

Students' Perceptions of Gamification Mechanics and Dynamics in a Gamified Learning Environment

Full Paper

SACLA 2019

© The authors/SACLA

Marisa Venter ^[0000-0002-5295-1014]

Central University of Technology, Free State, South Africa
marisa@cut.ac.za

Abstract. The infusion of learning material with game elements have been used to capture the attention of students, improving engagement and motivation. Some gamified learning environments have not been successful and educators should pilot test these platforms before full scale implementation. The goal of this study was to explore a gamified learning environment to determine if the use thereof could successfully be incorporated in a first year programming module. A group of 92 students used the Khan Academy platform for one academic term. Semi-structured interviews were used to collect qualitative data from students. The results indicate that students enjoyed using this platform and a large percentage of students reported that the lessons on the Khan Academy platform assisted them to better understand programming principles. The gamification elements in the platform namely points, badges and a leaderboard also motivated students to keep using the platform.

Keywords: Gamification, Points, Badges, Leaderboard, Khan Academy.

1 Introduction

“You can’t design a gamified experience only by putting points, badges, and leaderboards to it. Gamification is an art and every gamified adventure is unique. So you won’t be able to find a repetitive pattern to make everything engaging over and over again” [1]. Despite a prevalent confidence in the advantages of gamification, evaluation of gamification successes have often been ambiguous and cynical [2]. One reason for the failure of many gamified applications might be that designers have failed to give heed to the important principle emphasised by Ali Akhtari in the opening sentence of this paper.

Gamification, refers to the usage of game elements, such as game mechanics and design techniques, to enrich non-game settings in order to motivate and engage users [3]. Since the widespread use of gamification, less than a decade ago, it has been used

for educational purposes, as well as in other settings such as marketing and health [4]. When scrutinising reviews on how researchers have studied gamification in education, most studies report an emphasis on engagement and motivation as main variables [5, 6]. However, evidence is inconsistent about the impact of game elements, such as points, badges and leaderboards on user engagement. In addition, it is not clear why some gamified applications effectively engage users while others are not successful at all [2]. Programming courses are notoriously viewed as being highly challenging causing negative perceptions and lower levels of motivation among students [7]. The purpose of this paper is therefore to investigate the Khan Academy gamified programming platform as a potential means to improve the engagement and motivation of first year students at a University of Technology in South Africa. Specifically, the following research questions were asked:

- How do students experience the Khan Academy gamified programming platform?
- How do students experience the points, badges and leaderboard game elements in Khan Academy?

The paper is structured to provide an analysis of previous research conducted on gamification in Higher Education institutions in Section 2, followed by an explanation of the theoretical framework of the study in Section 3. In Section 4, the Khan Academy environment is discussed. Furthermore, in Section 5 the research methodology is discussed followed by the results in Section 6, the discussions in Section 7 and the conclusions in Section 8.

2 Gamification in Higher Education

Previous empirical studies that was published in peer reviewed academic journals that investigated gamification in higher education settings were reviewed for the past 3 years (2016-2018). The EBSCOhost and Science Direct platforms were used to locate appropriate studies. Only studies that focused on the usage of gamification elements and gamification of teaching platforms in higher education settings were included in the review. These studies are summarised in Table 1. The following information was reported for every study: a) authors and year, b) topic of study, c) main conclusions, d) advantages e) gamification elements used. A number of studies reported that gamification was beneficial in terms of academic / cognitive related matters including improved student performance (three studies) improved learning outcomes (two studies), higher quality of work (one study), perceived learning (one study), more academic effort (one study), improved attendance (one study) and attention (one study). Reported physiological or emotional benefits included, engagement (eight studies), motivation (four studies), enjoyment (two studies), confidence (two studies), satisfaction (one study) and attitude (one study). The most predominant gamification elements that were

investigated include points (10 studies), leaderboards (seven studies), badges (five studies), feedback (three studies), competition (two studies), challenges (two studies), and rewards (two studies).

Table 1. Review of the literature of gamification in higher education.

