An enhanced learning approach for increasing student engagement, motivation and learning using gamification in blended teaching

Pushpendra Kumar Rajput*

Department of Cybernetics,
School of Computer Science,
University of Petroleum & Energy Studies (UPES),
Dehradun 248007, Uttarakhand, India
Email: pushpendra@ddn.upes.ac.in
*Corresponding author

Kiran Kumar Ravulakollu

School of Computer Science,
University of Petroleum & Energy Studies (UPES),
Dehradun 248007, Uttarakhand, India
Email: kkravulakollu@ddn.upes.ac.in

Shailey Singhal

Department of Chemistry,
School of Engineering,
University of Petroleum & Energy Studies (UPES),
Dehradun 248007, Uttarakhand, India
Email: shailey@ddn.upes.ac.in

Abstract: Modern education has allowed the growth of independent learning in all varieties of student communities. At times, student involvement in the learning process of a given course ceases to exist as it reaches the end. The objective of this research is to deploy gamification as a tool for increasing student engagement, motivation and thereby to observe the growth of their learning. The study explores the possibilities of dimensions in the form of game design elements. These elements an instructor can deploy in the teaching-learning process. Quantitative and qualitative analysis performed on two batches of students for successive two terms shows a significant improvement in terms of engagement, motivation and student learning.

Keywords: learning; gamification; student engagement; blended teaching.

Reference to this paper should be made as follows: Rajput, P.K., Ravulakollu, K.K. and Singhal, S. (2022) 'An enhanced learning approach for increasing student engagement, motivation and learning using gamification in blended teaching', *Int. J. Technology Enhanced Learning*, Vol. 14, No. 1, pp.17–36.

Biographical notes: Pushpendra Kumar Rajput is an Assistant Professor in the Department of Cybernetics, School of Computer Science at the University of Petroleum and Energy Studies, Dehradun, UK, India. He received her BTech degree in Information Technology from Uttar Pradesh Technical University, Lucknow, UP, India and MTech degree in Computer Science & Engineering from Dr. B.R. Ambedkar NIT, Jalandhar, Punjab, India. Currently, he is pursuing the PhD degree in Computer Science & Engineering, from Dr. B.R. Ambedkar NIT, Jalandhar, Punjab, India.

Kiran Kumar Ravulakollu has been an Enthusiastic Person with varied knowledge skills. He graduated in Technology from Jawaharlal Nehru Technological University from the domain of Computer Science & Engineering. Later, he pursued his research fellowship and Doctoral degree (PhD) from University of Sunderland, UK in the domain of neural robotics. He is working with University of Petroleum & Energy Studies, India as Associate Professor in the School of Computer Science. His research interests included to a larger scope of technologies such as multimodal behaviour modelling, ambient intelligence, machine learning and neural networks.

Shailey Singhal is a Professor in the Department of Chemistry, University of Petroleum & Energy Studies, Dehradun. She received her PD degree in 2003 from CCS University, Meerut on Organometallic Compounds. She is working in potential areas of biogas and catalysis. She has been the Coordinator of Biogas Development & Training Centre, Dehradun established by Ministry of New & Renewable Energy, New Delhi. She has contributed towards the society by imparting trainings and arranging awareness camps for the residents of rural areas of Uttarakhand for the promotion and usage of biogas as a source of alternate fuel. She is heading a Govt. initiative, National Service Scheme (NSS) at UPES.

1 Introduction

The traditional education system demands classical teaching approaches and assessment methods in a schematic and structured orthodox way for all learners and educators. However, the modern generation of learners is comparatively less orthodox due to various reasons associated with the accessibility of technology, information and resources. The cognitive level of pedagogy learners is very sensitive due to the reachability of diversions. This sensitiveness at times has helped the strongly motivated learners to excel, while discouraged for other categories (Kirschner and Karpinski, 2010).

When it comes to blended mode of learning, learners should be at least moderately motivated and enthusiastic to learn. Educators do practice various methods of pedagogy teaching and assessment for increasing student engagement. Of the various engagement approaches gamification appears to be a most connected tool for modern pedagogy learners due to their association in sports, video/online games, digital equipment usage, etc. (Molnár, 2016).

In higher education, students are distracting from their studies because of several factors. These factors may include working part-time in any form while studying, spending a lot of time on the internet; playing games or the use of social sites, and diversified students from different backgrounds and capabilities. Owing all these factors,

educators adopted the way for content delivery according to the students' needs for this technological and internet era. Online courses, digital learning, online discussion boards, competitive coding portals are the result of making today's students comfortable in their own style of learning (Cheong et al., 2013).

When it comes to blended learning where instructors are making use of classroom teaching as well as e-learning tools for instruction delivery, student engagement and motivation become a great challenge. Flipped classrooms and MOOCs are few examples in which content delivery is done online. In such scenarios, instructor roles switch from traditional content delivery to supervise and lead a discussion. Owing the distributed availability of resources, it makes participants experience more engaging and rewarding.

Gamification makes use of the game in non-game contexts. It affects the way of behaving for any advisable action. Gamification has been proved an effective tool in many industries including education (Nah et al., 2013; Bourgonjon et al., 2010; Bustard et al., 2011; Connolly et al. 2012). However, gamification applies to any type of task or process. Gamification makes use of game-like activity that increases user's interest and engagement (Muntean, 2011). In academics, it also obtains student's motivation towards their learning. However, to achieve this objective we need to maintain a balance between tasks and exercises while designing game elements to incorporate gamification (Squire, 2008; Coyne, 2003). Motivation is an intrinsic characteristic of a game. Providing information on demands compensates one's abilities and further reduces frustration and getting bored (Whitton, 2007).

This study focuses on the usage of gamification in blended courses. The study analyses student perspectives on game elements added to their course content delivery and course assessment. The goal of the research is to gauge student engagement with such pursuit and the impression on their motivation and learning. In the study an experiment has been carried out where the same instructor included gamification in the same subject but for a different batch of students. We analysed the collected data from experiment to get our findings of student engagement, motivation and impact on their learning. To gauge the learning of students with gamification affect students' grades are considered.

2 Background

2.1 Overview

A. Engagement: Engagement comprises emotional, cognitive and behavioural factors of an individual. Student engagement is a degree of involvement and interest in their learning environment. It leads the educational research towards comprehending, expressing and guessing student behaviour in the learning environment (Axelson and Flick, 2010). However, fruitful engagement is offering opportunities for learning and development. It also helps students to develop a feeling about their professors, peers and institutions (Trowler, 2010). A good instructional design strategy can increase student engagement. Developed instructions should include relevant, real and interdisciplinary content. The inclusion of technology creates interest among learners, as they are more interactive with such tools and platforms (Joosten, 2010; Carini et al., 2006). Transparent and collaborating learning among peers and students and professors motivate learners to take part in learning activities (Parsons and

Taylor, 2011). In higher education, a learning culture makes students more engaged. In a learning culture, teachers are learning with students where achievement comes later whereas learning and engagement first (Kahu, 2013). Self-confidence, flexibility to work autonomously, active and collaborative learning, challenging learning experiences, institutional culture, getting support, availability and adaptive learning environment are the factors, which improve student engagement in an academic.

