the lecturer.

Control

Students are encouraged to take ownership and control of their learning by choosing to answer questions in quizzes and play games as part of participation in the class (Whitton 2007). Students should be able to reflect on their learning progress as a factor of what they have learnt (and how they learned it) to further their independent learning (Cochran and Brown 2016; Whitton 2007). 'KAHOOT!' quizzes incorporate 'contingency', 'choice' and 'power' (Malone and Lepper 1987) and provide a logical process where a question is presented, then related, relevant and intuitive options are shown which the student can select. A 'positive' affirmation is shown on their device's screen if answered correctly, or a 'commiserative' screen if the answer was incorrect – but the latter is identified as a learning opportunity (Dempsey *et al.* 2002).

Immersion

Whitton (2011) suggests that the level of concentration in the activity results in the gamer losing track of time and awareness. The fact that this could be possible using an educational game where students focus 100% on a 'KAHOOT!' quiz is a little unbelievable, but Koster (2005) suggests that the act of solving a puzzle or playing a game is inherently fun and retains attention. It is also worth considering that students of today, especially recent school leavers, have been raised with computers in nearly every household (and pocket), and therefore the immersion in, and reliance on, technology has changed the way students learn and process information (Byrne-Davis *et al.* 2015; Prensky 2001). Prensky (2001) stated that students of the gaming generation are used to fast feedback, respond to immediate gains and adapt faster to new forms of learning.

Interest

According to Whitton (2011; p. 604), interest is defined as the 'intrinsic fascination or enthralment' with a task. Malone (1980) also mentions 'curiosity', such as a sensory light or sound input or cognitive puzzle that retains our attention to learn and comprehend fully using feedback. In addition, to occur within andragogical learning, the student would find interest in the subject, and the *playing* of the game, as long as participation was relevant to the learning outcomes (Whitton 2011).

Purpose

Adult learners reported that being able to see improvement during play and perceiving being good at playing the game were important in any online game (Whitton 2011). They also reported that there was an initial barrier to participating in online games

due to difficulty in using the platform or not seeing value in the game goals, getting stuck in the game, not trusting the fairness of the game or a genuine lack of interest in games. Combating these issues would be considerably easier in 'KAHOOT!' as a quiz platform because the purpose and learning outcomes in 'practising' recently taught content is quite clear compared to the less demanding activities used by Whitton (2007, 2011).

The perception of gamification in 113 entry-level medical students as a formative assessment reduced the Whitton (2007) survey to 12 questions (Ismail and Mohammad 2017). The students responded positively to the questions relating to the use of 'KAHOOT!' as a challenge, immersive, interesting and providing purpose (Table 1). The students, however, identified that elements of control were lacking where 'KAHOOT!' failed to 'simplify complex subjects'. The limitations of this platform for teaching and reinforcing complicated course content were made apparent. One can see intuitively how this would be the case for many topics related to medicine for a platform with the capacity of a 95-character question and 60-character answers for each of four possible answers – only simple concepts would be adequately tested. Also, Ismail and Mohammad (2017) did not conduct a reliability or validity test on their shortened survey and instead used a four-point Likert scale, leading this author to speculate that the questions were perhaps too vague or oversimplified to encompass the degree of engagement they were trying to measure.

This study aimed to assess student opinions of 'KAHOOT!' in the tertiary sector. It is the first study to attempt to identify a direct relationship between the use of 'KAHOOT!' and the student's final grades. The cohort of students were Animal Science students undertaking an 'Introduction to Animal Husbandry' class. Animal Science students were presented with regular 'KAHOOT!' quizzes at the end of each class as a method of solidifying the content and to provide feedback to the student and lecturer throughout Semester 1, 2018. It was anticipated that students would react positively to the use of 'KAHOOT!' given the enthusiastic reports by others (e.g. Cutri *et al.* 2016; Fotaris *et al.* 2015, 2016; Icard 2014; Ismail and Mohammad 2017; Wang, Zhu, and Saetre 2016). The present research also sought to extend our understanding of the impact of gamified activities in a tertiary setting by examining the association between student engagement score and assessment and final grades within the class.