Author and Year	Topic	Main Conclusions	Advantages	Gamification Elements
Wiggins, 2016 [8]	Game-based learning (GBL) and gamification in higher education	<ul style="list-style-type: none"> Acknowledged that non-digital GBL is more dominant than digital GBL. Established that the communication faculty were to a large extent not familiar with gamification concepts, but did recognise game elements. 	Not included	Not included
Kuo & Chuang, 2016 [9]	Game mechanics employed in an online platform	<ul style="list-style-type: none"> Established that discussion board, graphical incentives and gamified thematic activities, were the most significant gamification elements for user retention and engagement. Indicated that a website where gamification elements were employed demonstrated an increase in the number of visitors to the site, as well as an increase in the duration of visitation. 	Retention and engagement and	Points, discussion board, leaderboard, graphical incentives, thematic activities, rewards, levels, and invitations
Hew, Huang, Chu & Chiu, 2016 [10]	Influence of game mechanics on student engagement and motivation and	<ul style="list-style-type: none"> Revealed that the use of a leaderboard, points, badges, and enhanced cognitive and behavioural engagement. Discovered that game elements inspired students to select more challenging activities and to deliver work of better quality. 	Engagement, increased effort, and higher quality work	Points, badges, and leaderboard
Morillas Barrio, Munoz Or ganero & Sanchez Soriano, 2016 [11]	Gamified student response systems (SRS)	<ul style="list-style-type: none"> Development of a gamified SRS. Established that gamified SRSs improved motivation, reduced boredom with lectures, and boosted student confidence. 	Motivation, engagement, confidence, and attention	Goal, feedback, challenges, illustration
Buckley & Doyle, 2016 [12]	Student learning and motivation	<ul style="list-style-type: none"> Determined that rewards, rules, feedback, and competition are the main game mechanics to employ in course gamification. Established that gamification motivated students to learn additional material not covered in class. 	Enhanced learning outcomes	Competition, rewards, rules, feedback

Table 1. Review of the literature of gamification in higher education. (Continued)

Author and Year	Topic	Main Conclusions	Advantages	Gamification Elements
Yildirim, 2017 [13]	Student attitude and performance	<ul style="list-style-type: none"> • Identification of main gamification elements. • Indicated that gamification enhanced student attitude towards lessons as well as increased performance. 	Improved learning outcomes and attitude	Collaboration points, badges, leaderboard
Sanchez-Martin, Canada-Canada & Davila-Acedo, 2017 [14]	Student competitive-collaborative attitudes and performance	<ul style="list-style-type: none"> • Showed a statistical significant correlation between grades on the final exam and accumulated points in the game. • Discovered that gamification instigated competitive student behaviour. 	Increased competition	Points and challenges
De Marcos, Garcia Cabot & Garcia Lopez, 2017 [15]	Social gamification	<ul style="list-style-type: none"> • Discovered that the gamified group performed better in practical projects than the group that was used as the control. • Noticed that students portrayed an affirmative attitude towards social gamification. 	Improved student performance	Badges, leaderboard, points, virtual shop
Stansbury & Earnest, 2017 [16]	Meaningful gamification	<ul style="list-style-type: none"> • Discovered that the self-reported learning of the gamified student group exceeded the self-reported learning of the student group that was used as a control. • Discovered that the student group that was gamified, was more motivated, engaged and enjoyed the learning experience more. . 	Perceived learning, engagement, motivation and enjoyment	Points, feedback role-play and narrative
Sailer, Hense, Mayr & Mandl, 2017 [17]	Game design elements	<ul style="list-style-type: none"> • Gamification elements were identified that promoted emotional need gratification. • Identified gamification as a potent means to motivate students. 	Psychological satisfaction	Badges, leaderboard, teammates, avatars and stories
Cakiroglu, Basibuyuk, Guler, Atabay & Memis, 2017 [18]	Effect of gamification on student engagement	<ul style="list-style-type: none"> • Indicated that the usage of points, quests and leaderboards enhanced the engagement of students. • Indicated an improvement in the self-reported levels of student academic effort, confidence, engagement and motivation. 	Engagement, confidence, performance, academic effort, motivation	Leaderboard, points reputation and real gifts

Table 1. Review of the literature of gamification in higher education. (Continued)

Author and Year	Topic	Main Conclusions	Advantages	Gamification Elements
Dias, 2017 [19]	Comparison of student performance and engagement of a gamified course to a course that is not gamified	<ul style="list-style-type: none"> Observed that the student group that was gamified displayed higher pass rates, attendance percentages and participation rates than the group that was not gamified. Identified that advantages were the result of the gamification elements added to the course. 	Performance, engagement, and attendance	Points, badges, and leaderboard
Song, Ju & Xu, 2017 [20]	Influence of points on the engagement of students	<ul style="list-style-type: none"> Indicated that the usage of points enhanced enjoyment and engagement of students. Detected that shy and unfocussed students had the highest likelihood to be engaged in a gamified class 	Enjoyment and engagement	Points
Lin & Kaur, 2018 [21]	Investigating the appropriateness of a game-based learning environment.	<ul style="list-style-type: none"> Students had a positive experience with Kahoot!. Results indicate that Kahoot! is a gamification platform that can enhance extrinsic and intrinsic motivation of higher education students. 	Engagement, motivation,	Competition, quiz, points, fantasy.

