Continuance Use Intention of a Gamified Programming Learning System

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Abstract. The gamification of education offers various advantages including increased engagement of students. Limited research is currently available that can shed light on the influence of various gamification elements in on-line learning environments on the engagement and continuance use intention of students. The objective of the study was therefore to investigate the influence of gamification elements in on-line learning environments on the engagement of students and consequently on the continuance use intention of students. The population of the study consisted of 192 second-year Information Technology students enrolled at the Central University of Technology (Free State). An on-line questionnaire was used to collect data from students. The results indicated that the rewards that students received, as well as their self-expression and status in a gamified programming learning environment are very important to enhance their engagement in these environments. Furthermore, the study revealed that meaningful experiences in on-line learning environments is the leading predictor of continuance use intention of students in gamified programming learning environments. The results of this study could assist instructors in information technology departments of higher education institutions to incorporate gamified programming learning environments into their learning offerings.

Keywords: Gamification · Online learning environments
Khan Academy

1 Introduction

Gamification of education is an emerging approach for increasing student engagement and motivation in educational settings [9]. The excitement surrounding gamification results from the belief in its potential to make monotonous tasks more enjoyable [24]. The term 'gamification' has been defined in several ways, such as 'the phenomenon of creating gameful experiences' [16], or 'the use of game design elements in non-game contexts' [8]. Gamification in education refers to the introduction of gameful experiences and game design elements in the design of learning processes [9].

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Regardless of the widespread belief in the benefits of gamification, various studies have stressed the difficulty of sustaining user engagement due to the fact that effects of game elements are often short-lived [18,30]. A substantial percentage of gamified information system users seemingly discontinue their engagement with the system within a short period after initial system adoption [15,31]. Therefore, it is essential to understand the mechanisms that explain why users would continue to use gamified information systems in higher education settings [9]. Without an understanding of how a gamified electronic learning system engages students and encourages them toward continued system use, higher education institutions will forfeit the opportunity to make productive use of these emerging technologies [40].

The purpose of this paper is to investigate the influence of gamification elements in on-line learning environments on the engagement of students and consequently on the continuance use intention (CUI) of students. The paper is structured to provide an overview of prior research conducted on CUI with regard to e-learning contexts in Sect. 2, followed by an explanation of the gamified on-line learning environment that was used in this study (called Khan Academy) in Sect. 3. In Sect. 4, the development of the theoretical model for the study is discussed. Section 5 presents the research method, followed by the results in Sect. 6. Discussions are given in Sect. 7 and the conclusions in Sect. 8.

2 CUI in the E-learning Context

While previous research in e-learning has focused on the initial adoption [43] the ultimate success of an information system (IS) is really determined by the continued usage thereof. Until the continuous usage of an IS can be confirmed, it is premature to classify it as a success [44]. CUI can be defined as an individual user's intention to continue using a particular IS or the long term usage intention of a technology [2]. A review of prior research that was conducted in the wider e-learning domain in terms of CUI is summarized in Table 1, sorted according to the year of study.

After analysing the tabulated CUI research from the broader e-learning domain, the following trends were observed. Only two studies focused on game-based learning environments [23,42], with other e-learning environments not featuring any game based elements. Furthermore, studies focusing on the CUI of e-learning systems have only been conducted in countries like Brazil, Canada, Taiwan, USA and Turkey. It can be concluded that research on CUI in the e-learning context has not yet reached maturity, since approximately only one study per year was conducted over the last ten years. This study will therefore contribute to the limited existing body of knowledge of CUI in the broader e-learning context and specifically in a gamified electronic learning context in an area that has not featured prominently in the literature.

