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# Overcoming the novelty effect in online gamified learning systems: An empirical evaluation of student engagement and performance

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## Abstract

Learners in the higher education context who engage with computer-based gamified learning systems often experience the novelty effect: a pattern of high activity during the gamified system's introduction followed by a drop in activity a few weeks later, once its novelty has worn off. We applied a two-tiered motivational, online gamified learning system over 2 years to a total number of 333 students. In a mixed methods research design, we used 3-year worth of longitudinal data (333 students for the treatment group and 175 in the control group) to assess students' engagement and performance in that period. Quantitative results established that students engaged and performed better in the gamified condition vis-à-vis the nongamified. Furthermore, students exhibited higher levels of engagement in the second year compared with the first year of the gamified condition. Our qualitative data suggest that students in the second year of the gamified delivery exhibited sustained engagement, overcoming the novelty effect. Thus, our main contribution is in suggesting ways of making the engagement meaningful and useful for the students, thus sustaining their engagement with computer-based gamified learning systems and overcoming the novelty effect.

## Lay Description

What is currently known about educational gamification

- Educational gamification has positive-leaning but mixed results in student learning outcomes.
- Educational gamified system design is critiqued for limited formative research, lack of prototyping, and underexplored user characteristics.
- Although gamified elements attract users on board, once the novelty effect wears off, user engagement falls.

What this paper adds

- A gamified VLE was developed to address several system design critiques.
- Evaluation of the longitudinal data indicates significant improvements on student engagement and performance and elimination of the novelty effect in computer-assisted learning systems.
- A shift from learner extrinsic to intrinsic motivation linked to gamification and pedagogical factors enabled the overcoming of the novelty effect.

Implications for practice and/or policy

- Coherent, meaningful gamification can successfully drive sustained student engagement in VLEs and can help overcome the novelty effect.
- How engagement is measured affects the understanding of the effectiveness of computer-assisted learning.
- Gamification and pedagogical factors need to be used in tandem for an engaged, sustained student learning journey that goes beyond the novelty effect.

KEYWORDS
computer-based learning system, gamification, meaningful, novelty effect, student engagement, student performance

## 1 | INTRODUCTION

Educational practitioners advocate harnessing the power of technology for student engagement (Alavi & Leidner, 2001; Chen, 2014; Dickie & Meier, 2015; Donnelly & Hume, 2015; Gourlay, 2015; Seery, 2015). Virtual learning environments (hereinafter VLEs), such as Blackboard, WebCT, and Moodle, are widely used for facilitating the learning of students in the higher education (hereinafter HE) sector. Yet the uninspiring use of VLEs may lead to student disengagement and lack of motivation, affecting students' learning negatively (Means, Toyama, Murphy, Bakia, & Jones, 2009). Many instructors overlook user-specific factors that can facilitate success (Petter, DeLone, & McLean, 2013) in the design of their online learning systems (Hassanzadeh, Kanaani, & Elahi, 2012) and simply augment or replicate traditional classroom processes online leading to disengagement (Revere & Kovach, 2011). Meanwhile, student engagement with lectures, and participation in seminars, has been declining in the recent years (Holmes, 2015; Soilemetzidis, Bennett, Buckley, Hillman, & Stoakes, 2014). In a VLE, the expectation is that students proactively engage with content. However, to make VLEs more engaging, research has argued for better integration among digital strategies, learning science, and relevant contextual factors (McKnight et al., 2016).

Educational gamification, which is the application of game mechanics and elements in an educational context, offers a user-centred, autonomous, and flexible learning environment (Deterding, Dixon, Khaled, & Nacke, 2011). A gamified learning system can encourage learners to pursue their own goals (Landers & Callan, 2011) and engage in deeper levels persistently (Anderson, Huttenlocher, Kleinberg, & Leskovec, 2014). Gamification is effective in other sectors such as finance, marketing, and economical areas, yet it was not originally designed for an educational context (Zichermann & Cunningham, 2011). Motivation-inducing mechanisms of a typical gamified system include challenges, time restrictions, feedback, and virtual status and can engage the learners and alter their motivational state as a result of user–user and user–system interactions.

Nevertheless, gamified learning systems have limitations. First, they rely on addictive, pattern-based methods, thus failing to afford a gaming experience (Deterding et al., 2011; Deterding, 2015; Nicholson, 2012; Robertson, 2010). Second, there is lack of iterative prototyping for system ideation (Deterding, 2015). Third, user characteristics and user needs/preferences are underexplored (Hamari, Koivisto, & Sarsa, 2014). There are exceptions (Davis, Sridharan, Koepke, Singh, & Boiko, 2018), but most system designers assume that users' characteristics follow gamer typologies (e.g., Bartle, 1996), that is, imaginary personae rather than data-driven profiles (Deterding, 2015). Final limitation is the distinct possibility that gamified learning systems may not sustain learners' individual interests and engagement longitudinally (Davis et al., 2018; Rodríguez-Aflecht et al., 2018), a phenomenon that we have labelled here as the novelty effect (Clark, 1983). This novelty effect has been documented in different bodies of literature: from the introduction of novel technology, the introduction of new IT systems to gamification systems (Hamari et al., 2014). Novelty effect refers to the human tendency for heightened engagement and/or performance when encountering the introduction of a novel phenomenon, such as the introduction of a new technology. In nongame contexts, introducing gamification usually results in a perceived increase in enjoyment as mundane tasks become “playful.” Subsequently, user interest and engagement may gradually disappear once game elements and mechanics are no longer keeping users entertained or satisfied, a phenomenon known as the “hedonic treadmill” (Brickman & Campbell, 1971). The novelty effect is particularly relevant in the context of computer-assisted learning whenever there is a new computer-based learning system implemented.

Thus, our contribution to the literature is twofold. First, we developed a gamified online learning system that adopted a design-based approach to address the design limitations of gamified systems. The longitudinal iterative cycles allowed us to observe the novelty effect and generate ways to overcome its potential negative impact on engagement. Second, our mixed methods research design used a rich set of data to validate the effectiveness of gamification and to reveal that student behavioural engagement and performance improved over three consecutive years. Qualitative feedback suggested that both gamification and pedagogical elements facilitated the development of learner extrinsic and intrinsic motivations to engage in learning activities, playing an important role in captivating and sustaining students' attention and efforts transcending the barrier of the novelty effect. These findings have direct implications for designers of gamified systems and the educators as well as VLE systems' developers who develop and use such learning systems.

## 2 | THEORETICAL BACKGROUND

### 2.1 | Gamification

Gamification (Deterding et al., 2011) is conceptually akin to *game design*, not to *games*. It focuses on how the designer's intentions and implementation choices lead to a specific change in target outcomes, such as increased learning, health, civic engagement, or job performance. Landers, Auer, Collmus, and Armstrong (2018) depict clear theoretical causal relationships between game dynamics (such as goals, competition and cooperation, and freedom to fail) and game mechanics (e.g., avatars, badges, boss fights, and content unlocking) as mapped against the users' psychological states (mediators), thus enhancing engagement or performance in learning activities. The causal pathway from gamification elements to desired user outcomes is moderated by design-relevant and design-irrelevant personal and contextual factors (Landers et al., 2018), such as demographics and environmental conditions (Hamari et al., 2014; Rodríguez-Aflecht et al., 2018; Seaborn & Fels, 2015).

### 2.2 | Gamification, engagement, and the learning journey

Student participation in a gamified learning system can be viewed as a journey that consists of discovery, onboarding, engaging, and end game (Conejo, 2014). Most gamification studies (e.g., Banfield & Wilkerson, 2014; Barata, Gama, Jorge, & Gonçalves, 2013; Cruz & Penley, 2014; Dicheva, Dichev, Agre, & Angelova, 2015; Hamari et al., 2014; Hanus & Fox, 2015) agree that during the journey, game components provide users with motivational affordances, and thus, they develop a stronger sense of competence, autonomy, and relatedness (Deci & Ryan, 2002). Whereas motivation is often viewed as a private, unobservable psychological, neural, and biological process, engagement is regarded as the publically observable behaviour that results from motivation (Reeve, 2012).

We view engagement as multidimensional, highly dynamic, fluctuating, context dependent, and interactive (Goldin, Epstein, Schorr, & Warner, 2011; Lu, Huang, Huang, & Yang, 2017). The literature suggests that engagement is a three-component construct consisting of cognitive, affective, and behavioural engagement elements (Fredricks, Filsecker, & Lawson, 2016; Henrie, Halverson, & Graham, 2015). Cognitive engagement, in education setting, refers to leaners' focused efforts, such as self-regulation and metacognitive behaviours, to understand what is being taught. Affective/emotional engagement refers to feelings learners have about their learning experience and their social connections. Behavioural engagement means the observable behaviours that lead to academic success, such as attendance, participation, and coursework completion (Fredricks, Filsecker, & Lawson, 2016). Deci and Ryan (2002) routinely investigate these same engagement components as part elements of their self-determination theory (hereinafter SDT) that can help explain users' psychological and behavioural engagement.