3 Mechanics-dynamics-aesthetics Theory

The theoretical base for the study is mechanics-dynamics-aesthetics theory (MDAT). MDAT is a formal approach to understanding games, and it offers an appropriate model to explain how gamification works [22]. The MDA framework was developed by [23] and delineates how game design elements result in certain responses from players. The MDAT model summarises a player's consumption process of a game into three components namely rules, system, and fun. The player first understand the rules of the game, and then proceeds to interact with the system and start to have fun. These three parts match the complements in a game designer's design process: (1) mechanics, (2) dynamics, and (3) aesthetics [23].

Game mechanics allude to the techniques, tools and gadgets that are the foundation that a game is built on, for example points, badges, avatars and leader boards [24]. The addition of game mechanics to an IS permits designers to embed more captivating user experiences into current tasks. These gamified tasks direct and gratify basic human needs, producing the habit-forming experiences that compel users to take part in specified activities, and to come back on a regular basis [25].

Game dynamics in a gamification context refer to fundamental desires system users have. Users have needs for status, reward, achievement, competition and self-expression. Game designers are in possession of the knowledge to address these desires within gaming settings, and gamification now make it possible for these principles to be used in broader contexts [25].

Game aesthetics is the feelings that players experience when they play a game. The emotional reactions from individuals will be dependent on the game dynamics. Emotions could vary from relaxation to excitement, or from rising tension to frustration to name but a few [2]. In classic game settings, game aesthetics refer to explicit types of “fun” that players pursue and experience while interacting with games [23]. When contrasting classic games (where users are looking for hedonic gratification – fun and entertainment) to enterprise gamification it should be noted that users are generally looking for instrumental gratifications where their main aim is to achieve a specified outcome for example learning or recognition that could lead to aesthetics such as confidence or cognisance [26].

MDAT has been created to theorise about classic games, but is adopted in this study for gamified systems, where game elements are used in contexts that are not games. MDAT elucidates that game mechanics like levels, points, badges, avatars and leader boards, set into motion gameplay dynamics like the desire for rewards, status and competition [27]. Even though some game elements tend to generate a specific game dynamics, there does not exist a fixed relationship between game dynamics and game elements. This means that a particular game dynamic can be caused by more than one game element and one game element can trigger multiple game dynamics [2]. Table 2 summarises the most commonly reported game dynamics that can be generated by various game elements (game mechanics).

In addition to the game dynamics showed in Fig. 2 (that is generated by various game mechanics), Umar Ruhi expanded the MDAT of Hunicke et al. [23] by including additional game mechanics and game elements in the “MDA framework and the 20 Cs of meaningful enterprise gamification” [26] as shown in Fig. 1. The expanded MDA framework was developed after rigorous research of gamified systems used in industry and the goal of the framework is to explain the relationships between the motivations of users, gameplay elements, and technology functions and characteristics that constitute productive gamification enterprise interventions [26].

Table 2. Game dynamics and related game elements.

Game dynamics	Related game elements / mechanics
<p>Rewards:</p> <ul style="list-style-type: none"> • People are motivated by getting something of value given for performing some action. A reward is offered after the incidence of a behaviour or action intending to cause that behaviour to recur [25]. 	<p>Points, Levels, Badges/trophies:</p> <ul style="list-style-type: none"> • Users acquire points as award for carrying out appointed activities. Points comprise one game elements in a gamified IS, which activate a dynamic that causes users to try obtaining more rewards [28]. • Levels bring about a dynamic that inspires users to attempt to increase their status by accomplishing appointed objectives or by the attainment of mileposts within a gamified IS [28]. • Trophies or badges represent a user's esteemed activities, thus inspiring people to try to attain noticeable rewards that reveal their achievements [28].
<p>Competition:</p> <ul style="list-style-type: none"> • People are regularly motivated by competition. Literature indicate that higher levels of performance can be attained when a competitive setting is created and the winner compensated. People gain gratification by comparing their achievements to that of others [25]. 	<p>Points, levels, badges, and leaderboards</p> <ul style="list-style-type: none"> • Leaderboards offer users the opportunity to compare themselves to others and compete against others. Users try to obtain higher points or scores for an activity, earn more trophies and badges and achieve higher levels [28].
<p>Self-expression:</p> <ul style="list-style-type: none"> • Individuals often search for an appropriate time to demonstrate their originality and autonomy, to distinguish themselves as unique. This refers to the human desire to display a particular style, personality and identity, and to produce group association [25]. 	<p>Points, levels, badges, and leaderboards, avatars and emoticons</p> <ul style="list-style-type: none"> • Points, levels, badges, leaderboards, and virtual goods bring about a dynamic of self-expression that give user the opportunity to produce their own personal identity or style. Moreover, by conveying their feelings and emotions through virtual goods (for example emoticons and avatars) users can connect with the other users (payers) in a more personalised manner [3].