B. *Motivation*: Motivation is an important factor that makes students excited and engaged in their learning. The motivation towards any activity either comes due to internal factors like curiosity to know about a field, interest in the area of study or due to some external rewards (Cialdella et. al., 2002; Ciampa, 2014). As motivation leads to spending more time and effort in the content, it is very important in the success of any student. The individual who needs extrinsic motivation should be considered in instructional design (Keller, 1983). Gamification is an important approach that increases extrinsic motivation by providing some rewards in the form of a game element (Garris et al., 2002). Motivation defines the learning style of a student. Often, intrinsically motivated students always willing to take part in a complex and more challenging task. These are deep learners. Another category of students based on their motivation is bulimic learners. These are extrinsically motivated generally by rewards. They react in any competitive activity where they can prove themselves as best. Some students are often motivated by a fear of failure. They are not interested in deep learning and generally avoid it. In the design of instructions, an instructor is expected to keep all the groups in mind and selects learning activity to target every individual (Keller and Suzuki, 2004).

2.2 Blended learning

However, face-to-face classroom teaching strategy had been the most effective approach in the past. Students are benefitted as becoming more organised, focused, attentive, on task and academically more productive. All these characteristics are inherited from face-to-face interaction bound within a managed classroom by the instructor. When it comes to face-to-face classroom management, an instructor can address student behaviour immediately; investigate before jumping to a conclusion, can interact individually and can involve students in personality development. 21st century student's interest is not in large lecture halls, they do not want to bind themselves in a traditional way of learning. Their demands are towards engagement in dialogue, working independently or in groups on projects, walking on the self-paced manner, getting or providing feedback timely. These requirements lead the teaching-learning process from traditional teacher-centred teaching methods to new learner-centred teaching methods (Wickramsinghe, 2016).

Online education offers flexibility to non-traditional students. The method considers different levels of learners. They are not worrying about missing classes or lecture notes. Thus, it provides a self-paced asynchronous way of learning. It also encourages students to ask more questions especially to those who hesitate to ask questions in the classroom. Online education affected not only in content delivery but demonstrated a fair evaluation and assessment as it reduces any face-to-face interaction between instructors and students. It provides a larger scope of collaborative work not barring students from the

same class (Huang, 1997). However, in the online teaching method, an instructor is not able to motivate students to some extent. The reason behind it is not to able to get the emotions of learners. Sometimes online engagement does not reflect qualitative engagement in spite of getting just the numbers. In online teaching, a professor can take action only after getting feedback from students. It is lacking in terms of immediacy. While in face-to-face classroom teaching, an instructor can adjust his/her course based on a class discussion or arguments made by students. When it comes to the Instructor point of view one major challenge in online courses is time spent on preparing the course and dedicating per student. The time requires are proportional to the number of students enrolled in the course. This is mainly due to time consumption in communication with students. Lack of communication may affect negatively the students (Cavanaugh, 2005).

Face-to-face classroom methods put forward the immediacy benefit for making students motivated, focused and academically more productive, while online teaching methodology focuses on today's student's demands of flexibility, availability, and engagement with the use of technology. Keeping all these factors in mind and taking advantage of both the approaches a hybrid approach is suggested by many academic researchers. This mode of the hybrid approach is called 'blended learning' where some part of content delivery and assessment will be done in face-to-face classroom mode, and another part will be in online mode. Blended learning demonstrates many properties like accessibility, pedagogical effectiveness and course interaction. The research shows that the blended learning approach increases student-teacher interaction that further leads to an overall upgrade in student engagement and learning (Aycock et al., 2018; Garnham and Kaleta, 2006; Dziuban and Moskal, 2018). The research also supports that student satisfaction is more in blended mode comparatively to either face-to-face classroom or fully online course (Means et al., 2009).

2.3 Game design elements

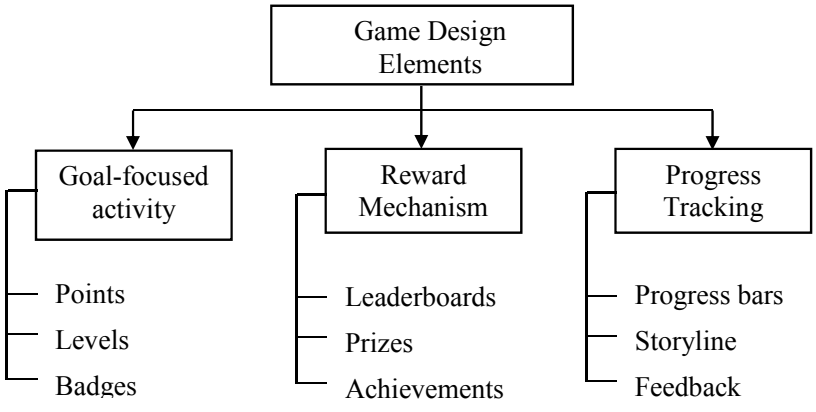
To incorporate gamification in any context there is a need to pick a suitable design element (Deterding et al., 2011). In education, many design elements are used to embed gamification in a course. These elements are broadly classified into three categories (Dickey, 2005) as shown in Figure 1.

1) *Goal focused activity:* The activity that going to be considered should primarily be aimed towards the achievement of a goal. However, from the instructor's point of view, it is necessary to justify the correlation and establish clear and valid criteria on quantitative and qualitative aspects of goal achievement.

2) *Reward mechanism:* Every activity that is considered as part of the gamification should have quantifiable reward criteria. The reward award mechanism should not only indicate the rewarding achievement but also the extent of achievement by differentiating between high low and medium performers.

3) *Progress tracking:* At times gamification is a continuous mechanism that allows learners to pass through various phases of assessment. The gamification should allow both learner and instructor to reflect the progress by giving timely and valid feedback with the help of constructive criticism.

Figure 1 Game design elements for education



2.4 Gamification in education

Gamification makes use of game elements in a non-game activity. The purpose is to encourage the user to involve in the activity. With the same objective, many researchers and studies show that gamification in education increases learners engagement, participation, enjoyment, motivation, performance, productive learning experience and sense of achievements (De Freitas and De Freitas, 2013; Brewer et al., 2013; Eleftheria et al., 2013; Gibson et al., 2013; Barata et al., 2013; Todor and Pitică, 2013).

Cristina Ioana Muntean explored how gamification is applicable in online content. A content suitable game design element can progressively achieve more focus on learners, for example, a learner should get special bonuses for any complex task or exercise (Bourgonjon et al., 2010). Rovai et al. (2007) represented a comparative study and shows that engagement levels of learners with low-intrinsic motivation are lower in the case of online learning. Gamification, adding some gaming elements can improve the motivation level of unmotivated learners and further their learning experience. In online content, one advantage of gamification is an association of computers or mobile devices.