Table 1. Prior research conducted on CUI in the e-learning context

Reference	Year	Country of study	Type of e-learning
[35]	2005	Canada	On-line learning system
[33]	2006	International	E-learning course
[42]	2009	Taiwan	Business simulation games
[21]	2010	Taiwan	Web-based learning system
[23]	2011	Taiwan	Business simulation games
[5]	2012	USA	Information-oriented mobile applications
[32]	2015	Brazil	Learner management system (Moodle)
[7]	2016	Turkey	On-line learning portal

3 Khan Academy

3.1 Learning Environment

Khan Academy originated as a set of YouTube tutorials which MIT graduate Sal Khan made for his cousin who was struggling with mathematics. Today it is a multi-million-dollar non-profit organization with the stated mission of 'not-for-profit with the goal of changing education for the better by providing free world-class education for anyone anywhere' [27]. It provides a comprehensive set of resources, with over 5000 courses delivered in 65 languages. The Khan Academy website has delivered more than 600 million lessons worldwide, with four million exercises completed per day [27].

In addition to mathematics, Khan Academy covers many areas of science, arts, humanities, computing and economics. The computer programming section of Khan Academy offers the following subjects: Introduction to JavaScript and Animation; Introduction to HTML/CSS: Making web pages; Introduction to SQL: Querying and managing data; Advanced JavaScript: Games and Visualizations; Advanced JavaScript: Natural simulations [19].

The Khan Academy learning environment mainly comprises watching a video explanation of the topic followed by self-assessments in the form of questions (multiple choice or short answer). In contrast, the computer programming learning environment involves a code editor and execution window as shown in Fig. 1 [27]. The programming subject, from Khan Academy, that was investigated in this paper was 'Introduction to SQL: Querying and managing data'. The code editor and execution window of one of the SQL lessons are shown in Fig. 1.

The left-hand frame comprises an editor with the SQL code that produces the output in the right-hand frame. The video is a demonstration of how to code the solution for a given topic. In this example, it is restricting group results with HAVING in SQL [19]. The video contains a developer discussing the development of the code. While the code is being generated, the output on the right changes instantaneously to reflect the code that is added in the editor window [19]. At any

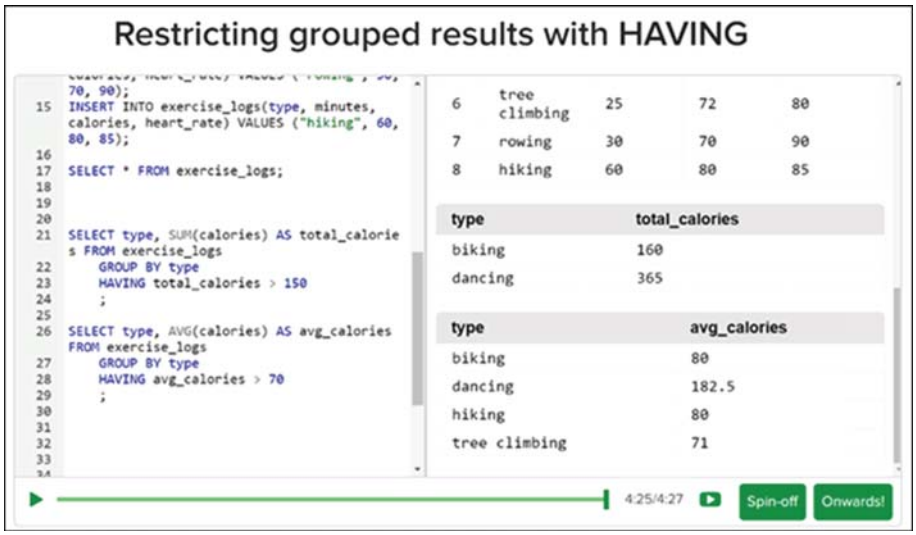

Fig. 1. SQL programming environment

given time, the user can pause the video and start to change the code, and the alterations are instantly reflected in the right-hand frame [19]. The SQL lessons demonstrate various SQL topics and directly after the video demonstration on a particular concept, the user is provided with the opportunity to complete a challenge by typing SQL code into the editor window. Instead of compilation errors, a character appears in the output frame with the explanation of the error, along with a prompt to show the user where the error occurs in the code as shown in Fig. 2 (on the left). Once the error has been corrected, and the challenge is successfully completed, the user is rewarded with points and a character that appears on the screen telling the user that all steps have been completed; see Fig. 2 on the right.