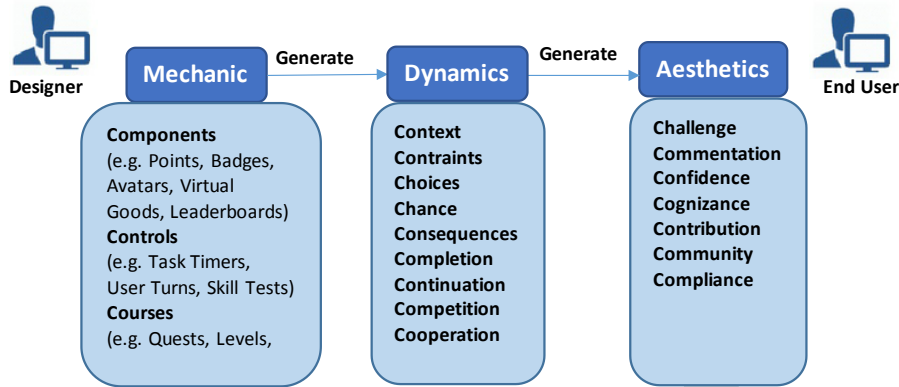


Fig. 1. Ruhi's MDA framework and the 20 Cs of meaningful enterprise gamification [26].

4 Online Gamified Learning Environment

The online gamified learning environment that was used in this study is the Khan Academy platform. This platform is a free open source educational platform which provides a comprehensive set of courses, covering many areas of science, arts & humanities, economics and computing [29]. The computer programming subject of Khan Academy that was used for this study is the "Introduction to JavaScript: Drawing and Animation" subject.

The Khan Academy programming learning environment predominantly comprises of the watching of a video explanation of the topic followed by an exercise that must be completed by the student. Users are expected to complete the exercise in a simulated environment where feedback is provided by various game characters. Students are rewarded with energy points for watching videos and successfully completing assignments. Various badges are rewarded based on the performance level of the user. Users are able to view their statistics at any given point in their dashboard shown in Fig. 2.

The Khan Academy platform provide students with the option of enrolling in a course with an instructor. The instructor is able to assign numerous tasks to students with due dates when these tasks should be completed. The instructor of a course in Khan Academy can obtain a list containing the performance of all students including the total points they have gained as well as the time in minutes that they spent on completing activities. Instructors can convert these lists into leaderboards by sorting the list in descending order according to obtained points. It is the responsibility of the instructor to post this leaderboard for students where they can all see it.

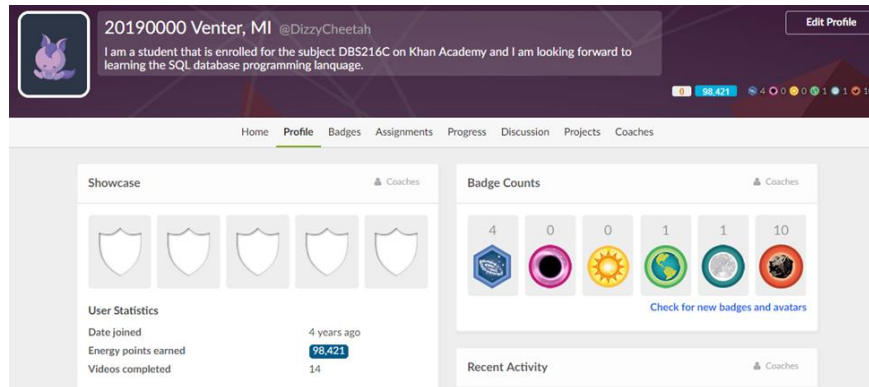


Fig. 2. Khan Academy Dashboard.