In blended or fully online courses, Learning Management Systems (LMS) are playing an important role. The LMS has become an ideal platform for implementing game design elements. Most of the LMSes have all the features required to implement gamification like tracking learner's progress, resource sharing and tool for collaboration. Sometimes peer ratings can be utilised as points earned for a leaderboard activity or a prize or badge can be given based on the highest rating (Prensky, 2001). It may encourage learners to get more rating that is possible with more contribution and participation, increases engagement. In face-to-face classroom teaching, gamification motivates students to attend the classes and be attentive in class that reduces disruption that arises due to technology use. These characteristics of gamification serve towards the main objective of blended learning.

However, at the time, of course, design, an instructor has to decide about gamification of a learning activity and how often gaming activity should be included in the course. An instructor has to focus on the following areas before deciding gamification of an activity:

- Requirement and cause of motivation
- Identification of behaviour to encourage or discourage
- Gamify activity with some specific goals
- Gamification should not be used in format assessment
- Create a balance between intrinsic motivated and non-motivated learners
- Rewards should be desirable by the learners.

3 Approach

The experiment is performed on undergraduate students in a higher education institution. The course has two semesters in a year. The study took two consecutive semesters for collecting findings. In the first semester, instruction has been designed without making any use of gamification and in the second semester, gaming activities are introduced. Two different batches of computer engineering students participated in the study. The study utilises self-reported data only. To achieve uniformity in instructions delivery same instructor has been assigned. The main objective of the study is to find the significance of gamification to improve motivation, engagement and learning. All the courses included in the study follow blended learning mode, in which students attend two face-to-face classroom lectures, one laboratory session per week. Students are also engaged in online content, discussion and completing assignments in Blackboard (Learning Management System used by UPES).

The study analyses data that supports learner's engagement, motivation and learning towards achievement. Data that shows learners' engagement is collected from LMS in the form of number of views, time spent in online content, downloads, timely submission of assignment and attempt for tests used for formal assessment. For motivation, data has been taken from forum discussion, participation in class and feedback is taken from students. To justify student learning experience authors considered final grades, projects quality submitted and learning experience shared by students.

In the context of gamification, we added goal-focused activity points for learners based on time spent in online activity as well as participation in face-to-face classroom and progress tracking activity in the form of feedback. These two activities included in Blackboard (University LMS). Badges based game element has been added into these educational activities. After the completion of each activity an individual is awarded with some badges. To keep students motivated number of badges collected have been considered as the part of final grade evaluation. The purpose of adding this game element is making students engaged with course content.

We also added one reward design element in the form of a leaderboard. The objective is to continuously motivating students to revise past course materials. The activity is scheduled in face-to-face sessions to motivate students and making active involvement of the instructor. The activity is planned on a mobile application 'Kahoot!'. Figure 2 shows two different screen students utilise during the game. After each question, an updated leaderboard is shown to users as shown in Figure 6. The tool provides analytics about

each question and students' flow of answering the questions. Sample question analytics is shown in Figures 3 and 4. Figure 5 demonstrates the flow of answering for the top 10 leaders.