Method

Participants

A total of 121 students enrolled in the Level 5 Principles of Animal Husbandry course at Unitec Institute of Technology, New Zealand, in Semester 1, 2018 participated in this study. They belonged to one of four cohorts: Level 4 Certificate in Companion Animal Management – Companion Animal stream, Level 4 Certificate in Companion Animal Management - Canine Behaviour and Training stream, Level 5 New Zealand Certificate in Animal Technologies (Veterinary Nursing), and Level 5 Bachelor of Applied Science students at the beginning of the semester. Over the semester, there were 11 classes when a 'KAHOOT!' quiz was implemented. The remaining classes were practical sessions. On average, 62 students participated in each of the quizzes across the semester, gaining an average of 73.56% correct score.

The research was approved by our institution's Human Ethics Committee Protocol 2018-1016.

Measures

The participants were asked to complete a 20-question survey on their experience of using 'KAHOOT!' in the lectures according to a 7-point Likert scale, where 1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = neutral, 5 = slightly agree, 6 = agree and 7 = strongly agree. The questions related to attributes of engagement: challenge, control, immersion, interest and purpose (Table 1). The following is a list of questions that represent each engagement attribute (see Appendix). Eight items were written from a 'negative' perspective, requiring reverse coding for analysis.

Procedure

The survey was conducted at the beginning of the final scheduled teaching period and required approximately 15 min to complete. A PowerPoint slide detailing the purpose of the survey and how to answer the questions was presented to the students before data collection. The slide also indicated that if a student elected not to participate, that they fold their survey and pass to then end of the row with the rest of the surveys which were collected by the instructor.

Data analysis

Reliability and validity tests and a PCA test using the IBM Statistics package SPSS® were applied to the survey. An engagement score, reflecting how the student 'felt' about the task, was correlated with that of student's assessment scores. These consisted of assessments including a written test referring to a practical health check on an animal worth 20%, two online tests worth 30% covering health, breeding and reproduction, the final exam worth 40% covering all topics and also the overall final grade of the paper covering 100% of the course.

Results

A total of 78 students participated in the engagement survey, with 72 usable samples across the four cohorts ($N_{L4 \text{ Companion Animal Management}} = 9$, $N_{L4 \text{ Canine Behaviour and Training}} = 14$, $N_{L5 \text{ Animal Technologies (Veterinary Nursing)}} = 38$ and $N_{L5 \text{ Bachelor of Applied Science}} = 14$).

Reliability and validity of survey

The reliability and validity of the survey were assessed. The survey had good reliability, Cronbach's alpha was $\alpha = 0.794$ with all questions of the survey considered, and this increased to $\alpha = 0.848$ when items Q2, Q3, Q8 and Q9 were removed as per the PCA analysis.

As a measure of construct validity, each item was correlated with engagement score to measure how well each item predicts the final score using the Pearson product–moment correlation. The critical *r*-value for a sample of 72 is 0.231. Of the survey items, 18 questions produced a correlation coefficient of greater than the critical value, indicating that they predict engagement score and had significant values of less than 0.05. Therefore, these items were valid. Two items were not valid as they had coefficient values less than the critical correlation value: Q2 [$r_{sp}(71) = -0.054, p = 0.650$] and Q9 [$r_{sp}(71) = 0.057, p = 0.637$].

Factor analysis

A PCA test was conducted on the data to assess the adequacy of the survey to measure the perception of the effect of ‘KAHOOT!’ on learning in 72 tertiary students. The analysis revealed that 16 variables had at least one correlation coefficient greater than 0.3, indicating that these items were measuring a similar construct to another item; therefore, the items with correlations less than 0.03 were removed. The Kaiser–Meyer–Olkin (KMO) score was 0.845, and individual KMO scores were all greater than 0.7, indicating ‘middling’ to ‘meritorious’ sampling adequacy according to Kaiser (1974). Bartlett’s test of sphericity was statistically significant [$\chi^2(120) = 424.31, p < 0.001$], indicating that the data were likely factorisable into smaller components. The PCA revealed four engagement attributes that had eigenvalues greater than 1, which explained 34.7%, 11.4%, 9.2% and 7.7% of the total variance, respectively. A fifth eigenvalue value was 0.822, accounting for another 5.7% of the variance and aligned with the visual inspection of the scree plot, indicating that the five components should be retained. The five-component solution using a *varimax oblimin* rotation (as the items were correlated) provided factor interpretability with single loadings for five items (Q5, Q10, Q1, Q14 and Q16) and dual loadings for 11 items (Q1, Q4, Q6, Q7, Q11, Q12, Q15, Q17, Q18, Q19 and Q20) when the criteria excluded coefficient values set to <0.4.