In SDT, there is a continuum of motivations from *amotivation* in the lower end of the continuum where individuals act passively or do not intend to act to the other extreme: *intrinsic motivation*. In between, there are other levels of motivation such as *external regulation*, where people act only to obtain rewards or avoid punishment, *introjected regulation*, where behaviour is contingent on self-esteem or guilt, *identified regulation*, where individuals perform an activity because they personally identify with its value or meaning, and *integrated regulation*. The latter is the form of extrinsic motivation that is most fully internalized and hence is said to be autonomous; as individuals identify with the value of an activity, it becomes part of their sense of self. Whereas external, introjected, identified, and integrated regulation belong to what Deci and Ryan (2002) called extrinsic motivation, intrinsic motivation refers to doing an activity for its own sake because individuals find the activity inherently interesting and satisfying. Whereas some game mechanics (e.g., badges, points, levels, or virtual goods) act as external rewards, other game mechanics (e.g., social graphs, teams, or content unlocking) may serve as intrinsic motivators to users who imbue these mechanics with personally important meanings (Banfield & Wilkerson, 2014). A well-designed gamification system can be efficient in onboarding users, that is, leveraging the desire of users to get on board with the game for potentially extrinsic reasons, such as situational interest (Rodríguez-Aflecht et al., 2018) or obtaining status and sharing accomplishments (Conley & Donaldson, 2015). As the learning continues, the learners may develop autonomy, competence, and/or (social) relatedness, that is, intrinsic motivations. Therefore, if the gamified system is intelligently designed, it should enable the learners to transcend the external motivators and develop intrinsic motivators it can trigger a longer term and deeper engagement among learners (Nicholson, 2012).

Based on the above reasoning, attempts to measure student engagement should be adapted to the learning context. In this study, our gamified system was implemented as a set of online learning activities. Therefore, behavioural engagement, measured by observable activity completions, would be more suitable than cognitive engagement, which focuses on less observable efforts of the mind. This assertion is supported by Henrie et al. (2015) where quantitative measures were deemed appropriate and effective for studying student engagement at the activity level (p. 48). Therefore, we propose that:

> **Hypothesis 1** Student online engagement in a VLE system is higher in the gamified condition than in a non-gamified condition.

Educators embrace student engagement as an important educational construct because it could anticipate and predict positive student outcomes, such as academic achievement, course grades, learning, and skill development (Reeve, 2012). Several studies revealed that gamification resulted in increased lecture attendance (Barata et al., 2013; Charles, Charles, McNeill, Bustard, & Black, 2011) and student participation (Barata et al., 2013; Charles et al., 2011; Li, Grossman, & Fitzmaurice, 2012), both shown to correlate positively with student performance (Adegoke, Salako, & Ayinde, 2013). Thus, student performance in the module's assessments becomes a relevant consequence of engagement. Other studies have been ambivalent about the impact of gamification on student performance. For example, de-Marcos, Garcia-Lopez, and Garcia-Cabot (2016) compared different gamification approaches and concluded that educational games, gamified systems, social networking, and social gamification approaches delivered higher learning performance than more traditional approaches. Social gamification approaches in particular returned better results in terms of immediacy and for all types of assessments. In contrast, DomíNguez et al. (2013) used an experimental design to test the effect of gamification on student learning outcomes. Their results showed that overall scores and scores on practical gamified assignments were greater in the experimental group, but student performance on written assignments and participation suffered. Similarly, Hanus and Fox (2015) found that students who participated in the gamified environment had lower final exam scores. Still, other researchers (Barata et al., 2013; Goehle, 2013) found little evidence of impact either positive or negative on student performance. Seaborn and Fels (2015) concluded in their review that the effectiveness of gamification is a positive-leaning but mixed picture.

We believe that if learners are intrinsically engaged in a gamified learning system, their intrinsic motivations could sustain long-term and deeper engagement in learning, and therefore, they are more likely to achieve the desired learning outcomes vis-à-vis a non-gamified experience. We thereby propose two interrelated hypotheses:

> **Hypothesis 2** Student online engagement in the gamified VLE is positively related to student performance.

> **Hypothesis 3** Student performance in the gamified condition is higher than that in the nongamified condition.

From a cognitive evaluation theory (Deci & Ryan, 1985) perspective, external rewards offered by many gamified elements may very likely erode intrinsic motivation, resulting in poorer performance. This “crowding-out effect” was supported by a study of (Hanus & Fox, 2015) where gamification (external incentives) undermines motivation, effort, and empowerment resulting in lower grades in a final exam. Nevertheless, a meta-analytic study (Cerasoli, Nicklin, & Ford, 2014) indicated that external incentives stimulating extrinsic motivation and intrinsic motivations are not necessarily antagonistic and should be best considered simultaneously. The research showed that intrinsic motivation became more salient when external incentives were indirectly tied to performance. We chose a self-report survey as our qualitative measure to capture evidence of the interplay between extrinsic motivation and intrinsic motivation.

## 2.3 | Addressing the weaknesses of gamified learning systems

We adopted a design-based research approach to gamification, characterized by an iterative cycle of design, enactment, and analysis and redesign (Barab & Squire, 2004), to eliminate known weakness of online gamified learning systems. A common gamification design limitation is that it fails to afford gaming characteristic experiences (Deterding et al., 2011; Nicholson, 2012; Robertson, 2010) and lacks in game design pattern choices. We addressed this by improving design choices to suit a greater range of learners and by providing a clearer “game” narrative through regular communications. Another limitation has been the dearth of formative research in educational gamified systems and a lack of iterative prototyping for system ideation (Deterding, 2015). To address this, we implemented the gamified learning system over two years, collected longitudinal data, and asked users for voluntary feedback regarding module contents.

A limitation that is not as prominent in the literature on gamification and yet it affected our system's iterative design is the “novelty effect” as illustrated by Hamari et al. (2014). Novelty effect is the tendency for user engagement to initially improve during the introduction of a novel phenomenon, only to drop once the phenomenon becomes familiar. Novelty effect has been reported in several empirical studies (de-Marcos et al., 2016; Hamari & Koivisto, 2015a; Hanus & Fox, 2015). Hamari and Koivisto (2015a) studied demographic differences in perceived benefits from an exercise gamification service, Fitocracy. They found that gamification could have some novelty value, causing perceptions of usefulness and enjoyment to be higher in the beginning and then to fade the longer the user continues using the service.

The novelty effect can have a positive impact; it is useful in order to get users to engage with a computer-based gamified learning system as users become curious and want to try the system. However, if the observed positive effects of gamification are attributed solely to the novelty effect, continued exposure to the gamified system would transform the novel experience into the mundane, thus removing from users the initial excitement to the experience of the novel phenomenon (Clark, 1983). Consequently, learners would end up being turned off by the gamified system, resulting to the opposite of what the gamified system was implemented for (van Roy & Zaman, 2015). The current literature does not explicitly inform designers of the impact the novelty effect may have on gamified systems, how long it may persist, and what are the ways designers may overcome its impact and maintain user engagement (Hamari & Koivisto, 2015b). The decrease in engagement can be severe if the system designers have a poor understanding in how to design the game elements to enhance the user experience. We therefore hypothesize that in our data, and we will find evidence to support:

**Hypothesis 4** The novelty effect influences student engagement in a way that causes engagement to decline across time.

Knowing that the new features of the gamified system would potentially trigger the novelty effect and temporarily increase student engagement and enjoyment, the aim of any gamified system over the long run would be to sustain student engagement throughout the module duration, thus overcoming the drop in engagement once the novelty effect wears off. We argue that the iterative cycles, which incorporate improvement on the gamified module design, would reduce the impact of the novelty effect, leading to the following hypothesis:

**Hypothesis 5** Novelty effect in the second iterative gamified VLE would be lower than that of the first iterative design.

# 3 | METHODOLOGY

## 3.1 | Context

A gamified, online learning system was designed and implemented on the institution's VLE (Moodle) for two consecutive academic years (2015–2017) at a post-1992 university in the United Kingdom. The module targeted was the Personal and Professional Development (PPD) module; its aims were to educate second-year undergraduate learners about business communication and research. It covered four themes: self-awareness, professionalism, job acquisition, and business research methods. The teaching team consisted of 12 tutors, including the module leader. Each tutor was responsible for 12 to 16 students.

There had been two long-standing issues with PPD: limited contact hours and low student engagement. We attempted to overcome these issues by developing a gamified learning system to make the module more interesting, engaging, and fun. The team created a clear "game narrative" on Moodle and used gamification elements such as quests, levels, leader boards, and badges. Figure 1 shows a comparison between the traditional PPD in 2014–2015 where the VLE was used as depository and the PPD in 2015–2016 where the VLE was gamified.

The learning system was two tiered: *essential learning* (EL) and *super learning* (SL). EL activities (ELs) and SL activities (SLs) were provided over 24 weeks across two academic terms in each academic year (Term 1: Weeks 1–12; Term 2: Weeks 13–24). Both ELs and SLs were aligned with the module's learning objectives. ELs were blended with an offline *flipped classroom* set-up and were compulsory. ELs introduced the students to content covered in the module, utilizing short texts, quizzes, and video clips from the public domain (see Figure 2 for examples of ELs).

All ELs were available on Moodle at the beginning of Term 1 but were linked to specific deadlines over the academic year. SLs were optional and pertained to three different levels of difficulty following Bloom's taxonomy (Anderson, Krathwohl, & Bloom, 2001). SLs were designed to challenge high ability learners while giving them flexibility and autonomy in the learning process. The expectation was that learners who completed SLs would be intrinsically motivated to do so as completing the SLs would not necessarily provide any fundamental advantage in summative assessment performance. Thus, SLs (with a few exceptions) were not bound by deadlines. Points, badges, and leader boards were used as motivators to reward students for achievement (see Figure 3).