3.2 Gamification

Khan Academy has implemented several specific gaming elements within its on-line environment including badges, points, specific goals, leader boards and progress indicators which will be discussed next. Khan Academy has five different types of badges which can be earned while interacting with the learning material: see Fig. 3 [19]. The most common badge is the Meteorite (viewed as entry-level) with the Black Hole being the rarest (viewed as advanced-level). In addition, completing activities will allow the students to earn energy points, which are then displayed on their personalised dashboard, along with the number of videos they have completed. Moreover, Khan Academy gives a student the opportunity to enroll in a class with an instructor. The instructor can assign various goals to

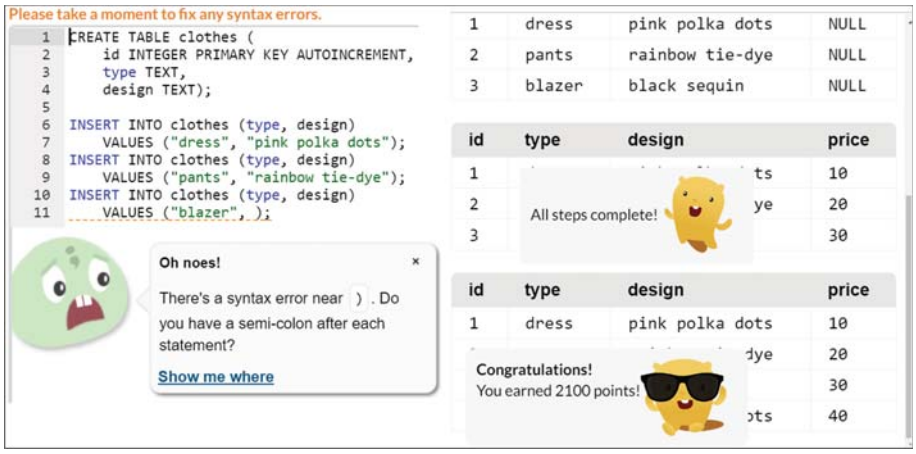

Fig. 2. Error condition (left), success condition (right)

students with due dates when these goals should be achieved. Goals can also be suggested by the system, based on past performance, or may be defined by the user.

Fig. 3. Badge types in Khan Academy

In order for users to see their status on a leader board in Khan Academy, they must be enrolled in a subject with an instructor. The instructor has access to the leader board consisting of a list of students and the number of energy points they have gained and minutes they have spent on specified activities. In order for users to see their rankings, the instructor should post the leader board for all users to see. Furthermore, Khan Academy provides several different indicators

for showing progress to the user. It will display information for achieving goals (Fig. 4: on the left) as well as activity indicators (Fig. 4: on the right).

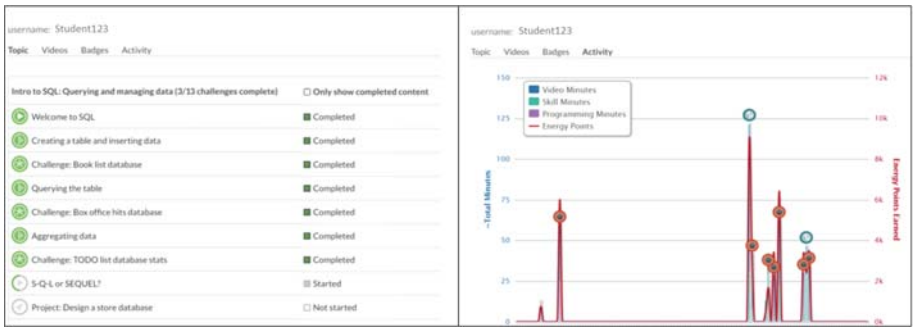

Fig. 4. Progress indicators in Khan Academy

Activity information is displayed through a bar graph indicating the amount of activity within Khan Academy each day and how many energy points were earned within a specific time period. Khan Academy also sends each registered user an email once a week detailing the progress that was made during that particular week.