A summary of the original loadings and PCA-generated loadings of questions to the engagement factor is presented in Table 2. Considering the comparison of intended and PCA loadings, the engagement factor being assessed by a particular

Table 2. The questions associated with the original question loadings, single PCA loadings and dual PCA loadings for each engagement factor are shown in separate columns.

Factor	Original question loadings	Single principal components analysis (PCA) identified loadings	Dual PCA loadings
Challenge	Q1, Q4, Q5, Q6, Q7	Q5 , Q10, Q13, Q14, Q16	Q1, Q4, Q6, Q7 , Q11, Q12, Q17, Q19, Q20
Control	Q8, Q9, Q10		Q18
Immersion	Q11, Q12, Q13	Q7	Q11, Q12 , Q15, Q20
Interest	Q14, Q15, Q16		Q15 , Q17, Q19
Purpose	Q17, Q18, Q19, Q20		Q1, Q4, Q6

Note: Questions that loaded onto the intended attribute are shown in bold.

question could be improved; eight of the questions were loaded onto their intended engagement factor, even if these were dual loadings. There were no single loadings for components of ‘control’ or ‘interest’ or ‘purpose’, suggesting that these components have direct links with other components or in how each component is interpreted by students.

Survey results

One-way analysis of variance confirmed the similarity across cohorts with no significant differences between mean scores across cohorts [F 's (3, 68) = 0.10 ≤ χ ≤ 2.53, all p 's > 0.05, η^2 = 0.05 ≤ χ ≤ 0.10]. The median selections for each question are shown in Figure 1. Generally, students selected either ‘agree’ (ordinal value 6) or ‘strongly agree’ (ordinal value 7) for the questions framed in a positive way (Q1, Q2, Q4, Q5, Q7, Q10, Q11, Q12, Q14, Q16, Q17 and Q20). Students selected ‘slightly disagree’ (ordinal value 3), ‘disagree’ (ordinal value 2) and ‘strongly disagree’ (ordinal value 1) for questions that are framed in a negative way (Q3, Q6, Q8, Q13, Q15, Q18 and Q19) and ‘neutral’ for a single question, Q9. The interquartile ranges were wider for the negatively framed questions, extending up to two ordinal values above and below the median, whereas for the positively framed questions the interquartile range was typically one ordinal value below the median. The difference between positively and negatively framed questions is likely due to the large proportion of students selecting ‘strongly agree’ for positively framed questions Q1, Q7, Q10 and Q14.

Although, students appeared to perceive ‘KAHOOT!’ as a positive experience in the classroom, with most students selecting positive answers for individual items, there were no significant correlations between assessment grades and engagement score when Q2, Q3, Q8 and Q9 were removed as per the PCA (r_p 's = 0.094 ≤ χ ≤ 0.134, all p 's > 0.05). The absence of a relationship between assessment grades and engagement score indicates that the survey as a whole did not provide a measure of engagement; however, the single question items do provide invaluable insights into positive student perception of the gamification tool. The comments given by

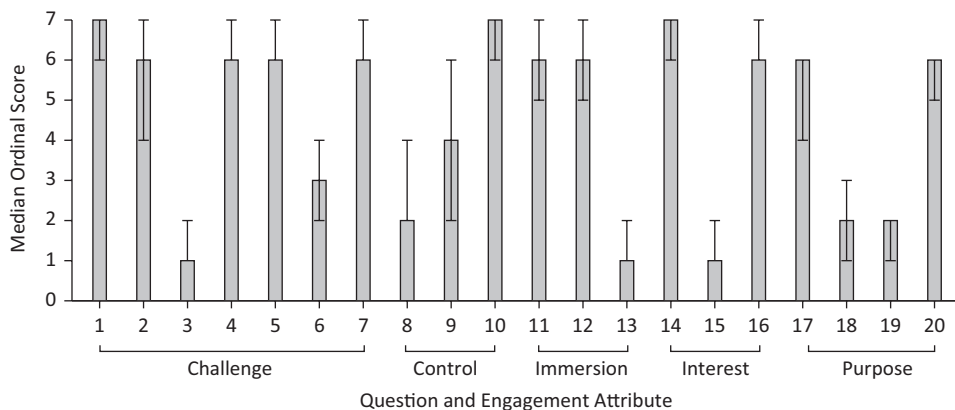


Figure 1. Median ordinal score (1–7) for each question related to each engagement attribute for the Kahoot! survey across cohorts. The error bars are the interquartile ranges.

the students about the use of ‘KAHOOT!’ in their class confirm that assessment. Out of the 29 responses, 26 were positive, and the quizzes were considered fun and a highlight of the class. Students also indicated that it helped solidify learning, pay attention, and it functioned as a reward or to break up the class and compete with their friends. Two comments were negative, with one suggesting that they found the format stressful, and one comment was neutral, suggesting questions should be available after the quiz (Table 3).