Each SL was assigned points, depending on difficulty level. Various badges were used for different kinds of achievements. Every 3 to

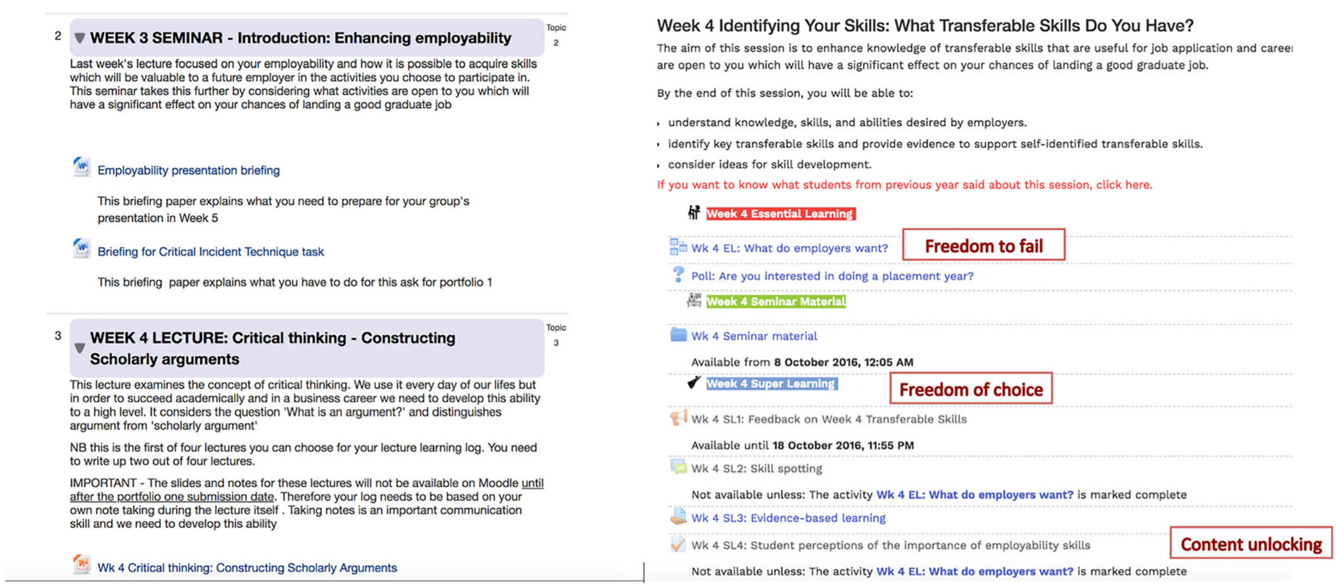



**FIGURE 1** Traditional (left) versus gamified (right) interfaces on Moodle [Colour figure can be viewed at wileyonlinelibrary.com]

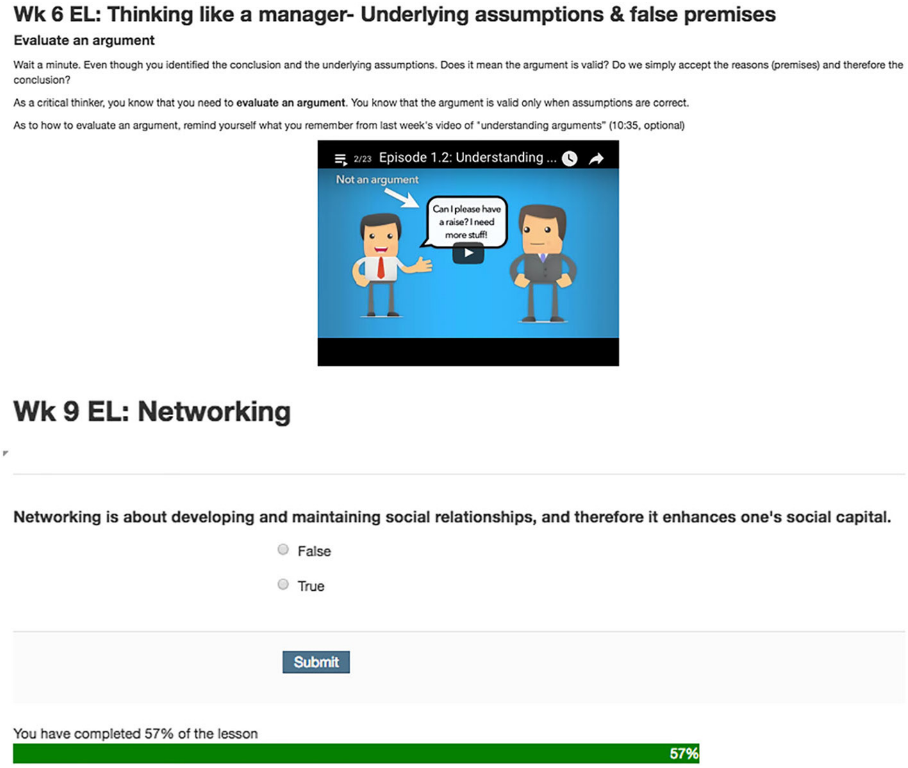



**FIGURE 2** Examples of essential learning (EL) activities [Colour figure can be viewed at wileyonlinelibrary.com]

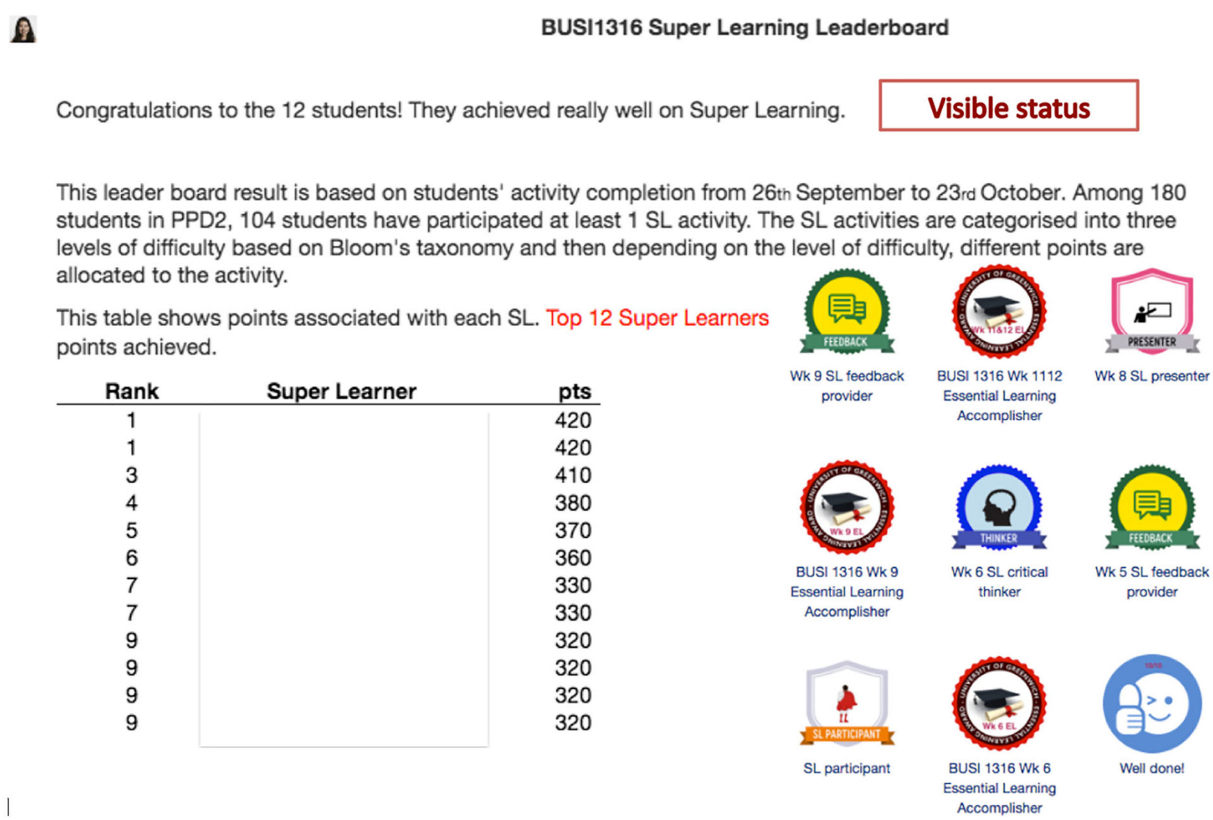



**FIGURE 3** Super learning (SL) leader board and badges [Colour figure can be viewed at wileyonlinelibrary.com]

4 weeks, a leader board, which included the top super learners, was announced to recognize their achievements. Lists of 2015–2016 ELs and SLs are included in Appendices A and B in the Supporting Information.

## 3.2 | Gamification design

As explained in Section 2.3, we employed the design-based approach to our gamified learning system, and there were two iterations in this study where we went through stages of design, enactment, analysis, and redesign.

### 3.2.1 | The first iteration

The design of the first iteration was based on a framework proposed by Werbach and Hunter (2015), including six steps: (a) defining system objectives, (b) delineating target behaviours, (c) describing players, (d) devising activity cycles, (e) don't forget the fun, and (f) deploying the appropriate tools.

In the first iteration, we assumed that the user population consisted of a typology of achievers, explorers, socializers, and killers (Bartle, 1996). Assuming SDT holds true, we designed learning activities that catered for all types of users while aiming to develop their autonomy, competence, and/or (social) relatedness. To tap into the learners' need for autonomy, learners had freedom to choose what, when, and where to engage in the gamified learning system (Deci & Ryan, 2002). To give learners a sense of competence, common extrinsic gamification tools such as badges and leader boards were used to reward achievement (Deci & Ryan, 2002). To give learners a sense of relatedness (Deci & Ryan, 2002) and social engagement, tasks were designed to allow them to co-create knowledge as well as to provide opportunities for individuality (Wood & Reiners, 2012) using tools such as Wikis and Forum (Tsay, Kofinas, and Kuo, 2018).

When the ELs and SLs were launched, they were presented to learners as challenges within a competitive longitudinal framework. A points-based competition was used as the unifying narrative around which the learners' learning journey was framed and the activities were aligned. Appendix C in the Supporting Information shows a variety of game design elements used in the EL and SLs (adapted from Blohm & Leimeister, 2013).