Figure 2 User layouts

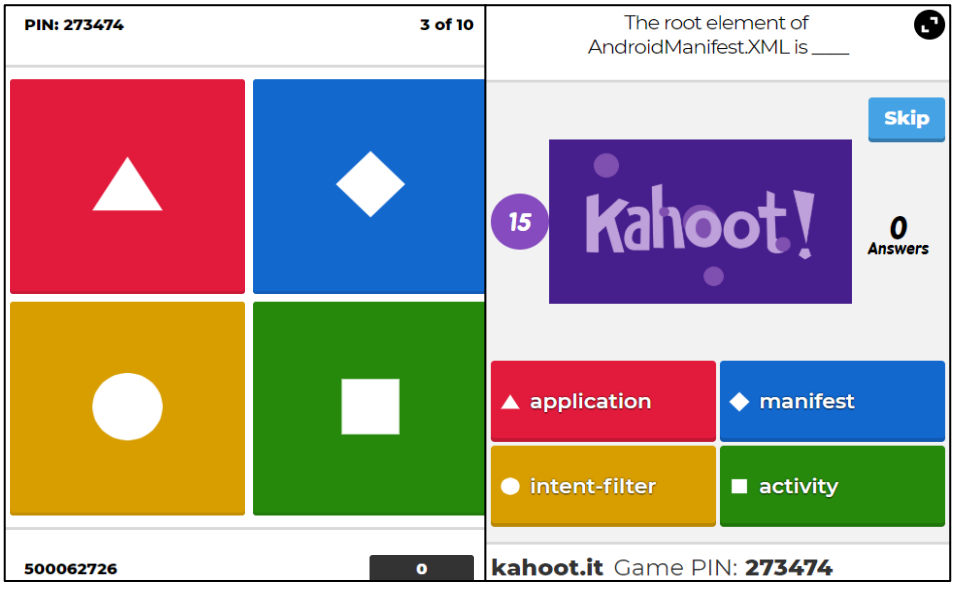


Figure 3 Correct-incorrect answer ratio for a question

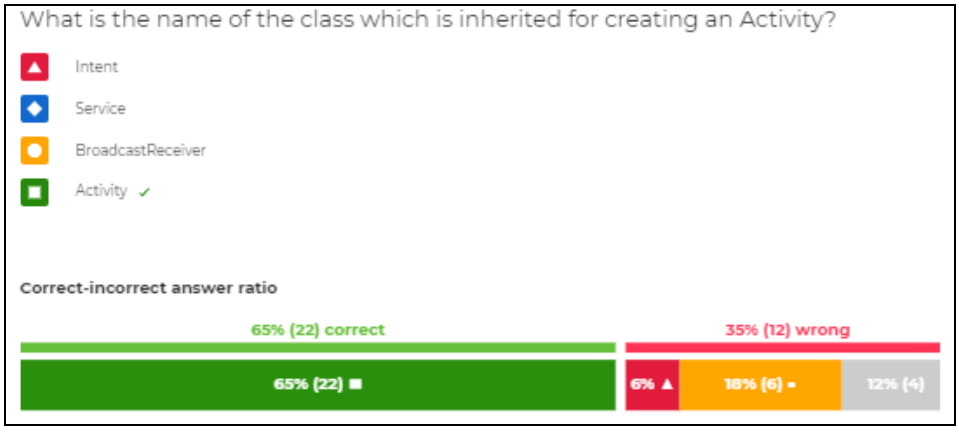


Figure 4 Answer timing for the question

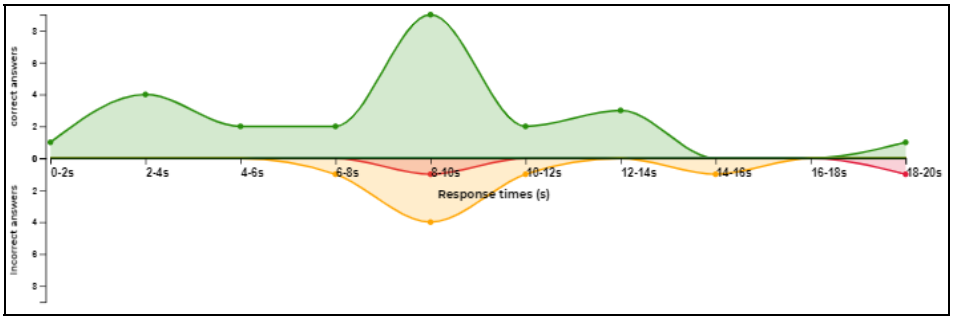


Figure 5 Top 10 players progress in quiz

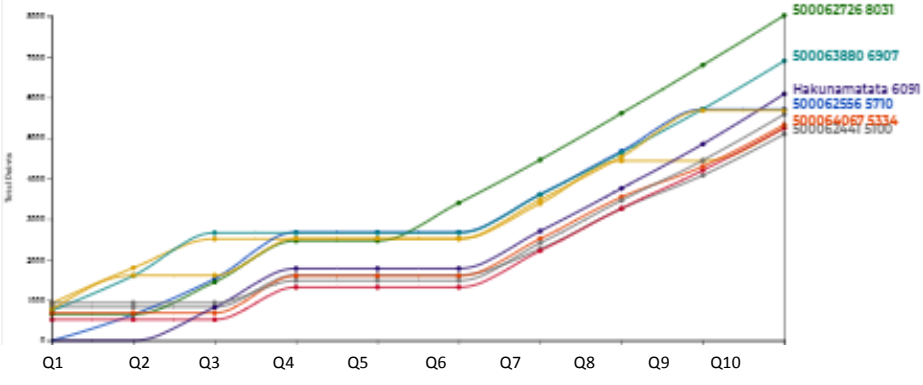


Figure 6 Leaderboard for the quiz

Rank	Nickname	Accuracy	Final score
1	500062726	80%	8031
2	500063880	70%	6907
3	Hakunamatata	60%	6091
4	500062556	60%	5710
5	Vissi	60%	5686

To minimise intrinsic motivation impact, the study considered two different batches of students. The same subject was taught in both the batches. The two batches are from the same program and specialisation that supports the expectation criteria of the instructor.

4 Data collection

We considered data from two different batches of an academic year. The first semester of the batche succeeded in non-gamified mode while the second semester is being gamified.

We collected data into two phases; one from course progress and achievements and another a survey are conducted based on a questionnaire. In the first phase, authors captured continuous data regarding student attendance, count for online content visits, lab evaluation, the quizzes, the exams and the final grades. In the second phase, student feedback towards proposed approach is considered. We collected this feedback by conducting and asking students to participate in a survey. The survey targets student experience of learning with gamification. Our questionnaire supports three dimensions of learner engagement, motivation and learning.

There are 146 students in both the batches, out of which 137 participated in the second phase of data collection that is based on a questionnaire. We found 9 students who did not complete the survey that is not included in the analysis. Hence, we used 128 samples for the study. The characteristics of the students' samples considered for experimentation are shown in Table 1. In the experiment, 51 samples from 3rd year batch are selected randomly where 40 male students and 11 female students are considered

Table 1 Characteristics of students participated

Factors	*Population*		*Sample*	
	Count (n)	*%*	*Count (n)*	*%*
Gender				
Male	125	85.03	125	85.03
Female	21	14.28	21	14.28
Age in years				
Mean in years	20.12		20.12	
Data collection				
Progressive data	147	100	102	69.38
Questionnaire	147	100	137	93.17
Year of study				
2nd Year	51	34.69	51	34.69
3rd Year	95	64.62	51	34.69

5 Results and discussion

5.1 Engagement

Student involvement in activities, attending sessions, a curiosity that defines student engagement in the course reflect how students spent their time. Student attendance in face-to-face sessions and time spent over online content are considered to show student engagement in a non-gamified and gamified semester.

A significant difference between mean student attendances is recorded in non-gamified and gamified semesters $\left(ANOVA, F_{value} = 11.82 > F_{critical} = 3.034, p < 0.001\right)$. Figure 7 shows an increase of 9.54% in attendance with $\left(t-test, p\left(0.00032\right) < 0.05\right)$. The findings reflect that gamification activities attracted students and created interest to

attend face-to-face sessions with $Mann-Whitne's U = 2141, p < 0.05$ between non-gamified and gamified approaches.

Figure 7 Mean student attendance for gamified and non-gamified semesters

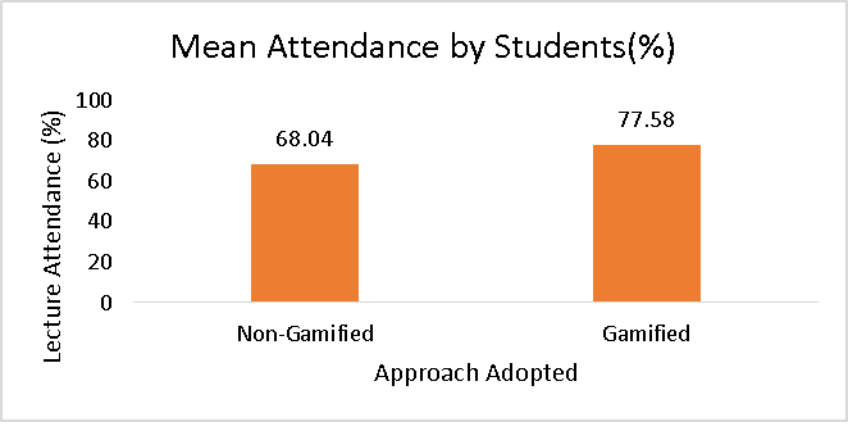
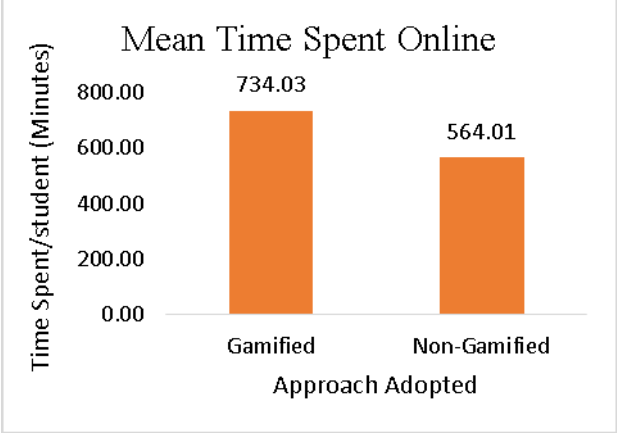


Figure 8 demonstrates that a significant difference of 30% in mean time spent by student $(ANOVA, F_{value} = 38.83 > F_{critical} = 3.90, p < 0.001)$, between gamified and non-gamified semesters is recoreded. Authors found a very strong correlation between face-to-face session attended and time spent in online content in a gamified semester $(Spearman's\ coefficient, \rho = 0.783, p < 0.001)$.