Table 3. Each comment provided by a student is given.

Comment
All cool, fun, only bummer is don't have a smart phone
<i>Better for facts than concepts; often too fast, speed of answering affects which is stressful</i>
Do it more often
Great way to learn!
<i>I don't like Kahoot :(</i>
I enjoyed the opportunity to beat my friends in Kahoot! and test my knowledge and understanding
I find Kahoot really fun, it allows me to acknowledge what I've learnt and focus on what I got wrong
I love it :)
I love the Kahoot quizzes. It's fun and engaging and I like to test what I have learnt
I really enjoy it :)
If I know there is Kahoot I pay more attention in class as I want to win – it adds fun to learning – other classes should do this, Anatomy would be great for Kahoot :)
It definitely made me pay more attention and I quite like the ones that were almost a trick question – made me pause and think harder!
It is a fun way to get students engaged in the class
It is nice to break up sometimes monotonous lectures with something fun like Kahoot :)
It is something that I look forward to in every class because it is a fun way to absorb what has been taught
It was a fun, engaging way of learning even if I didn't know the answer I still learnt the gaps in my knowledge
It was fun and thanks for the crunchie bar :)
It's a great way to test knowledge and we then know what we need to improve on. It's fun while it tests our knowledge – I love it :)
It's fun! It was used last year in Biology as well and it helps to retain information
It's one of the highlights of the class. It feels like a small reward for sitting through a 2 h lecture
Kahoot is fun and helps left brain people with learning
Kahoot is life
Kahoot! is a great way to engage in learning and very useful for myself as it helps with my dyslexic brain.
*Leave answers in the app for later reference if applicable
Love it!
Love it!
Love Kahoot
Love Kahoot!!!
Loved it

Note: Those comments classified as negative are presented in italics, and an asterisk accompanies those that are classified as neutral.

Discussion

The purpose of this study was to assess the engagement of students to the quiz-based platform game 'KAHOOT!' as a method of formative self-assessment and to enhance the learning experience through gamification. In terms of the former, there was no correlation between the summative assessment grades of the Animal Science course and the engagement score generated by the 20-question survey; therefore; it cannot be concluded that the use of 'KAHOOT!' will result in higher grades for students. Considering the former, however, it is clear from the responses to the individual questions in the survey and the comments given by the students that they, like many of their peers, found the use of 'KAHOOT!' to be fun, engaging and a motivating tool that helped maintain their attention during class (Q12, Figure 1) while also having a positive effect on their understanding of the material (Q7 and Q8, Figure 1). To finish the class with a fun, entertaining and relevant activity which encompassed a bit of self- and class competition (Q11 and Q14, Figure 1) ended the class on a high note that gave the students a goal for their independent work (Q17 and Q20, Figure 1). Future investigation into the use of 'KAHOOT!' in the tertiary classroom could look at the impact of game-play on course retention, use of other educational resources, or if learning is improved in a group of students using 'KAHOOT!' compared to those without access to gameplay. Of particular interest is whether the timing of the quiz, at the beginning or middle (e.g. Cutri *et al.* 2016), or the end of class as utilized in this study provides greater engagement or mastery of the course content.

Whitton (2011) made the point that adult learners need to be inherently interested in the topic and also should understand the value in the use of gamification in their learning. It seems that at least for the students in the current study, their engagement with the material via 'KAHOOT!' was enough to reinforce attention, provide an aspect of fun and healthy competition linked to the information and identify areas for further examination, if it did not necessarily make a measurable advance on their final grade. Reinforcing 'enjoyment' in learning is not a factor considered in the literature specifically as it is expected to be inherent; however, considering the identification of learned helplessness (e.g. Davis and McPartland 2012; Fotaris *et al.* 2015; Mark 1983) in students, tools to maintain and increase positive feelings about learning are the missing pieces of adult education.