Success was defined in two ways: (a) learners getting on board with the learning activities of the gamified system and stay engaged across time and (b) learners achieving improved student performance. When analysing data of student engagement and performance in the first iteration, we were confident that the gamification intervention changed students' behavioural engagement in online learning and consequently their module performance (Tsay et al., 2018) . The intervention demonstrated success, and therefore, the gamified online learning system was continued in 2016–2017 with improvements. However, we were aware that system improvements were needed to be made among other things to address a drop in engagement observed towards the end of the first semester, a drop that we attribute here in this work to the novelty effect.

### 3.2.2 | The second iteration

In the second iteration, we collected user information and asked users for voluntary feedback regarding system improvement and activity design throughout. Several actions outlined in Table 1 were taken at both system design and enactment stages in the second iteration.

First, the first-year student engagement and performance data were used as formative research for the second iteration. The student background information collected in the first year suggested that learners from different backgrounds engaged differently (Tsay et al., 2018) , and as a consequence, the design pattern choices and learning activities were expanded and diversified in the second iteration to suit preferences of learners from diverse backgrounds (Koivisto & Hamari, 2017). As a result, the number of ELs increased from 14 in 2015–2016 to 16 in 2016–2017, and the number of SLs increased from 37 in 2015–2016 to 56 in 2016–2017 on Moodle. Second, using the principles of user-centred design and a student-centred learning approach (Baeten, Kyndt, Struyven, & Dochy, 2010; Gulliksen et al., 2003), we asked learners to give voluntary feedback on their experiences of the gamified VLE. Third, we identified the most and the least popular learning activities in the first iteration (based on activity completion rates), and in the second iteration, we promoted the popular ones and removed the least popular ones. This action was supported by anecdotal student feedback on which activities students thought

**TABLE 1** Critiques and improvement implications on the gamified module design

| Critique on the gamification design | Improvement implications |
|---|---|
| Lacking guidance in game design pattern choice (Deterding, 2015; Nicholson, 2015; Robertson, 2010) | • Diversify design choices to suit different types of learners<br>• Make the "game" narrative clearer |
| No iterative prototyping (Deterding, 2015) | • Ask users for voluntary feedback regarding module contents<br>• Identify most popular learning activities based on the first iteration and promoted them in the second iteration<br>• Remove learning activities that are not perceived useful (less engaged)<br>• Regular communication with users |
| Little formative research and understanding of users (Deterding, 2015; Nicholson, 2015) | • Longitudinal study<br>• Collect user information (demographics and learning motivation)<br>• Ask users for voluntary feedback regarding system improvement and activity design<br>• Regular communication with users |

were useful. Fourth, we developed a clearer narrative in the second iteration, to facilitate the onboarding process of our learners onto the gamified system using more sustained communication to enhance engagement. These measures aimed to minimize the moderate novelty effect (drops in engagement) noticed in the first iteration (authors' reference to be added). In the communications, we reminded learners that the optional SLs would help them learn "above and beyond" what was essential. Completion of SLs would be rewarded with points, badges, and leader board, and participation in SLs could enhance the quality of the two summative assessments. We also set a clear goal (Locke & Latham, 1990) for students in the marking criteria by stipulating that EL completion contributes to final grade. For example, learners were told, "for good and excellent engagement, a student needs to complete at least 70% of ELs" as opposed to "Your EL completion is a major part of the engagement." Finally, the module leader instigated regular, weekly communications with students in the second year, highlighting featured SLs and emphasizing the importance of ELs and SLs to their assessments.

### 3.3 | Sample and data collection procedure

Comparable student background data are available for the cohorts participating in the gamified learning system (i.e., 2015–2016 and 2016–2017) but are missing for the nongamified delivery. However, the university has used the same admission criteria for the last 5 years, and all three student cohorts undertook the same program of study. Although the 2014–2015 student background information is unavailable, the data we collected in 2015–2016 and 2016–2017 (see Table 2) indicate that the gender composition and percentage of international student were similar. The three cohorts were comparable in size, all large cohorts, and the assessments in 2014–2015 are almost identical to the two cohorts in the gamified delivery. Thus, we assumed that all three cohorts were broadly similar in terms of prior student performance.

For data collection between 2015 and 2017, we informed students that data about their background information, online learning engagement, and module performance would be collected and analysed in an aggregated form, to improve the module design. Participation in the gamified online learning system was voluntary, and students were provided an opt-out option. Therefore, the sample size on different variables varied from 107 to 165 in academic year 2015–2016 and from 110 to 168 in academic year 2016–2017. Quantitative data analysis was conducted using SPSS version 21.0 (IBM Corp., 2012).

### 3.4 | Measures

To evaluate the effectiveness of the gamification intervention and system iterations, we used a pragmatic, mixed methods approach and utilized a range of measures, quantitative and qualitative, the former aiming to assess significance of the results whereas the latter aiming to understand the qualitative nature of the results. The aim was to triangulate our results; whereas the first three hypotheses derived from the literature were explanatory, the fourth and fifth hypotheses were exploratory. We wished to examine a complex phenomenon that is only partially addressed in the literature: the novelty effect caused by the introduction of a gamified learning system and the means to overcome it. As a result, we utilized qualitative data to examine the motivations of students to engage with our learning system.

Engagement and performance data were obtained from four modules on Moodle, including the nongamified PPD 2014–2015 module, the gamified PPD 2015–2016 and 2016–2017 modules, and another nongamified 2015–2016 module (pseudoname "CMC"), which was an unrelated yet highly engaging nongamified business module for second-year undergraduates. The CMC module acted as a control group to check the levels of engagement and performance with a traditionally delivered model, which was considered an exemplar in terms of engagement among modules delivered more traditionally.

As the gamified system was embedded in Moodle, we collected our preliminary data generated by Moodle and conducted preprocessing and postprocessing of the data for our hypothesis testing. The preprocessing of the data was embedded in the structure of EL and SLs by predefining the Moodle-based activities as EL and SL according to their pedagogical significance. Therefore, the students' views and completions of these two sets of learning activities were analysed, respectively.

In terms of the postprocessing of data, we processed the data according to the different hypotheses we were testing. Because our hypotheses were directly related to the observable, behavioural aspects of student engagement, we created two proxies, "process" engagement and "results" engagement. These two engagement proxies are different: In "process" engagement, a student may view a learning activity several times but not necessarily complete the required task in the activity. The use of proxies to capture behavioural engagement is common in other online learning studies (Aluja-Banet, Sancho, & Vukic, 2017; Guo, Kim, & Rubin, 2014).

For Hypothesis 1, we used "process" engagement data based on views of a learning activity (an umbrella term that includes any module-related item posted on a module's Moodle site). For Hypotheses 2 and 3, we used "result" engagement data of student learning activity completion rate, by activity. For Hypothesis 4, we recoded the "result" engagement data used in Hypothesis 2 and used student learning

**TABLE 2** Student compositions

| | Academic year | Number of response | Female | Male | International student |
|---|---|---|---|---|---|
| Number (%) | 2015–2016 | 136 | 70 (51.5%) | 66 (48.5%) | 39 (29%) |
| Number (%) | 2016–2017 | 168 | 89 (53%) | 79 (47%) | 43 (26%) |

**TABLE 3** View count based on the learning activity and student number in the gamified modules and the nongamified modules

| Module title | Number of learning activity (a) | Number of students (b) | Total view (c) | View count per activity (c/a) | View count per person (c/b) | View count per activity per person (c/a * b) |
|---|---|---|---|---|---|---|
| Nongamified PPD (2014–2015) | 37 | 181 | 5,303 | 143.32 | 29.30 | 0.77 |
| Nongamified CMC (2015–2016) | 36 | 175 | 7,377 | 204.92 | 42.89 | 1.19 |
| Gamified PPD (2015–2016) | 87 | 165 | 25,295 | 290.75 | 153.30 | 1.76 |
| Gamified PPD (2016–2017) | 139 | 168 | 49,042 | 352.82 | 291.92 | 2.10 |

activity completion by week for hypothesis testing. Finally, for Hypothesis 5, we used both "process" and "result" engagement data to examine the effectiveness of system iteration and improvement.

### 3.4.1 | View count on learning activity (academic year 2014–2017)

The term "learning activity" is used as an umbrella term that includes any module-related item posted on a module's Moodle site. A learning activity can be a file (e.g., pdf, excel, word, and ppt), a folder with files, a URL (more commonly used by modules with traditional ways of delivery and use VLEs as repository), feedback, assignment, quizzes, forum, or wiki (as designed in the gamified module). We were able to obtain data on Moodle regarding views of each posted learning activity (but not who viewed or when an activity was viewed) for three cohorts of PPD and CMC. We suggest that views count on each learning activity is an indicator of "process" engagement as opposed to "result" engagement because students could view a learning activity several times without completing it. Table 3 presented the descriptive statistics of views on the learning activity in each module.

### 3.4.2 | Number of EL and SL completion (academic year 2015–2017)

This measure was used for "result" engagement, representing observable behavioural engagement in completing a learning activity. For engagement in an online learning activity (coded A[*i*]), "1" was coded for an activity completion and "0" for noncompletion. Therefore, the number of EL and SL completion for each student was calculated. The date and time of an activity completion were also recorded. Hence, the student learning activity completion rate both by activity and by week was captured and tested in Hypotheses 2–5. The descriptive statistics of "result" engagement are shown in Table 4.

**TABLE 4** Descriptive statistics for result engagement in 2015–2016 and 2016–2017

| | M | Min | Max | *SD* |
|---|---|---|---|---|
| 2015–2016 (*n* = 136) | | | | |
| No. of EL (14) | 8.06 | 0 | 14 | 4.34 |
| No. of SL (37) | 9.51 | 0 | 34 | 8.53 |
| No. of EL and SL (51) | 17.57 | 0 | 48 | 12.19 |
| 2016–2017 (*n* = 168) | | | | |
| No. of EL (16) | 12.83 | 0 | 16 | 3.77 |
| No. of SL (56) | 16.34 | 0 | 52 | 14.54 |
| No. of EL and SL (72) | 29.18 | 0 | 68 | 16.63 |

Abbreviations: EL, essential learning; SL, super learning.