4 Theoretical Model

A theoretical model was developed in order to predict the influence of gamification elements in the Khan Academy on-line learning environment on the engagement of students and consequently on the CUI of students. Gamification research over the past decade provided many constructs that might predict a user's CUI, including social influence [13], attitude toward a gamified IS [14], self-efficacy and satisfaction [40]. Flow experience (FE) is one of the predominant constructs that has been used to explain the CUI of users in various gamification and game-based learning environments [17,23]. Flow is a concept that was recognised and named by [6] to describe the psychological state of operation in which a person performing an activity is completely immersed in an emotion of full immersion, energised focus and enjoyment [6]. This emotional state is considered to be so rewarding that a person is inherently motivated to repeat the activity for its own sake [12]. When studying the CUI of users, researchers find this characteristic of flow particularly useful to predict the CUI of users. According to [6], the characteristics of flow include a loss of self-consciousness, a distortion of time, intense concentration, and a sense of being in control [37]. FE is therefore the first construct that was included in the theoretical model in order to predict the CUI of students towards a gamified learning environment. FE in the current study was measured by a combination of four constructs namely enjoyment, immersion, time distortion and control [1].

FE has been used extensively in IS research as a construct that represents the depth of engagement from a hedonic viewpoint. However, researchers presently stress that a gamified IS should not rely solely on hedonic user experience that is based on deep engagement, but it should also focus on the creation of pathways that will assist users to discover meaningful relations between their own interests and system use [30,39]. Meaningful engagement (ME) refers to a state of mind in which a person experiences a sense of meaning and deeply comprehends the essence of the experienced events [40]. ME derives its theoretical basis from the Self-Determination Theory which is focused on what motivates an individual to make choices without external influence [29]. In a ME state, people are constantly aware of the contextual situation in which given tasks are performed, and people actively discover new paths to achieve their goals and feel that they are utilising power to meet environmental challenges [30]. Consequently, a users' ME in the interaction with the gamified IS has been proposed as a key determinant for the continued use of the system [4]. ME was therefore selected as the second construct that was included in the theoretical model in order to predict CUI. Drawing on existing literature, ME was measured in the current study by a combination of three constructs, namely self-expansion, meaning, and active discovery [40].

One of the key objectives of gamification is to make an activity more engaging [9]. To identify the antecedents of FE and ME, a literature search was conducted in order to identify frequently used gamification elements that influence user engagement. Four gamification elements were identified from gamification literature, namely rewards, status, competition, and self-expression, that may increase user engagement in the context of gamification [3,16,36,38]. The rewards construct in this study refer to the perception of students that it is possible for them to earn and accumulate points, and that they will have the possibility to earn more points if they try harder [18]. In addition, the status construct refers to the perception of students that it is possible for them to have a higher status than others, and to be regarded highly by others, and that it is possible for them to increase their status [47]. Moreover, the self-expression construct in the study refers to the perception of users that it is possible for them to express their identity through game elements in a way that is distinct from others [25]. Finally, the competition construct refers to the perception of students that it is possible for them to compete with others and that it is possible for them to compare their performance to other students and to threaten the status of other students through their active participation [20]. These four constructs were therefore entered into the model created for the study as antecedents of FE and ME. The theoretical model that was developed for the study is shown in Fig. 5.

5 Method

The research instrument that was used to test the theoretical model of the study is a survey. Multiple-item summated rating scales were used to measure each construct that consisted of a 7-point Likert scale with two anchor points namely (1) 'Strongly Disagree' and (7) 'Strongly Agree'. The items in these scales were