Figure 8 Mean time spent by student on online content



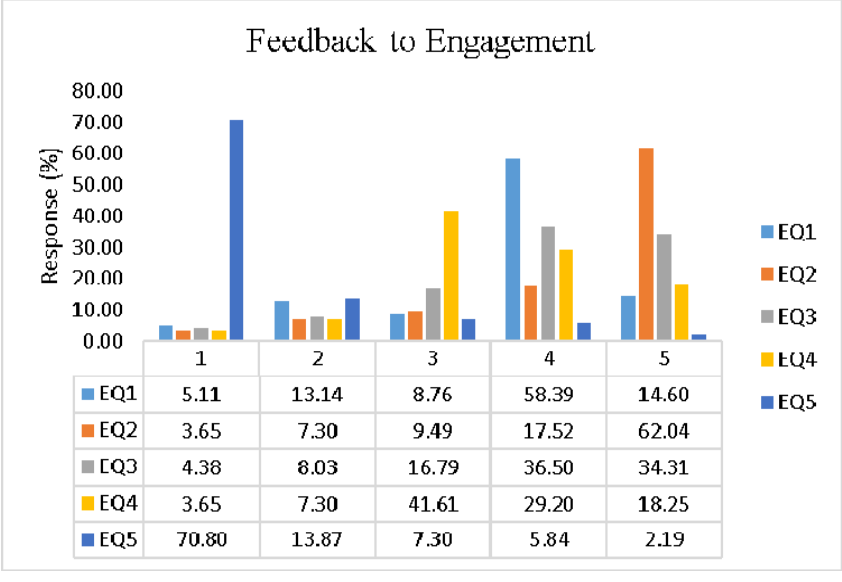
The statistics show quantitatively that gamification increases student engagement in both lectures as well as online content. To get qualitative feedback from students we included five different statements (see Table 2) in our questionnaire that supports the engagement dimension.

Table 2 Feedback questionnaire for 'engagement' aspect

S. No.	*Question*	*Response*
EQ1	I wanted to participate in all gaming activities.	1-strongly disagree; 5-strongly agree
EQ2	I could spent more time for my learning.	1-strongly disagree; 5-strongly agree
EQ3	I felt excited during such activities.	1-strongly disagree; 5-strongly agree
EQ4	I spent more time on subject preparation.	1-strongly disagree; 5-strongly agree
EQ5	Gaming activities wasted my time and were not fruitful.	1-strongly disagree; 5-strongly agree

Figure 9 shows student reply for each statement included in a survey form. The majority of responses reflect gamification increases engagement to a certain level as 72.99% (rated 4 or 5) participants wanted to participate in all gaming activities. Only 18.25 % (rated 1 or 2) participants think that some activities are not of their interest. The majority of participants (79.50%) agreed on they could spend more time on their learning. Very few students (10.95%) concluded that it did not affect learning time. 70.81% of participants responded that they felt excited when engaged in such activities. Nearly half of the students (47.45%) concurred the approach helped them to spend more time on subject preparation. At the same time, 41.61% of participants reacted like; it did not affect subject preparation time. Only 8.03% of participants think that the inclusion of gamification was not useful and wasted our time. On the other hand, 84.67% of participants opposed the statement.

Figure 9 Responses to 'engagement' questionnaire



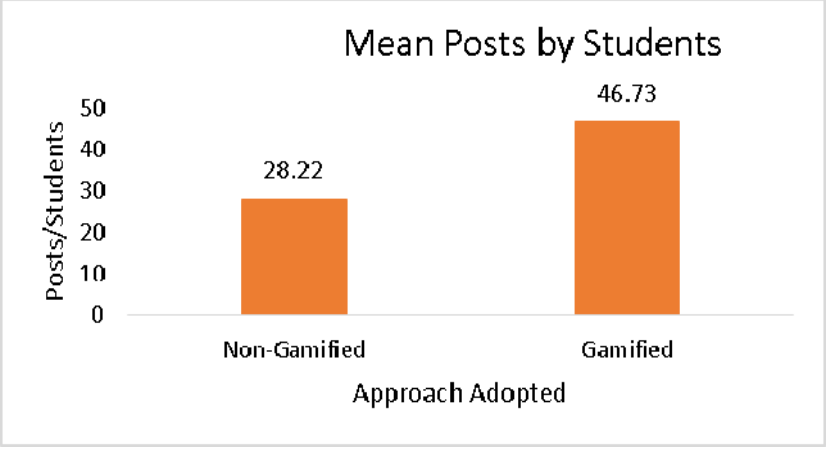
	1	2	3	4	5
EQ1	5.11	13.14	8.76	58.39	14.60
EQ2	3.65	7.30	9.49	17.52	62.04
EQ3	4.38	8.03	16.79	36.50	34.31
EQ4	3.65	7.30	41.61	29.20	18.25
EQ5	70.80	13.87	7.30	5.84	2.19

5.2 Motivation/Participation

Personal experience, rewards, personal interest, and learning environment affect student motivation that further leads to participation. Student participation displays a degree of motivation. The authors observed student participation in lectures where more students were found taking part in face-to-face lectures. Students came in front and explored more challenging problems. The study considered the number of posts created by students.

We found significant differences between mean posts by students in a non-gamified and gamified semesters $\left(ANOVA, F_{value} = 28.83 > F_{critical} = 3.70, p < 0.001\right)$. Figure 10 displays a 65.59% increase when it comes to adaptation of gamified approach. A significant correlation $\left(\rho = 0.683, p < 0.001\right)$ between attendance and posts by students and $\left(\rho = 0.978, p < 0.001\right)$ between time spent online and posts by student conclude that more engaged students are motivated and participate more in learning.

Figure 10 Mean post by students



Apart from lecture participation and showing interest in online activities, students demonstrated their interest by taking part in formal assessment activities. As shown in Figure 11 student participation increases in initial assessment activities. Activity 4 belongs to the end semester examination. It has no impact as all students (except who dropped the courses) participated in it. More participation in Activity 1 shows the degree of motivation.

Like engagement dimensions, we included five statements in our questionnaire supporting student motivation. The statements included are listed in Table 3.