### 3.4.3 | Module performance (academic year 2014–2017)

The module assessment, consisting of Portfolios 1 and 2 and module engagement, was the same in three cohorts, with minor changes in weighting of each component in 2016–2017. Therefore, the module performance data allow us to test the effect of gamification on student performance. The term 1 assignment, Portfolio 1, assessed students' employability; it required students to develop a personal branding video, conduct a mini-research on current graduate job market, pursue extracurricular activities with evidence, and reflect on a chosen extracurricular activity (i.e., networking) using critical incident analysis. Portfolio 2 assessed basic research skills. Students were required to write a small-scale business research project based on their group research work in Term 2. In terms of engagement, students were assessed across two terms based on class attendance and contribution to two group presentations in 2014–2015. In 2015–2017, engagement was assessed by class attendance, contribution to two group presentations, and completion of ELs. Engagement in SLs did not count towards the final grade classification (Table 5).

### 3.4.4 | Control variables (academic year 2015–2017)

We included gender (male = 1; female = 0), prior performance, and class attendance as control variables to test the relationship between online learning engagement and student performance. From Table 2, it seemed that in both cohorts, the sample included was gender balanced. As to prior performance, we obtained student performance in the year 1 PPD module (107 data points) for the 2015–2016 data and accumulated year 1 GPA (110 data points) for the 2016–2017 data. Finally, students' class attendance data were obtained from the university's web portal (see Table 6).

**TABLE 5** Descriptive statistics for assessment types and student performance means and standard deviations

| Cohort | Assessment components | N | Overall mean | *SD* |
|---|---|---|---|---|
| 2014–2015 | Portfolio 1 (35%) | 175 | 56.90 | 13.12 |
| | Portfolio 2 (55%) | | 58.67 | 12.07 |
| | Engagement (10%) | | 64.87 | 14.54 |
| | Total (100%) | | 58.67 | 10.96 |
| 2015–2016 | Portfolio 1 (35%) | 165 | 62.06 | 14.91 |
| | Portfolio 2 (55%) | | 59.95 | 17.57 |
| | Engagement (10%) | | 67.38 | 18.01 |
| | Total (100%) | | 61.35 | 15.01 |
| 2016–2017 | Portfolio 1 (45%) + engagement (5%) | 168 | 59.57 | 15.29 |
| | Portfolio 2 (45%) + engagement (5%) | | 59.23 | 17.09 |
| | Total (100%) | | 59.57 | 14.78 |

**TABLE 6** Descriptive statistics for student prior performance and class attendance ($n$ = 110–168)

| | *M* | Min | Max | *SD* |
|---|---|---|---|---|
| 2015–2016 ($n$ = 136) | | | | |
| PPD1 performance[a] | 61.52 | 33 | 82 | 11.69 |
| Class attendance | 13.54 | 2 | 21 | 4.20 |
| 2016–2017 ($n$ = 168) | | | | |
| Accumulated GPA[b] | 60.35 | 0 | 78.2 | 9.37 |
| Class attendance | 15.4 | 2 | 23 | 4.21 |

Abbreviation: GPA, grade point average.
[a]$n$ = 107.
[b]$n$ = 110.

### 3.4.5 | Qualitative feedback (academic year 2016–2017)

We collected qualitative feedback from 44 students from the second iteration of the gamified system at Week 20 towards the end of the second term, and we asked three questions related to engagement and nonengagement in ELs and SLs: "Why did you sometimes not engage in ELs?" "Why did you keep engaging in ELs?" and "Why did you keep engaging in SLs?"

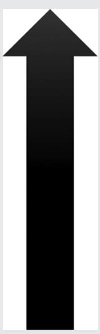
Content analysis methods include applying existing coding schemes to categorizing the data (Clarà & Mauri, 2010). The purpose of gathering qualitative feedback in this study has been to explore the interplay between extrinsic motivation and intrinsic motivation from students' perspective. Thus, the data were coded on the basis of the concepts from the SDT continuum. The analysis thus followed the general principles of an empirical content analysis (Patton, 2002) and was inductive in nature. The data were analysed to coalesce against the different types of motivation identified by the SDT through a process of data abstraction from the manifest and literal content to its latent meanings (Erlingsson & Brysiewicz, 2017). Two researchers interpreted the data and went through the same process of abstraction. Table 7 shows an example of analysis leading to higher level of abstraction. This process enabled that the researchers' reasoning process was directly based on empirical data.

## 4 | RESULTS

### 4.1 | Process engagement in gamified versus nongamified conditions

Hypothesis 1 stated that student engagement in the VLE would be higher in the gamified conditions than in the nongamified conditions. We examined "process" engagement, view count on learning activity, as an indicator. From Table 3, it is found that in the two gamified conditions, each of the learning activities attracted more "traffic" (i.e.,

**TABLE 7** Abstraction of qualitative data towards an SDT motivational affordance



| | |
|---|---|
| Code | External regulation |
| Condensed meaning unit | Students believed that EL engagement help them achieve good grades and receive rewards |
| Meaning unit | ELs have an impact on my grade |
| | For the engagement mark |
| | It is essential to engaging marks |
| | To get good marks |
| | To get better grades |
| | Contribute to portfolio grade |
| | For engagement points within the PPD portfolios |
| | To maintain my grade |
| | To also get a badge to increase my profile |

**TABLE 8** Comparison of student process engagement between the gamified and the nongamified conditions

| | Cohort | N | *M* | *SD* | df | *F* value | *p* value |
|---|---|---|---|---|---|---|---|
| View count per learning activity | Nongamified PPD (2014–2015) | 37 | 143.32 | 103.86 | 298 | 3.74 | .012 |
| | Nongamified CMC (2015–2016) | 36 | 204.92 | 170.95 | | | |
| | Gamified PPD (2015–2016) | 87 | 290.75 | 394.37 | | | |
| | Gamified PPD (2016–2017) | 139 | 352.72 | 445.61 | | | |
| View count per learning activity (for an average student) | Nongamified PPD (2014–2015) | 37 | .79 | .57 | 298 | 4.05 | .008 |
| | Nongamified CMC (2015–2016) | 36 | 1.19 | .99 | | | |
| | Gamified PPD (2015–2016) | 87 | 1.76 | 2.39 | | | |
| | Gamified PPD (2016–2017) | 139 | 2.10 | 2.65 | | | |

student views; see column (c) and (c/b)). Also, the average view count per learning activity was higher in the gamified modules (352.82 and 290.75 views) than in the nongamified modules (143.32 and 204.92 views). Moreover, the view count per activity for an average student in the gamified conditions (2.10 and 1.76 views) was higher than that in the nongamified conditions (0.77 and 1.19 views).

To test Hypothesis 1, one-way analyses of variance (ANOVAs) were performed. In Table 8, there was a significant difference on average views per learning activity, $F(298) = 3.74$, $p = .012$. Especially, post hoc analyses using the Scheffé post hoc criterion for significance suggested that the average view count per learning activity in 2016–2017 ($M = 352.72$, $SD = 445.61$) was significantly higher than that in 2014–2015 ($M = 143.32$, $SD = 103.86$). In addition, there was a significant difference on views per learning activity for an average student, $F(298) = 4.05$, $p = .008$. Specifically, post hoc analyses suggested that the average view count per learning activity for an average student in 2016–2017 ($M = 2.10$, $SD = 2.65$) was significantly higher than that in 2014–2015 ($M = 0.79$, $SD = 0.57$). We therefore can reasonably conclude that student online learning engagement was higher in the gamified conditions than that in the nongamified conditions, including the CMC module that was an exemplary nongamified module in terms of student engagement and performance. Hypothesis 1 was supported.

## 4.2 | Result engagement and student performance

Hypothesis 2 stated that student online engagement in the gamified VLE is positively related to student performance. We performed hierarchical regression analyses using the 2015–2016 and 2016–2017 PPD module data, respectively. Tables 9 and 10 showed that completion of online learning activities, whether it is EL (Model 2) or SL (Model 3), or both (Model 4), improves student performance, controlling for gender, class attendance, and prior performance (a prior module, PPD1 performance used in 2015–2016 data whereas

**TABLE 9** Summary of regression analysis for variables predicting student performance in 2015–2016 (*n* = 107)

| Variable | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| Step 1 | | | | |
| Gender | −.17* | −.08 | −.12 | −.10 |
| Class attendance | .44*** | .37*** | .39*** | .38*** |
| PPD1 performance | .35*** | .28*** | .31*** | .30*** |
| Step 2 | | | | |
| Number of EL completion | | .26** | | |
| Number of SL completion | | | .24** | |
| Number of EL + SL completion | | | | .27** |
| *F* | 25.14*** | 22.78*** | 23.08*** | 18.72*** |
| Adjusted $R^2$ | .406 | .451 | .455 | .460 |
| $R^2$ change | | .05** | .05** | .06** |

*Note.* Standardized coefficients are reported for tested variables.
Abbreviations: EL, essential learning; SL, super learning.
$*p < .05$.; $**p < .01$.; $***p < .001$.