The survey was considered to be reliable with a Cronbach's alpha value of 0.848 when items Q2, Q3, Q8 and Q9 were removed as suggested by the PCA analysis. The PCA revealed the adequacy of the modified survey to measure the perception of the effect of 'KAHOOT!' on learning. With both these measures and the PCA, 16 questions would remain for future use to measure engagement using a gamification tool such as 'KAHOOT!'. In the future, the test-retest method of confirming reliability and validity would be used to measure the engagement of 'KAHOOT!' over time and across different courses. Gamification would likely prove to be useful for courses where attendance and retention are low.

Traditionally, surveys are designed so that certain questions load onto one specific dimension of the survey. For example, in the present study, Q1–Q7 were designed to measure the 'challenge' attribute, Q8–Q10 the 'control' attribute, Q11–Q13 the 'immersion' attribute, Q14–Q16 the 'interest' attribute and Q17–Q20 the 'purpose' attribute (Tables 1 and 3). The results of the factor analysis, however, indicated that only questions of the 'challenge' attribute (Q1, Q5, Q4, Q6 and Q7) and the

'immersion' attribute (Q7) loaded reliably onto this attribute and all but one loaded onto two attributes. It seems that the components of engagement associated with 'KAHOOT!' are strongly linked indicated by the dual loadings (Table 3). It is evident that the students perceive the use of gameplay to be 'challenging' as the primary engagement tool as most of the questions loaded onto this attribute. The attributes of 'immersion', 'interest' and 'purpose' appear to be less important. The attribute of 'control' appears to be the least important to the students probably due to the overall purpose of using the tool from the lecturers' perspective.

Implementation of gamified learning needs to consider a limitation raised elsewhere (Ismail and Muhammad 2017) that while these activities may promote engagement and reinforce learning of basic concepts, more thought needs to be given to their use if the intention is to encourage the application of that knowledge. In contrast, the implementation of gameplay in the context of this study was a short, formative activity provided at the end of the lecture to reinforce attention in class and end on a 'high note' rather than a formative assessment used in the middle of the class (e.g. Cutri *et al.* 2016). Therefore, it is not surprising that students do not consider the features of 'control' (Table 1), based on fairness, level of choice or the speed and transparency of feedback within the gameplay, as important. The features of the more usual constructive-formative testing may have been overwhelmed by the 'game-like' social element of shared achievement or commiseration with classmates over correct and incorrect answers, or perhaps by the use of bright colours and music, that is 'KAHOOT!', compared to a summative test preparation activity completed independently of class time that is devoid of attention-grabbing visual effect.

Quiz platforms such as 'KAHOOT!' would not function as an engagement and learning tool without merging of some attributes, particularly that of 'interest' and 'immersion', and possibly that of 'challenge' and 'control' or 'purpose' and 'interest'. One could argue that it would be difficult to be *immersed* in an activity without being *interested* in it – especially within a lecture environment that provides no other stimuli of which to attend (except ignoring the class or leaving) to a visually and auditorily stimulating game. The multi-attentional composite that is a game, even one that is quiz-based such as 'KAHOOT!', predicts multiple loadings on dimensions. While the relationship between assessment grade and engagement score was not conclusive, it was clear that students responded well to gameplay.

In the future, the clarity of the questions in the current survey could be improved to ensure that dual loadings are not spurious and are in fact a real effect. Therefore, in the next iteration of the quiz, students would be asked to attend to a single construct within each question rather than the compounds identified in the current quiz. For example, in Q16 it was asked whether the students found KAHOOT! to be *visually appealing* and *exciting*. Double-barrelled questions would be more effective if they were split into two questions to harness student perception of single outcomes. It was apparent that the Animal Science students in the present study were engaged with the game, content and identification of gaps in their learning. The engagement of the students with the game, however, did not automatically translate to an improvement in their final grade as evidenced by the poor correlations between assessment and engagement score. It might be that the 75-odd students who most likely attended and participated in most classes would have achieved the same grade regardless of gameplay. Hakulinen and Auvinen (2014) found that high-achieving students were not motivated by the reinforcement of 'badges', earned by achieving a particular goal

as reinforcer, whereas students who responded positively to earning a badge were also high achievers and intrinsically and extrinsically motivated by gameplay.