Figure 11 Participation in assessment activities

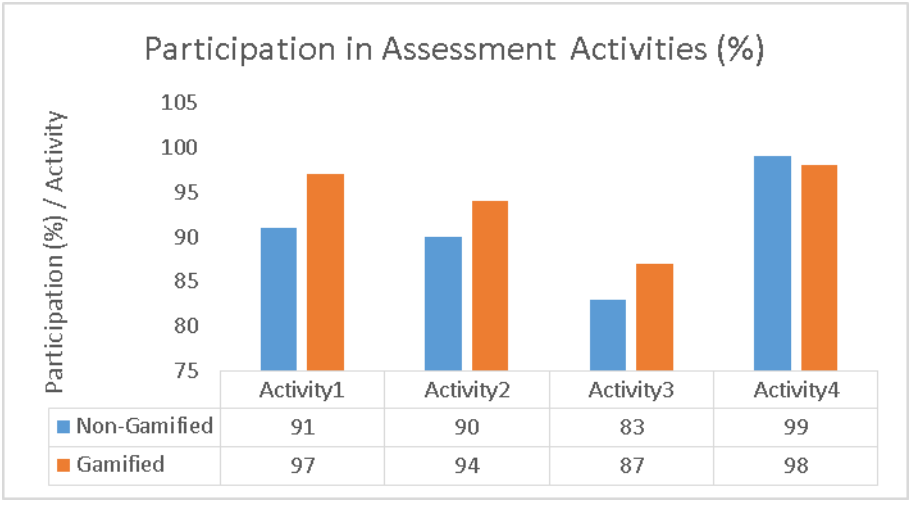
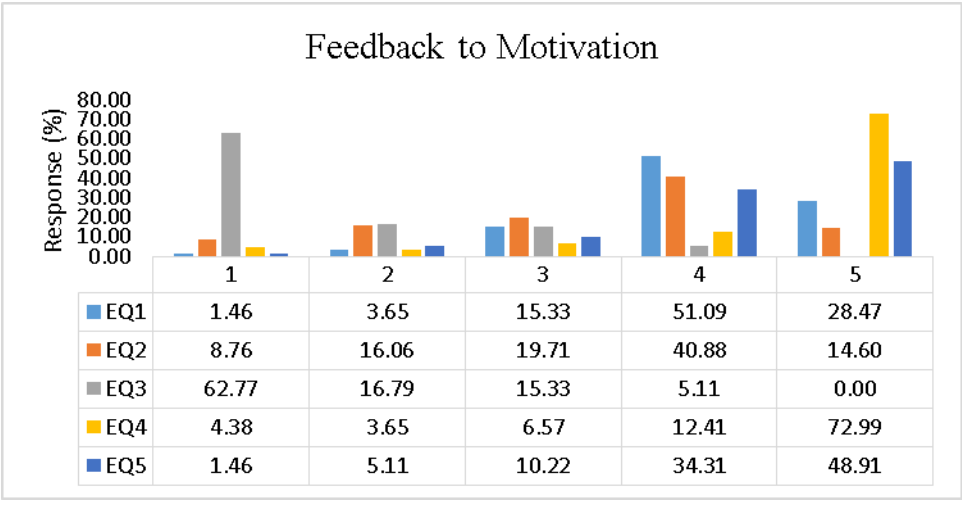


Table 3 Feedback questionnaire for 'motivation' aspect

S. No.	*Question*	*Response*
MQ1	The approach has motivated me and created interest.	1-strongly disagree; 5-strongly agree
MQ2	Gamification is very interesting to the learner	1-strongly disagree; 5-strongly agree
MQ3	Gaming is distractive and ineffective	1-strongly disagree; 5-strongly agree
MQ4	I am motivated to participate in more challenges	1-strongly disagree; 5-strongly agree
MQ5	Gamification should be encouraged more	1-strongly disagree; 5-strongly agree

Figure 12 contains responses to an individual statement. More than half (51.09%) participants agreed while 28.47% are strongly agreed that gamification has motivated them for learning and created interest in the course. Only 8.76% participant believes that adding a gaming element increases the level of their interest. 55.48% of participants decided that gaming activities increased their level of interest in the course. When it comes to the statement 'Gaming is distractive and ineffective', 67.77 strongly differ from the statement while 16.79% disagreed. Few students (5.11%) thought that statement has some meaning and responded as agreed with the statement. The majority of students (72.99%) strongly accepted that they are motivated to participate in the more challenging task. Approximately half of the participants (48.91%) strongly recommended that gamification should be encouraged in other courses as well and 34.31% rated agreed.

Figure 12 Responses to 'motivation' questionnaire



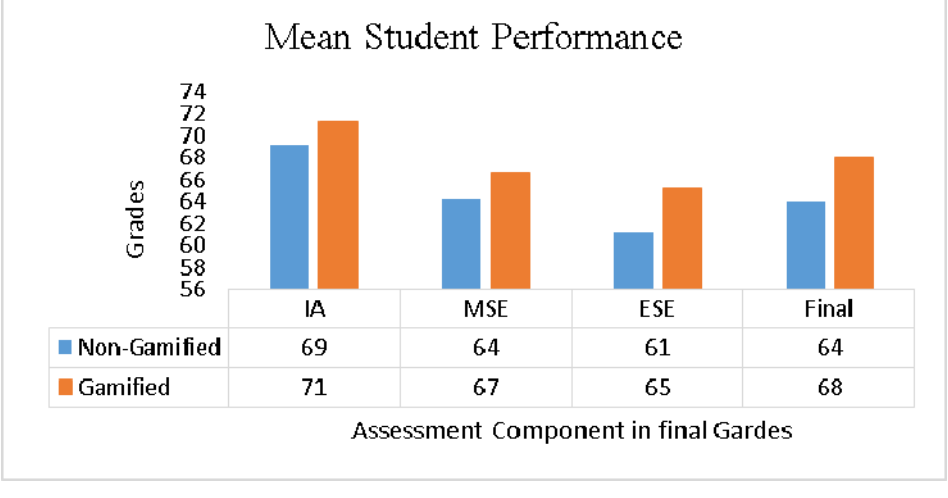
	1	2	3	4	5
EQ1	1.46	3.65	15.33	51.09	28.47
EQ2	8.76	16.06	19.71	40.88	14.60
EQ3	62.77	16.79	15.33	5.11	0.00
EQ4	4.38	3.65	6.57	12.41	72.99
EQ5	1.46	5.11	10.22	34.31	48.91

On an average of 13.43%, participants are not able to decide the impact of gamification on any of these areas included in the questionnaire and rated 3. Statistics and survey result shows that gamification increases the motivation level of students and they participated more compared to a traditional approach.

5.3 Learning

For the learning aspect of students, we considered their final grades achieved in respective courses. Figure 13 illustrates the contribution of individual components in the final grade of the student. We found that the gamified semester has an improvement over a non-gamified semester in both the scenarios.

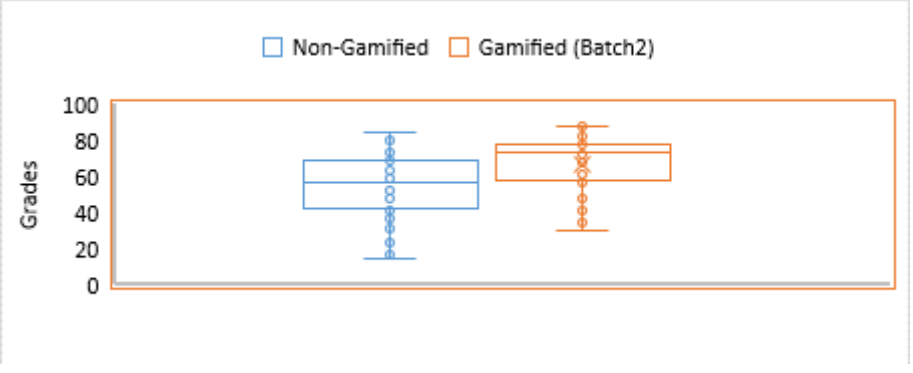
Figure 13 Component wise mean student grades



	IA	MSE	ESE	Final
Non-Gamified	69	64	61	64
Gamified	71	67	65	68

Significant differences in mean student final grades, $(ANOVA, F_{value} = 7.1, p < 0.001)$ were found. The minimum grades acquired in each semester are 15 and 30 in non-gamified and gamified respectively. It shows that the weakest students performed better in the proposed new approach. The study also shows (see Figure 14) that approach minimised the range of lowest and highest grades and improved learning grades.