**TABLE 10** Summary of regression analysis for variables predicting student performance in 2016–2017 (*n* = 110)

| Variable | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| Step 1 | | | | |
| Gender | −.05 | .002 | −.01 | .001 |
| Class attendance | .48*** | .36*** | .44*** | .41*** |
| Accumulated GPA | .33*** | .19*** | .31** | .28*** |
| Step 2 | | | | |
| Number of EL completion | | .45*** | | |
| Number of SL completion | | | .10** | |
| Number of EL + SL completion | | | | .25*** |
| *F* | 39.31*** | 54.55*** | 32.58*** | 36.28*** |
| Adjusted $R^2$ | .411 | .565 | .434 | .461 |
| $R^2$ change | | .15*** | .026** | .05*** |

*Note.* Standardized coefficients are reported for tested variables.
Abbreviations: EL, essential learning; SL, super learning.
$*p < .05$.; $**p < .01$.; $***p < .001$.

**TABLE 11** Comparison of student performance between the gamified and the nongamified PPD modules

| Assessment (%) | Cohort | N | *M* | *SD* | df | *F* value | *p* value |
|---|---|---|---|---|---|---|---|
| Final (100%) | 2014–2015 | 175 | 58.67 | 10.96 | 496 | 6.229 | .002 |
| | 2015–2016 | 160 | 62.69 | 10.49 | | | |
| | 2016–2017 | 162 | 61.51 | 10.79 | | | |

accumulated GPA used in the 2016–2017 data). Therefore, Hypothesis 2 was supported.

Hypothesis 3 stated that student performance in the gamified conditions is better than that in the nongamified condition. To test this hypothesis, we used one-way ANOVA to test the average module performance among two gamified PPD modules (2015–2017) and the nongamified PPD one (2014–2015). Table 11 showed the differences in mean scores. Using the Scheffé post hoc criterion for significance, we found that there was a significant difference between the module mean score of 2014–2015 and those of the other two academic years. However, the module average for 2015–2016 was not significantly different from the module mean for 2016–2017, meaning student performance did not differ significantly despite the improvements in the gamified system. The results above support Hypothesis 3.

## 4.3 | Impact of novelty effect in the two gamified iterations

Hypothesis 4 stated that the novelty effect influences student engagement in a way that engagement would decline over time. Figures 4–7 showed patterns of student engagement in ELs and SLs in PPD in two academic years. From Figures 4 and 5, the completion rate for an average EL activity, generally speaking, increased from 53% (87.86/166) in academic year 2015–2016 to 78% in 2016–2017 (130.76/168). Figures 6 and 7 showed patterns of SL completion rate by activity. The completion rate for an average SL activity increased from 23% in academic year 2015–2016 (39.43/166) to 29% in academic year 2016–2017 (49.01/168). The bumps and dips reflected different levels of difficulty in learning tasks. Feedback from students suggested that the SL completion depended on student perceptions of the usefulness of an SL activity.

Figures 4–7 showed percentage of student completion on EL or SLs; however, they did not show time of completion. Although ELs and SLs were introduced in a linear fashion, we subsequently realized that their completion time appeared to be unlinked to the order they were introduced. That was unexpected as we had assumed that if students were motivated by the gamification aspect, they would complete activities as they are released, that is, by the deadline in order to get the points. Thus, we recoded the data for each learning activity

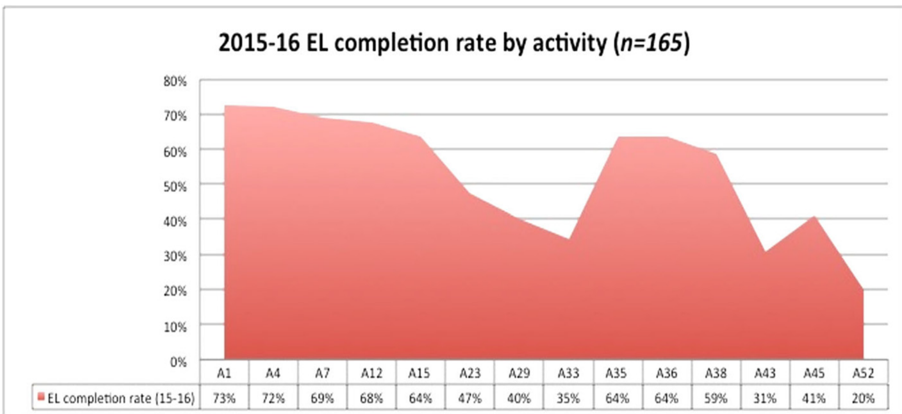



**FIGURE 4** 2015–2016 essential learning (EL) completion rate by activity (*n* = 165) [Colour figure can be viewed at wileyonlinelibrary.com]

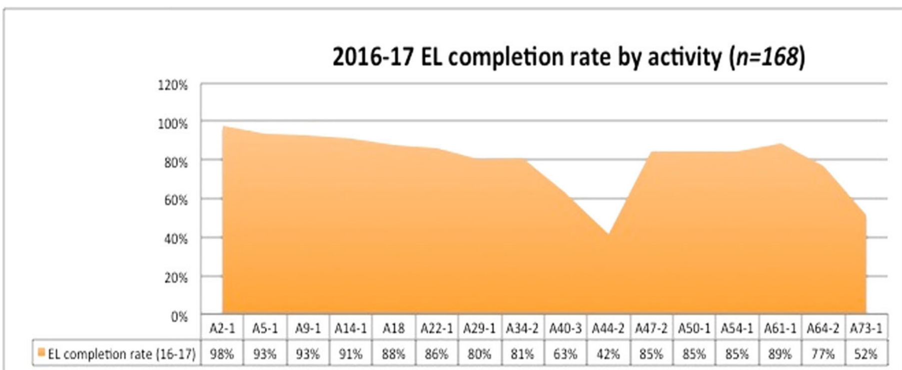



**FIGURE 5** 2016–2017 essential learning (EL) completion rate by activity (*n* = 168) [Colour figure can be viewed at wileyonlinelibrary.com]

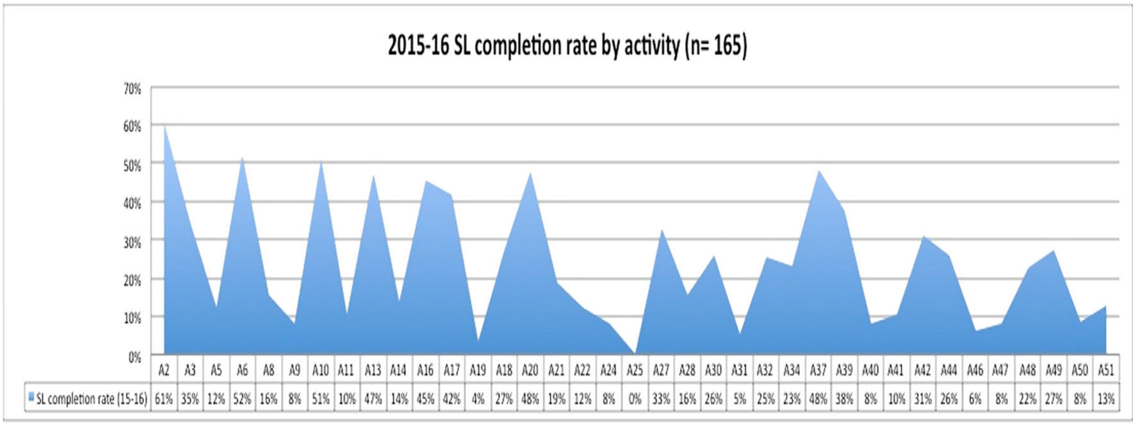



**FIGURE 6** 2015–2016 super learning (SL) completion rate by activity (*n* = 165) [Colour figure can be viewed at wileyonlinelibrary.com]

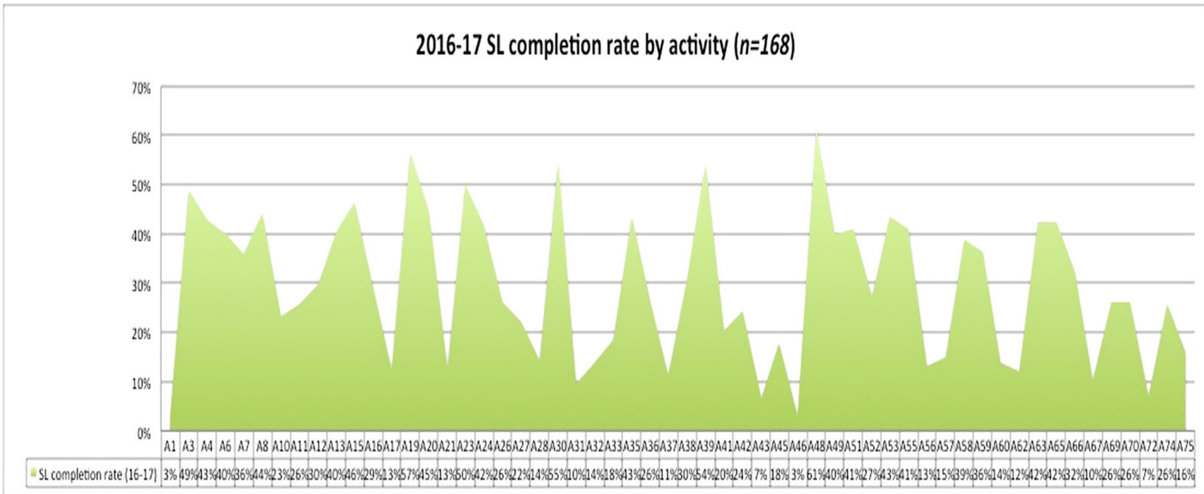



**FIGURE 7** 2016–2017 super learning (SL) completion rate by activity (*n* = 168) [Colour figure can be viewed at wileyonlinelibrary.com]

based on the actual week when a student completed it. Figures 8 and 9 showed the number of EL/SL completion by week in two academic years, indicating that student "result" engagement (i.e., activity completion) started high in both terms (Weeks 1 and 13), decreased gradually, and then went up again towards the end of each term (Weeks 11 and 24). Furthermore, by comparing Figures 8 and 9, the novelty effect seemed more prominent in the 2015–2016 data than in the 2016–2017 data and more prominent in Term 1 (e.g., drop of