In conclusion, to engage students in their learning by providing a fun, competitive and reinforcing end to a class using gameplay is a positive social learning strategy. Implementation of the tool is simple, aesthetically pleasing and inclusive as well as being anonymous for self- and class assessment of student learning. To demonstrate that gamification of the classroom improves student learning outcomes would require more controlled research designs where separate cohorts of students are compared learning the same course content but with and without the gamified element and is a research objective for the future. While the present study has not provided evidence that this tool is associated with higher grades in assessments that should not, however, deter lecturers considering incorporating 'KAHOOT!' quizzes or other device-enabled games for tertiary students in their classes, the benefits of fostering engagement, enjoyment and immersion within adult learning are all essential for encouraging and reinforcing independent scholarship and are generally well received by students.

References

- Bicen, H. & Kocakoyun, S. (2017) 'Educational Technology: Current Issues', World Journal on Educational Technology, vol. 9, no. 1, pp. 18–23. Retrieved from <http://dergipark.org.tr/itej/issue/39211/461500>
- Byrne-Davis, L., *et al.*, (2015) 'Just-in-time research: A call to arms for research into mobile technologies in higher education', Research in Learning Technology, vol. 23, pp. 1–10. doi: 10.1136/bmj.326.7384.328
- Cochran, C. & Brown, S. (2016) 'Andragogy and the Adult Learner'. In Flores, K.A., Kirstein, K. D., Schieber, C. E., & Olswang, S. G. (Eds). Supporting the Success of Adult and Online Students. Washington, USA: CreateSpace Independent Publishing Platform, pp. 73–84
- Cutri, R. P. E., *et al.*, (2016) 'Kahoot, a new and cheap way to get classroom-response instead of using clickers'. In *ASEE's 123rd Annual Conference & Exposition*, New Orleans, LA. #14649. June 26-29, 2016. Retrieved from <https://www.asee.org/public/conferences/64/papers/14649/view>
- Davis, M. H. & McPartland, J. M. (2012) 'High school reform and student engagement', in Christenson, S. L., Reschly, A. L., and Wylie, C. (eds) Handbook of Research on Student Engagement. New York: Springer, pp. 515–539.
- Dellos, R. (2015) "'KAHOOT!' A digital game resource for learning', International Journal of Instructional Technology and Distance Learning, vol. 12 no. 4, pp. 49–52. Retrieved from http://www.itdl.org/Journal/Apr_15/Apr15.pdf
- Dempsey, J. V., Haynes, L. L., Lucassen, B. A. and Casey, M. S. (2002) 'Forty simple computer games and what they could mean to educators', Simulation & Gaming: An Interdisciplinary Journal, vol. 33, pp. 157–168. Retrieved from www.savie.ca/SAGE/Articles/100013_013-Dempsey-2002.pdf
- Fotaris, P., Mastoras, T., Leinfellner, R. and Yasmine, R. (2015) From hiscore to high marks: Empirical study of teaching programming through gamification. In *Proceedings of the 9th European Conference on Games Based Learning ECGBL 2015*, Steinkjer, Norway, 8-9 October 2015. Available from: <http://eprints.uwe.ac.uk/28599>
- Hakulinen, L. & Auvinen, T. (2014) 'The effect of gamification on students with different achievement goal orientations'. In The Conference on Learning and Teaching in Computing and Engineering (LaTiCE) Proceedings, Kuching, Malaysia in April 2014. doi: 10.1109/LaTiCE.2014.10