Figure 14 Final grade boxplot



A correlation analysis shown in Table 4 displays that participants being more engaged, motivated and involved can secure better grades.

Table 4 Correlation of final grades with different dimensions

S. No.	*Correlation dimension*	*Spearman's coefficient* (ρ)	*p-value*
1	Attendance	0.521	$p<0.001$
2	Time spent	0.752	$p<0.001$
3	No of posts	0.649	$p<0.001$

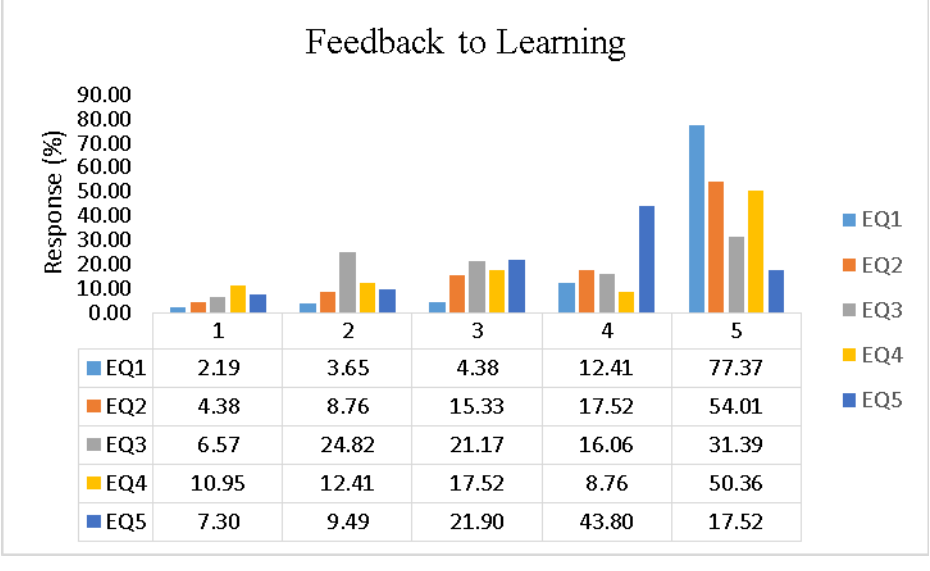
To collect qualitative feedback we added five questions, which address the learning dimension. The questionnaire for the learning aspect is shown in Table 5.

Table 5 Feedback questionnaire for the 'learning' aspect

S. No.	*Question*	*Response*
LQ1	Is gamification effective for self-reflection	1-much less; 5-much more
LQ2	How gamification improved your learning potential?	1-much less; 5-much more
LQ3	The approach required more work and effort.	1-much less; 5- much more
LQ4	Gamification helped you to achieve better grades.	1-much less; 5-much more
LQ5	Gamification is effective and recommended	1-much less; 5-much more

Figure 15 shows the responses for each statement included in the feedback. The majority of participants (77.37%) believed that gamification provided a better opportunity for self-reflection. 12% of participants accepted statements with a rating 4 in a 5-scale rating. More than half (54.01%) of participants considered much more contribution of gamification for improving their learning potential. 15% are not able to make any decision regarding the statement. The opinion of students varies that gamification required more work. We found that 24.82% responded less work and 16.06% responded more work is required. 31.39% says that much more work and effort is required as you are adding new gaming element in the course. 50% of participants strongly supported that gamification helped them to improve their grades. Nearly half (43.80%) of the participants recommended at a 4 scale and 17.52% rated level 5. 21.90% are not able to make a decision regarding effectiveness and recommendation.

Figure 15 Responses to 'learning' questionnaire



	1	2	3	4	5
EQ1	2.19	3.65	4.38	12.41	77.37
EQ2	4.38	8.76	15.33	17.52	54.01
EQ3	6.57	24.82	21.17	16.06	31.39
EQ4	10.95	12.41	17.52	8.76	50.36
EQ5	7.30	9.49	21.90	43.80	17.52

Conclusively the responses from participants reflect that gamification provides self-reflection, it is an effective approach and helps learners in their better learning.

6 Conclusions

Unlike andragogy learning, pedagogy demands student involvement with stringer motivation during the learning process. The blended teaching approach takes the benefits of face-to-face classroom teaching and digital learning. The approach stabilises properties of traditional pedagogy like; focused, managed, behavioural aspects and online learning like; flexibility, availability and self-paced learning. The objective of our research was to deploy gamification in a blended course and analyse its impact on student engagement, motivation and learning. The research provided a constructive approach by considering student, course, pedagogy and culture as a means for analysing the overall student performance.

Authors applied the approach and tools in two different semesters of an IT-based undergraduate course. The experiment duration was one academic year in which the first semester is considered with a traditional approach while gamification is adopted in the second semester. Total 147 participants are picked to perform experimentation. After the successful completion of courses, we asked students to participate in a questionnaire survey. 93.17% of total students participated in a survey and responded to each dimension of the questionnaire. The study included three dimensions engagement, motivation and learning for evaluation.

The quantitative analysis for each dimension shows that gamification enhanced learner's engagement, motivation and affected their learning. The result shows that students attended more classes, spent more time in the gamified semester. A significant difference is found in the ANOVA analysis. Similarly, the number of posts increased assuring more involvement. It has been found that the students who are more involved, engaged during their semester scored better grades in each component of assessment.

For qualitative analysis, survey responses are considered. It is noticed that only 2.19% of participants believe that gamification was not fruitful for them. Among all participants, 79.50% were found excited during such activities. 48.91% of students strongly recommended the approach to be adopted in other courses and 72.99% of participants strongly agreed on gamification has motivated them to participate in a more challenging task. Furthermore, half of the participants responded that gamification helped much more in their grade improvement.

However, the study investigated all three dimensions and found the approach very useful in each of these dimensions. Although the study is limited to specific case studies. The study utilises self-reported data. Further investigations for finding how many game elements and what type of elements should be included in such courses are suggested.

References

Axelson, R.D. and Flick, A. (2010) 'Defining student engagement', *Change: The magazine of higher learning*, Vol. 43, No. 1, pp.38–43.

Aycock, A., Garnham, C. and Kaleta, R. (2018) 'Lessons learned from the hybrid course project', *Teaching with Technology Today*, Vol. 8, No. 6.

Barata, G., Gama, S., Jorge, J. and Gonçalves, D. (2013) 'Engaging engineering students with gamification', *Proceedings of the 5th International Conference on Games and Virtual Worlds for Serious Applications (VS-GAMES)*, IEEE, pp.1–8.

Bourgonjon, J., Valcke, M., Soetaert, R. and Schellens, T. (2010) 'Students' perceptions about the use of video games in the classroom', *Computers and Education*, Vol. 54, No. 4, pp.1145–1156.