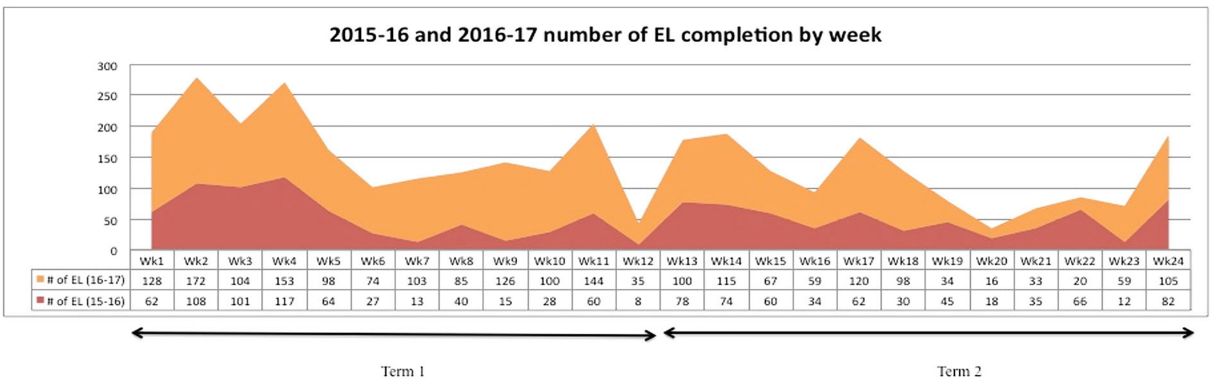



**FIGURE 8** 2015–2016 and 2016–2017 number of essential learning (EL) completion by week [Colour figure can be viewed at wileyonlinelibrary.com]

engagement after Week 4) than in Term 2. This seems to partially support the negative impact that novelty effect has on engagement; however, it also indicates that by the second iteration of the gamified condition, the novelty effect was mollified.

Hypothesis 5 stated that the novelty effect would be less prominent or may even disappear in the second iteration of the gamified condition compared with that in the first iterative design. This means student engagement should be more sustainable across time in the second iteration (e.g., 2016–2017). Regarding the process engagement data, in Sorry. The table 12 attached here.Table 12, ANOVA test revealed no significant differences on either average view count per learning activity or average view count per learning activity for an average student between the 2015–2016 cohort and the 2016–2017 cohort (We missed table 12 in the manuscript.I add it as an attachment here.see Table 12). The results strongly suggest that students' process engagement increased as a result of the online system's improvements but not at a statistically significant level.

With regard to result engagement, we used student completion rate per learning activity as a data point (see Figures 4–7) and conducted an independent samples *t* test on the student completion rate between the 2015–2016 and 2016–2017 learning activities. Table 13 is missing in this manuscript. See the attachment for Table 13.Table 13 showed a significant difference between the 2015–2016 cohort and the 2016–2017 cohort on EL completion rate ($p < .000$), indicating that indeed the improvements resulted in statistically higher engagement. However, differences in the SLs' completion rate between the two cohorts were not significant, indicating that the proportion of students who may be intrinsically motivated remained relatively steady.

Overall, it appears that in the second iteration of the online learning system, the drops in engagement are nearly non-existent (the only exception being Week 12, the end of Term 1), thus suggesting that the novelty effect has been eliminated. This observation seems consistent for both ELs and, to a lesser extent, SLs. The even spread of activity completion indicates that in the second iteration, the system was applied and implemented more successfully and locked the students for longer in the cycle of engagement, well beyond onboarding and well into the endpoint of the module. Thus, in 2016–2017, we witnessed more sustained activity. This observation leads to the inference that in the second iteration, other factors came into play to sustain student online learning engagement. Thus, Hypothesis 5 was supported.

However, this left us with one last question: Why student engagement did not go down when the novelty wore off during the second iteration? We searched for answers in our qualitative data, examined in Section 4.4.

## 4.4 | What sustained engagement in the VLE learning?

As informed by the gamification design literature, the increased engagement was due to the improvements on the gamified system, which addressed a number of game design issues in the second iteration, including the novelty effect. After the interpretative content analysis, the data are summarized and presented in Appendices D and E in the Supporting Information.

Although many responses showed that students were extrinsically motivated to engage in both ELs and SLs, the types of extrinsic motivation differed markedly. ELs were viewed as compulsory learning, instrumental to their module performance. For them, the gamified elements did not seem particularly relevant. Though some students thought SLs were compulsory and instrumental to assessment performance, more students engaged in SLs because of the gamification elements. That is, the gamified motivational learning system provided challenges, rewards, and opportunities to compete with other learners and that was an attractive extrinsic motivator for students to engage with SLs.

Another remarkable insight from the data was related to SDT's identified regulation concept. ELs and SLs seem to have tapped into students' self-valued goals, which afforded the activities with personal importance. Students wanted to engage in these learning activities because they wanted to understand the subject, learn new things, and

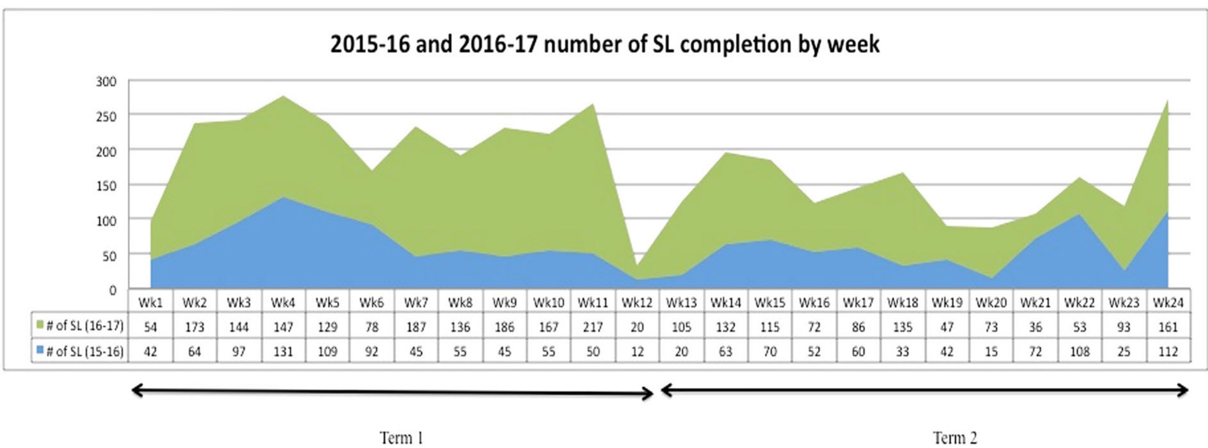



**FIGURE 9** 2015–2016 and 2016–2017 number of super learning (SL) completion by week [Colour figure can be viewed at wileyonlinelibrary.com]

find out if they are right or wrong. Learners were locked into the gamified learning system because of the perceived learning benefits. That is why perceived usefulness was a frequently cited reason for engagement in ELs and SLs Table 14 should be Appendix D and Table 15 should be Appendix E.(see Tables 14 and 15). Students found ELs and SLs useful in understanding the module topics and/or refreshing their understanding of key concepts. However, most students reported that the usefulness of ELs is linked to assignment completion (short-term goals), whereas most students perceived SLs useful because SLs completion improved their skills and knowledge development (long-term goals).

Thus, it seems that our online gamified learning system achieved considerable sustained engagement primarily because it was perceived useful and also because of the triggering of intrinsic motivation via SLs. The motivational affordances from the gamification design clearly affected students' psychological state. The majority of students in SL perceived learning as a challenge, fun, and emotionally uplifting.

Figure 10 summarizes student responses as to why sometimes students did not engage in ELs. Based on 53 answers provided by 44 students, the two main reasons were commitment to other modules (37.74%) and forgetfulness (18.87%). PPD modules were not perceived as important as other subject-specific modules. Also, the EL completion is a portion of the engagement assessment that is only 10% of the final mark or grade value. Some students may choose to prioritize other learning activities over ELs when being overloaded with module work. The data indicate that for more than half the students, lack of engagement was the result of forgetfulness or commitment to other modules overwhelming engagement with the PDP module. It appears that improved engagement with the gamified system in the second year, though not statistically significant enough, may well be linked to the weekly communications by the teaching team rather than any other improvements in the system.

# 5 | DISCUSSION

## 5.1 | Gamified VLE design implications

Although it is assumed that in the digital era, teacher practitioners would be competent in using educational technologies, research shows that general technological competences (e.g., the ability to navigate commonly used hardware and software) do not guarantee competence in effective pedagogical and educational use of technology (Uerz, Volman, & Kral, 2018). McLaughlin (2013) revealed, for example, a great variation in Scottish HE academics' use of VLE tools. Most educators would use VLEs for file storage, posting announcements, and delivering learning materials but would use less VLE reports to track student progress or to engage students in collaborative activities via discussion boards, Wikis, or other collaboration tools. Respondents also acknowledged that although VLEs have the potential to enhance the student experience, there is a need to develop expertise in developing VLE systems that enable and realize that potential.

Our research contributes to educational practice and computer-enabled learning by inviting practitioners to reconsider their approach to developing online learning systems. Specifically, we suggest that an iterative process in designing a computer-based gamified learning system can help iron out the flaws in the original design of the system. Rather than listing learning activities on a VLE and treating the VLE as file repositories, developing a "game narrative" with the support of VLE elements can successfully and sustainably deliver meaning in the VLE context. An online gamified learning system must be embedded in the curriculum to develop a sensible narrative and transcend the novelty effect, inherent in its introduction. This approach to designing a system is independent of the VLE; our system was implemented in Moodle, but with reasonable adjustments, it could easily be applied in other VLEs, such as Blackboard and WebCT.