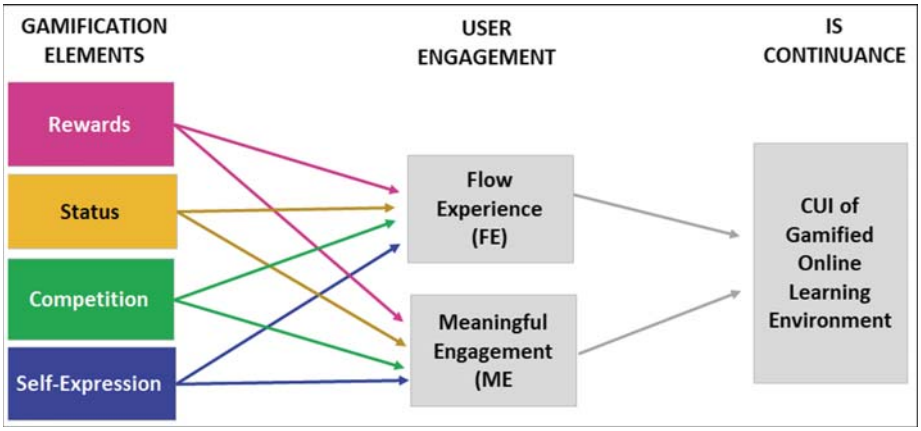

Fig. 5. Theoretical model for CUI of gamified on-line learning environments

adapted from existing literature in order to ensure content validity of the survey instrument. The items were adapted by replacing the specific type of IS used in the original wording of the item to 'Khan Academy'. For example if the original item was 'I enjoy using the Web' [1], the adapted item would be 'I enjoy using Khan Academy'.

Scales for CUI contained 3 items that were adapted from [22]. Scales for FE contained 14 items and 4 sub scales, namely immersion (3 items), time distortion (3 items), control (3 items) and enjoyment (3 items) that were adapted from [1]. Scales for ME contained 9 items and 3 sub scales, namely self-expansion (3 items), meaning (3 items) and active discovery (3 items) that were adapted from [40]. Scales for rewards contained 3 items and were adapted from [18]. In addition, scales for status contained 3 items and were adapted from [47]. Scales for self-expression contained 3 items and were adapted from [25]. Finally, the scales for competition contained 3 items and were adapted from [20]. The reliability of each scale of the survey instrument was evaluated by calculating Cronbach's alpha [11]. Acceptable values of alpha range from 0.70 to 0.95 [11]. Cronbach's alpha for the constructs were as follows: CUI (0.77); FE (0.85); immersion (0.70); time distortion (0.78); control (0.70); enjoyment (0.75); ME (0.91); self-expansion (0.75); meaning (0.75); active discovery (0.71); rewards (0.74); status (0.70); self-expression (0.70) and competition (0.70). All scales fell into the acceptable range and the data collection tool for the study was deemed to be a reliable measuring instrument. Regression analysis using SPSS version 19 was used to analyse the collected data.

The population for the study was limited to students enrolled for the subjects Databases II (DBS216C) and Information Systems II (NIL20DB) at the Central University of Technology in the Free State province. The content of these subjects offered in the first semester are the same. The theory component of the subjects focus on database design while the practical component focuses on SQL

database programming. In the practical periods of these subjects, students were exposed to the 'Introduction to SQL subject on Khan Academy. The lecturer of these subjects created a subject on Khan Academy (called Databases II) and then enrolled all the students for this subject. The instructor assigned various tasks to students in Khan Academy, which they had to perform in the Khan Academy environment. All these assignments were part of the 'Introduction to SQL' subject on Khan Academy.

Students were exposed to the Khan Academy on-line platform for the first academic term. After this period, a survey was administered on-line by making use of QuestionPro. The link to the questionnaire was placed in the learning management system used by the students, and students were asked to voluntary complete the questionnaire. Ethical procedures as stipulated by the Central University of Technology were adhered to.

6 Results

From Table 2 it can be seen that 72% of the students were male, and 28% female. Furthermore, Table 3 shows that the majority of students (64.7%) accessed Khan Academy two or three times a week, and that 15.7% of students accessed Khan Academy more than three times a week.