- Icard, B. (2014) 'Educational technology best practices', *International Journal of Instructional Technology & Distance Learning*, vol. 11, no. 3, pp. 37–42. Retrieved from http://www.itdl.org/Journal/Mar_14/Mar14.pdf
- Ismail, M. A.-A. & Mohammad, J. A.-M. (2017) 'Kahoot: A Promising Tool for Formative Assessment in Medical Education', *Education in Medicine Journal*, vol. 9, no. 2, pp. 19–26. doi: 10.21315/eimj2017.9.2.2
- KAHOOT! (2015) '*KAHOOT!* is One of the World's Fastest Growing Learning Brands'. Accessed at <https://support.kahoot.com/hc/en-us/categories/115000091647-About-Kahoot>
- Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, 39, 31–36. doi: 10.1007/BF02291575
- Karaaslan, I. A. & Budak, L. (2012) 'Research on the use of mobile phone features by university students and its impact on their communication practices in everyday life.' *Journal of Yasar University*, vol. 26, pp. 4548–4525.
- Koster, R. (2005) *A theory of fun for game design*. Scottsdale, AZ: Paraglyph Press.
- Malone, T.W. (1980) '*What makes things fun to learn? A study of intrinsically motivating computer games*', Technical report, Xerox Palo Alto Research Center, Palo Alto, California.
- Malone, T. & Lepper (1987). Making Learning Fun: A Taxonomy of Intrinsic Motivations for Learning. In Snow, R. & Farr, M. J. (Eds), *Aptitude, Learning, and Instruction Volume 3: Conative and Affective Process Analyses*. Hillsdale, NJ. (pp 223-253).
- Mark, S. F. (1983) 'To succeed or not to succeed: A critical review of issues in learned helplessness.', *Contemporary Educational Psychology*, 8, pp. 1–19. doi: 16/0361-476X(83)90030-9
- Moreno-Ger, P., Burgos, D. & Torrente, J. (2009) 'Digital games in eLearning environments: Current uses and emerging trends.', *Simulation & Gaming: An Interdisciplinary Journal*, vol. 40, pp. 669–687. doi: 10.1177/1046878109340294
- Özer, H. H. & Bicen, H. (2017) 'The Effect of Gamified Learning Environment on Student Success', *International Journal of Scientific Study*, vol. 5, no. 8, pp. 108–113. doi: 10.1108/IJILT-02-2017-0009
- Prensky, M. (2001) *Digital Game-Based Learning*. New York: McGraw Hill.
- Ren, C. & Wagner, J. (2016) "KAHOOT!", *The Electronic Journal for English as a Second Language* August, vol. 20, no. 2, pp. 1–10. Retrieved from <http://www.tesl-ej.org/pdf/ej78/m1.pdf>
- Simoes, J., Redondo, R. D. & Vilas, A. F. (2003) 'A social gamification framework for a K-6 learning platform.', *Computers in Human Behavior*, vol. 2, pp 345–353. doi: 10.1016/j.chb.2012.06.007
- Wang, A. I., Zhu, M. & Saetre, R. (2016) 'The effect of digitizing and gamifying quizzing in classrooms', In *Proceedings of the 10th European Conference on Games Based Learning*, Paisley, UK, pp. 729–737. Available at: <https://brage.bibsys.no/xmlui/handle/11250/2426374>
- Whitton, N. (2007) An investigation into the potential of collaborative computer game-based learning in higher education. Napier University, Edinburgh, Scotland.
- Whitton, N. (2011) 'Game engagement theory and adult learning', *Simulation & Gaming: An Interdisciplinary Journal*, vol. 42, no. 5, pp. 596–609. doi: 10.1177/1046878110378587

Appendix

Kahoot Survey 2018

Challenge

- Q1. I want to participate in the 'KAHOOT!' activities.
- *Q2. I do not care if I win, only that I attempt the 'KAHOOT!' Quiz.
- *Q3. I find the technology of 'KAHOOT!' difficult to use.
- Q4. I participate in the 'KAHOOT!' quizzes because I want to measure my own learning.
- Q5. The 'KAHOOT!' quizzes challenge me in a positive way.
- *Q6. I find the 'KAHOOT!' quizzes difficult.
- Q7. I had all the information to complete the 'KAHOOT!' quizzes successfully.

Control

- *Q8. I find the choices in the 'KAHOOT!' questions too limited to help my learning.
- Q9. I complete the 'KAHOOT!' quizzes because they are anonymous
- Q10. I wish 'KAHOOT!' was used in my other classes.

Immersion

- Q11. I enjoy trying to beat my classmates in the 'KAHOOT!' on a regular basis.
- Q12. Knowing there will be a 'KAHOOT!' quiz helps me pay attention in the class.
- *Q13. I do not enjoy the 'KAHOOT!' quizzes.

Interest

- Q14. 'KAHOOT!' is fun and I enjoy trying to get the correct answer.
- *Q15. If I answer a question incorrectly, I do not finish the 'KAHOOT!' quiz.
- Q16. 'KAHOOT!' is visually appealing and exciting.

Purpose

- Q17. I use 'KAHOOT!' to direct future learning and what I need to study.
- *Q18. 'KAHOOT!' doesn't help me measure my learning.
- *Q19. I don't think that 'KAHOOT!' helps me understand concepts in Animal Husbandry.
- Q20. 'KAHOOT!' gives me context and the opportunity to apply new information.