Brewer, R., Anthony, L., Brown, Q., Irwin, G., Nias, J. and Tate, B. (2013) 'Using gamification to motivate children to complete empirical studies in lab environments', *Proceedings of the 12th International Conference on Interaction Design and Children*, pp.388–391.

Bustard, D.W., Black, M.M., Charles, T., Moore, A.A., McKinney, M.E.T. and Moffett, P. (2011) 'GEL: a generic tool for game-enhanced learning', *Proceedings of International Conference on Engineering Education*, Belfast, UK, iNEER.

Carini, R.M., Kuh, G.D. and Klein, S.P. (2006) 'Student engagement and student learning: testing the linkages', *Research in Higher Education*, Vol. 47, No. 1, pp.1–32.

Cavanaugh, J. (2005) 'Teaching online – a time comparison', *Online Journal of Distance Learning Administration*, Vol. 8, No. 1. Available online at: https://www.learntechlib.org/p/193233/

Cheong, C., Cheong, F. and Filippou, J. (2013) 'Quick quiz: a gamified approach for enhancing learning', in *Pacific Asia Conference on Information Systems (PACIS 2013)*, Jeju Island, Korea, 18–22 June, pp.1–14.

Cialdella, K., Herlin, C. and Hoefler, A. (2002) *Motivating Student Learning To Enhance Academic Progress*, Dissertation.

Ciampa, K. (2014) 'Learning in a mobile age: an investigation of student motivation', *Journal of Computer Assisted Learning*, Vol. 30, No. 1, pp.82–96.

Connolly, T.M., Boyle, E.A., MacArthur, E., Hainey, T. and Boyle, J.M. (2012) 'A systematic literature review of empirical evidence on computer games and serious games', *Computers and Education*, Vol. 59, No. 2, pp.661–686.

Coyne, R. (2003) 'Mindless repetition: Learning from computer games', *Design Studies*, Vol. 24, No. 3, pp.199–212.

De Freitas, A.A. and de Freitas, M.M. (2013) 'Classroom lLive: a software-assisted gamification tool', *Computer Science Education*, Vol. 23, No. 2, pp.186–206.

Deterding, S., Dixon, D., Khaled, R. and Nacke, L. (2011) 'From game design elements to gamefulness: defining gamification', *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*, pp.9–15.

Dickey, M.D. (2005) 'Engaging by design: how engagement strategies in popular computer and video games can inform instructional design', *Educational Technology Research and Development*, Vol. 53, No. 2, pp.67–83.

Dziuban, C. and Moskal, P. (2011) 'A course is a course is a course: factor invariance in student evaluation of online, blended and face-to-face learning environments', *The Internet and Higher Education*, Vol. 14, No. 4, pp.236–241.

Eleftheria, C.A., Charikleia, P., Iason, C.G., Athanasios, T. and Dimitrios, T. (2013) 'An innovative augmented reality educational platform using Gamification to enhance lifelong learning and cultural education', *The Indian Institute of Advanced Study*, IEEE, pp.1–5.

Garnham, C. and Kaleta, R. (2006) 'Introduction to hybrid courses', *Teaching with Technology Today*, Vol. 8, No. 6.

Garris, R., Ahlers, R. and Driskell, J.E. (2002) 'Games, motivation, and learning: a research and practice model', *Simulation and gaming*, Vol. 33, No. 4, pp.441–467.

Gibson, D., Ostashewski, N., Flintoff, K., Grant, S. and Knight, E. (2015) 'Digital badges in education', *Education and Information Technologies*, Vol. 20, No. 2, pp.403–410.

Huang, A.H. (1997) 'Challenges and opportunities of online education', *Journal of educational technology systems*, Vol. 25, No. 3, pp.229–247.

Joosten, T. (2010) 'Mobile learning and social media: Increasing engagement and interactivity', Paper presented at the *New Media Consortium Conference*, June 9–12, Anaheim, CA.

Kahu, E.R. (2013) 'Framing student engagement in higher education', *Studies in higher education*, Vol. 38, No. 5, pp.pp.758–773.

Keller, J. and Suzuki, K. (2004) 'Learner motivation and e-learning design: a multinationally validated process', *Journal of Educational Media*, Vol. 29, No. 3, pp.229–239.

Keller, J.M. (1983) 'Motivational design of instruction', *Instructional Design Theories and Models: An Overview of Their Current Status*, Vol. 1, pp.383–434.

Kirschner, P.A. and Karpinski, A.C. (2010) 'Facebook® and academic performance', *Computers in Human Behavior*, Vol. 26, No. 6, pp.1237–1245.

Means, B., Toyama, Y., Murphy, R., Bakia, M. and Jones, K. (2009) *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies*, U.S. Department of Education, Office of Planning, Evaluation, and Policy Development, Washington, D.C.

Molnár, G. (2016) 'Digital learning on the basis of 21st century higher education', *Opus et Educatio*, Vol. 3, pp.699–706.

Muntean, C.I. (2011) 'Raising engagement in e-learning through gamification', *Proceedings of the 6th International Conference on Virtual Learning*, Vol. 1, pp.323–329.

Nah, F., Telaprolu, V., Rallapalli, S. and Venkata, P. (2013) 'Gamification of Education using Computer Games', *Proceedings of the International Conference on Human Interface and the Management of Information*, Springer, Berlin, Heidelberg, pp.99–107.

Parsons, J., and Taylor, L. (2011) 'Improving student engagement', *Current Issues in Education*, Vol. 14, No. 1.

Prensky, M. (2001) 'Fun, play and games: what makes games engaging', *Digital game-based learning*, Vol. 5, No. 1, pp.5–31.

Rovai, A., Ponton, M., Wighting, M. and Baker, J. (2007) 'A comparative analysis of student motivation in traditional classroom and e-learning courses', *International Journal on E-learning*, Vol. 6, No. 3, pp.413–432.

Squire, K.D. (2008) 'Video game-based learning: an emerging paradigm for instruction', *Performance Improvement Quarterly*, Vol. 21, No. 2, pp.7–36.

Todor, V. and Pitică, D. (2013) 'The gamification of the study of electronics in dedicated e-learning platforms', *Proceedings of the 36th International Spring Seminar on Electronics Technology*, IEEE, pp.428–431.

Trowler, V. (2010) 'Student engagement literature review', *The Higher Education Academy*, Vol. 11, No. 1, pp.1–15.

Whitton, N.J. (2007) *An Investigation into the Potential of Collaborative Computer Game-based Learning in Higher Education*, Doctoral dissertation, Edinburgh Napier University.

Wickramsinghe, S., Peiris, C.N. and Peiris, S.E. (2016) *Theme: Sustainable Development of Quality Assurance in Higher Education Sub-theme: the Internet Generation and its Implication on Higher Education Quality Management*, (OER, MOOCs, Online Distance Courses and Assessment).

Zepke, N. and Leach, L. (2010) 'Improving student engagement: ten proposals for action', *Active Learning in Higher Education*, Vol. 11, No. 3, pp.167–177.