Table 2. Gender

Gender	*n*	Percent
Male	139	72%
Female	53	28%
Total	192	100%

Table 3. Khan Academy Access per Week

Access per week	*n*	Percent
Not at all	3	1.5%
About once a week	31	15.2%
Two or three times a week	132	64.7%
More than three times a week	32	15.7%
Total	204	100.0%

Three regression models were constructed in order to test the theoretical model of the study. These results are discussed next. The first stepwise multiple

regression model was constructed in order to determine what predictive power the four gamification elements (rewards, status, competition and self-expression) had towards FE. Three gamification elements, namely rewards ($\beta = 0.333$, $p < 0.001$), self-expression ($\beta = 0.317$, $p < 0.001$) and status ($\beta = 0.233$, $p < 0.001$) made a statistical significant contribution to the prediction of FE and were entered into the model. This resulted in a significant model $R^2 = 0.559$, F(3,192) = 84.53, $p < 0.001$, adjusted $R^2 = 0.552$. The adjusted R^2 value indicates that approximately 55% of the FE construct could be accounted for by the rewards, self-expression and status constructs. Competition ($\beta = 0.018$, $p = 0.789$) was the only construct that did not make a statistically significant contribution toward the prediction of FE. The following guidelines, presented by [10], were used to interpret R^2: very weak (0–4%); moderate (16–36%); strong (36–64%) and very strong (64–100%). From these guidelines, it can be seen that the model that was constructed had strong predictive power towards the FE construct.

The second stepwise multiple regression model was constructed in order to determine what predictive power the four gamification elements had towards ME. The following three gamification elements, namely rewards ($\beta = 0.492$, $p < 0.001$), self-expression ($\beta = 0.266$, $p < 0.001$) and status ($\beta = 0.148$, $p = 0.017$) made a statistical significant contribution to the prediction of ME and were entered into the model. This resulted in a significant model $R^2 = 0.606$, F(3,192) = 102.41, $p < 0.001$, adjusted $R^2 = 0.600$. The adjusted R^2 value indicates that approximately 60% of the ME construct could be predicted by the rewards, self-expression and status constructs. As with FE, competition ($\beta = 035.018$, $p = 0.567$) did not make a statistically significant contribution toward the prediction of ME. From the guidelines presented by [10], it can be seen that the model that was constructed had a strong predictive power towards the ME construct.

The last stepwise regression model was constructed in order to determine what predictive power the FE and ME constructs had towards CUI. Both ME ($\beta = 0.464$, $p < 0.001$) and FE ($\beta = 0.276$, $p = 0.002$) made a statistical significant contribution to the prediction of CUI and were entered into the last regression model. This resulted in a significant model $R^2 = 0.503$, F(3,192) = 101.90, $p < 0.001$, adjusted $R^2 = 0.499$. The adjusted R^2 value indicates that approximately 50% of the CUI construct could be predicted by the FE and ME constructs. The resulting model had strong predictive power towards CUI, according to [10]. The results of the stepwise multiple regression models are shown in Fig. 6.

7 Discussion

When the results are investigated, it can be seen that the rewards gamification element had the strongest predictive power towards FE and ME. This result is consistent with research that found that rewards in mobile educational games was one of the most important reasons learners wanted to continue playing these