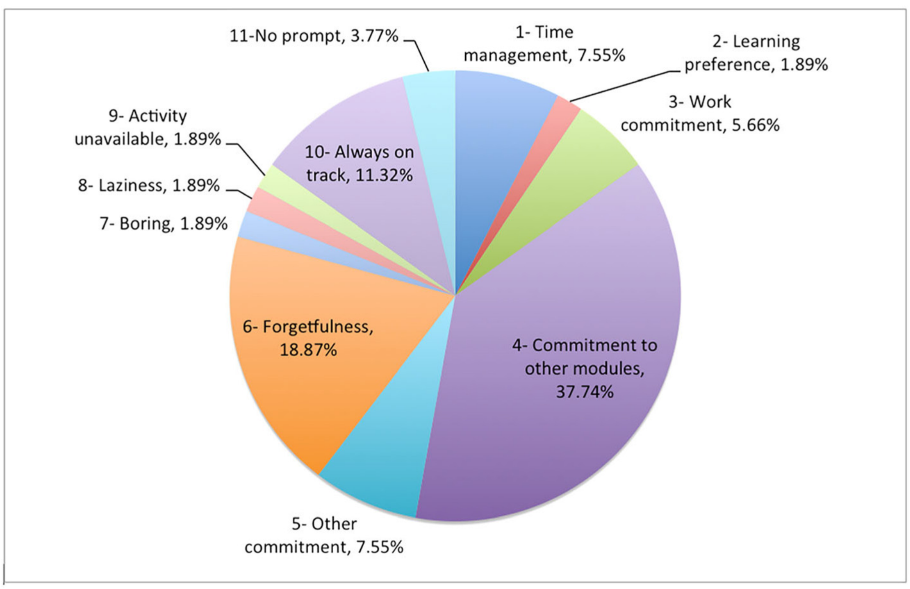



**FIGURE 10** Reasons for nonengagement in essential learning activities [Colour figure can be viewed at wileyonlinelibrary.com]

Evidence of sustained engagement was found in both ELs' and SLs' data. However, the meaning of engagement with the VLE differed: For students focusing on ELs, it was an instrumental, extrinsically motivated learning system that helped them do better in the module, whereas for the learners who engaged with SLs, the system afforded a different range of motivations beyond the perceived usefulness and instrumentality of the system. For a substantial proportion of the cohort in the second iteration, the engagement with the gamified learning system was intrinsically driven and transcended the novelty attraction of a gamified online learning system to become a habitual, playful, game-like activity, overcoming the novelty effect.

## 5.2 | Creating meaningful gamification

This study enhances our understanding of gamification research through quantitative findings, by suggesting the extent to which gamification influences student engagement. The number, level of engagement, and performance of students in the gamified deliveries far outstripped those of the students in the nongamified deliveries. Students seem to be attracted to the unique VLE and actively participated in learning activities. Overtime, there seem to be a point of saturation, as shown in the case of the first iteration of the gamified system, where once the students got used to the gamified elements in the VLE, their engagement with ELs in particular wanes, indicating that the novelty effect onboarded students onto the system but eventually led to negative impact on engagement. However, in the second iteration of the gamified system, we were able to sustain engagement with the ELs, and the novelty effect of the gamified learning system only had the positive onboarding impact, and we experienced no drop in engagement once the novelty wore off. It seems that once the novelty of the gamified system wears off (Hamari et al., 2014), common extrinsic motivators of gamification design (e.g., points, badges, and leader board) lose their influence on student engagement and were uniformly absent in the qualitative data we obtained with regard to ELs. For some students, the saturation of extrinsic motivators results in reduction of engagement, which explains why Hypothesis 4 was partially fulfilled. Thus, not every gamified learning system can provide a meaningful, sustained engagement to the students. Especially, if a system focuses only on gamified elements that resemble external motivators, it will very likely be negatively affected once the novelty wears off. The work of Landers et al. (2018) suggested that apart from the gamification elements, design-irrelevant context factors (e.g., pedagogical factors) contributed to sustained student engagement. This idea, also supported by Glover (2013), that although gamification can make learning more engaging, it should not be viewed in isolation to other tools and methods.

In our gamified learning system, we attribute its relative success to an integration of gamified learning design and pedagogical principles to achieve a "meaningful gamification" (Nicholson, 2015) experience, which ultimately satisfies learners' psychological needs of competence, autonomy, and relatedness (Leese, 2009). If a gamified learning journey consists of discovery, onboarding, engaging, and end game (Conejo, 2014), we may conclude that a gamified learning system helps greatly with onboarding users, but on its own, it cannot keep them once the novelty effect is gone. In our case, the learners were locked into the system because they perceive "meaningfulness" in their learning experience beyond the novelty of a gamified learning system.

In the recipe for meaningful gamification, Nicholson (2015) proposed six elements: play, choice, exposition, information, engagement, and reflection. In our gamified learning system, "play" and "choice" were reflected in those optional SLs that were designed to allow for freedom of choice and to facilitate the freedom to explore and the possibilities to fail within safe boundaries. In terms of exposition, a gameful narrative for student learners was created, and "the rules of the game" were made clear from the beginning. Regarding "information," the teaching team's regular communication about the importance of learning activities as well as the quality and relevance of the learning activities to the module's learning outcomes were well received by students. In addition, tutor feedback was provided to students' submitted work, and therefore, the "engagement" element was successfully incorporated as qualitative student feedback suggested that they found SLs useful not only for assessment preparation but also for personal development and found that ELs facilitated their learning in the seminar and helped them engage with the sessions. Finally, the "reflection" element was evident as students expressed that both ELs and SLs have contributed to learning improvement. All these elements create conditions for "meaningful gamification" (Nicholson, 2015), shifting students' regulation from non-self-determined (i.e., extrinsic motivation or introjection) to self-determined (i.e., identification, integration, and intrinsic motivation; Ryan & Connell, 1989), which was thought to intrinsically motivate students and therefore deepen the long-term engagement and learning experienced by the users.

## 5.3 | Engagement: How it is measured matters

An unexpected insight from this research provides a cautionary note: Depending on the way student engagement is measured, one can evaluate quite differently the effectiveness of a gamified system. When we originally used "views of a learning activity" as an indicator, we found that the "traffic" in gamified modules was higher than that in nongamified modules (Table 8). However, traffic (visits) does not mean actual engagement in terms of learning activity completion. Then we switched to users' activity completion (rates) as a second, more robust indicator of learning engagement (Figures 4–7). Even though this measure showed actual engagement, it did not account for the time dimension, that is, when a student completed a learning activity. Therefore, a third indicator, number of activities completed by week, was used (Figures 8 and 9), which allowed us to notice the novelty effect; that is, we noticed that the activity in the first iteration dropped a few weeks after the introduction of the new learning system. We also realized that some students engaged in previous weeks' ELs or SLs weeks after the activities were first introduced. This implies that the gamification design that was using the competitive nature (through deadlines) of the learner was not the only determinant of overall engagement (Harviainen, Lainema, & Saarinen, 2014). The self-paced design of the system where learning activities can be taken anytime may also facilitate flexibility and autonomy in learning, and it seems to have encouraged in our case engagement and deeper learning (Deci & Ryan, 2012). This was a salient aspect of our gamified online learning system and a contributor to its success as it became very popular among mature students and students in part-time employment (authors' reference).

In summary, our 2-year gamification project provided empirical evidence in support of the use of gamified learning systems within a VLE. Our iterative design did improve the gamified system in the second year and enabled higher levels of student engagement, overcoming the novelty effect. The increase in learning engagement and performance across both years of the gamified intervention indicates that there was significant success vis-à-vis the nongamified version of the module and the results of an unrelated yet highly engaging nongamified business module. The noted improvements between the first and second years of the gamified system indicated that the main issue resolved was the novelty effect. However, they were not statistically significant as it appears that the first iteration was well designed and achieved high levels of engagement and performance, even though not consistently sustained, with the second iteration only achieving marginal gains and eliminating the novelty effect.

## 6 | CONCLUSION

In conclusion, the computer-based gamified learning system took learners on board and enabled their learning. Importantly, the gamification elements alone did not sustain engagement, although they helped with the discovery and onboarding of the students. That lack of sustained engagement is often dubbed as the novelty effect, and our system was able to overcome it, especially in its second iteration. The emphasis on a coherent narrative and the design of an online gamified learning system with embedded pedagogical elements such as the careful selection and usefulness of learning tasks, clearer expectations, regular communication, and feedback enabled the students to learn, leading to high and sustained levels of engagement. The emphasis on a coherent narrative enabled students to take a learning journey that moved them beyond the gamification aspect of the system and thus progressed them from a state of extrinsic motivation to more intrinsic-like states of being. Our study demonstrates that these pedagogical factors are in line with ingredients of "meaningful gamification."

Thus, designers of gamified systems and VLEs should implement such context-specific practices that reduce the impact of the novelty effect that gamification may have on learners by making the system pedagogically relevant to the audience it addresses. It is not the technology that is the limiting factor in computer-based gamified systems, it is often the relevance of the content and the manner that this content is delivered. There are clear indications that having a clear communication strategy in delivering that coherent narrative has an important impact on the users and thus on the success of the learning system.

There is a limitation in our study: We gamified the computer-based learning aspects of the module and did not consider the offline aspects of the module. Thus, our assessment of student engagement may be incomplete. A possible solution to this limitation may be incorporating the offline learning into the narrative of a competition and recording the activities and performance onto the system to achieve a fuller picture of student engagement.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.


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