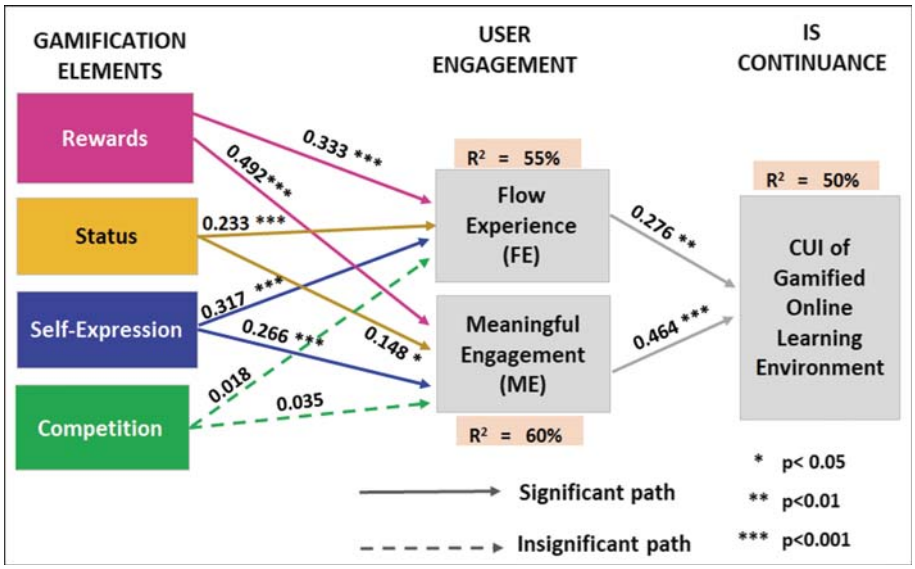

Fig. 6. Results of multiple stepwise regression

games [46]. Moreover, the strong motivational appeal of rewards found in this study can be compared with research that found that learners enjoyed an educational game with in-game rewards twice as much as an educational game without rewards [28]. The implication of this finding is that the rewards that students earn in a gamified on-line learning environment could sustain engagement in these environments which could lead to higher levels of CUI.

The self-expression construct had the second strongest predictive power towards FE and ME. This finding is consistent with prior research that found that providing users with opportunities to express their self-identity through choosing the types and names of their avatars, increased their intrinsic motivation and learning of the subject matter [34]. In Khan Academy, users can customise their profiles by selecting their own avatar which develops and grows as the user makes progress. The implication of this finding is that in a gamified learning environment it is important to provide users the opportunity to express their unique identity in order for them to distinguish themselves from others.

The status gaming element also made a statistical significant contribution towards the prediction of FE and ME. Users will be able to observe a higher status in a gamified environment if they notice that they can efficiently track their performance and level-up when they achieve certain mileposts [41]. These results can be compared to research conducted by [40] that indicated that the status construct made a statistical significant contribution towards the prediction of FE ($\beta = 0.388$, $p < 0.001$) and ME ($\beta = 0.326$, $p < 0.01$) in their study. This implies that when users are able to effectively track their performance in a gamified learning environment, it could improve the engagement of users.

The only gamification element that did not make any statistical significant contribution towards the prediction of FE or ME was the competition construct. These results are similar to various findings in digital game-based learning environments that showed that learners strongly preferred to collaborate with other learners and did not want to compete with them [45,46]. Another reason could be that some students at the bottom of the leader board become downtrodden and disheartened, thinking that it is not possible for them to surpass their fellow students, which lead them to disengage with the system [46].

The study lastly confirmed that the FE and ME are both statistical significant predictors of the CUI in gamified learning environments. What is noteworthy in the current study is that ME had a much higher predictive power (nearly twice as much) towards CUI than FE. This finding is in accordance with an experiential study that found that users of a gamified IS consider FE to be less important than ME for their CUI [26]. This study showed that users who perceive their interaction with an IS as personally meaningful were more likely to continue to use the IS [26]. This implies that it is more important for students to perceive that they are meaningfully engaged by the system, as opposed to experiencing a state of flow. Moreover, higher perceptions of ME will lead to higher levels of CUI.

8 Conclusions

The contribution of this study is that it sheds lights on the influence that several gamification elements have on sustaining a user's engagement in a gamified programming learning environment. Moreover, the theoretical model of the study made a novel contribution to the literature on CUI by incorporating gamification elements as predictors of FE and ME in a CUI model for an e-learning context. The model developed for the study indicated that the rewards that students receive, as well as their self-expression and status in a gamified learning programming environment are very important to enhance their engagement in these environments. Furthermore, the study revealed that ME in on-line learning programming environments is the leading predictor of CUI of students in these environments.

A shortcoming of the current study is that the population was limited to two student groups in one province in South Africa with only one gamified learning environment being investigated. Therefore, the results obtained from the study cannot be generalised to the broader population of South Africa or to other gamified learning systems. Suggestions for future research would therefore be an invitation to researchers at institutions from other provinces to test the model developed for the study in similar or other gamified learning environments in order to validate the findings of the current study.

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