5 Methods

A qualitative research design was used for the study. A qualitative approach is one in which the researcher frequently makes knowledge claims based primarily on constructivist/interpretivist perspectives [30]. This approach focuses on understanding and discovering the perspectives, experiences and thoughts of the participants [31]. The population for the study was limited to 92 students enrolled for the Extended Information Technology Diploma at the Central University of Technology in the Free State province. Students enrolled for the subject Life Skills I, were exposed to the Khan Academy environment for two practical periods per week for one academic term. The lecturer created a subject on Khan Academy “Life Skills I” and all students enrolled for this subject on Khan Academy. The instructor assigned various activities to students in Khan Academy, and they had to complete these activities on the Khan Academy platform. Students received marks for their completion of these assignments and this mark contributed 5% of the final mark of the Life Skills 1 subject. Data was collected by semi-structured group interviews and students were asked to voluntarily take part in these interviews. Ethical procedures as stipulated by the Central University of Technology were adhered to. Data gathered from the interviews were transcribed and analysed with MS Excel by using content analysis. The content analysis of the transcribed data was conducted according to the procedure suggested by Ezzy [32]. The steps as suggested by Ezzy [32] are as follows: Define the unit of analysis, e.g. words or sentences; review the text in order to code it; review all codes and place them into categories; count and log the occurrences of words, codes and categories; make use of statistical analysis and quantitative methods to interpret the results. Usage data of students, including the total number of minutes spent in the Khan Academy environment, number of points and badges were directly downloaded from the Khan Academy platform.

6 Results

Table 3 summarises the usage data of students that was downloaded directly from the Khan Academy environment. It can be seen that on average students earned a total of 18892.59 points and 8.16 badges while spending an average amount of 128.99 minutes on the Khan Academy platform.

Table 3. Khan Academy usage data.

	Badges Earned	Point Earned	Total Minutes Spent
n	92	92	92
Mean	8.16	18892.59	128.99
Std. Deviation	3.452	10372.394	87.581
Minimum	1	486	9
Maximum	16	67505	697

6.1 Overall Experience of Khan Academy Environment

The first research question of the study was: “How do students experience the Khan Academy gamified programming platform?” In order to determine how students experienced the Khan Academy environment the first interview question that was asked was: “What is your overall experience of the Khan Academy environment?” Students were asked to freely comment on all interview questions and no multiple choice answers were provided. A total of 68 responses were categorised into seven themes and the results are shown in Table 4.

Table 4. Overall Experience of the Khan Academy Environment.

Theme	Count	%
Understand programming / learn skills	26	38
Enjoyment	23	34
Time too limited	8	12
Easy to use	4	6
Unpleasant experience	3	4
Want more challenge	2	3
Difficult to relate to JavaScript	2	3

The largest majority of students (26) said that the Khan Academy environment assisted them to understand programming or to learn various skills. Students also experienced the platform in a very positive light with 23 students saying that they found the Khan Academy environment enjoyable and four students commenting that it was easy to use.

In addition, eight students commented that the time was too limited for them to complete their assignments and that they needed more time. Only a small percentage of students experienced the Khan Academy environment in a negative light with three students reporting they had an unpleasant experience, while two students wanted a more challenging environment and two students struggled to relate to the Khan Academy environment.

6.2 Experience of Points, Badges and Leaderboard

The second research question of the study was: “How do students experience the points, badges and leaderboard game elements in Khan Academy? In order to investigate this research question the following interview questions were posed:

Interview question 2: “How did you experience the points you received in Khan Academy?”

Interview question 3: “How did you experience the badges you received in Khan Academy?”

Interview question 4: “How did you experience the leaderboard you received in Khan Academy?”

The results of these interview questions is summarised in Table 5, 6 and 7.

A total of 54 responses were categorized into five themes for interview question 2 and the results are shown in Table 5.

Table 5. Perceptions regarding points.

Theme	Count	%
Rewarding Experience	23	43
Motivation to obtain more points	16	30
Don't understand the point system	6	11
Don't care about points	5	9
Not Satisfied	4	7

From Table 5 it can be seen that students experienced the points that they received in the Khan Academy environment in a very positive light with 23 students commenting that it was a rewarding experience. Some specific comments made by students were:

- “It was inspiring and enjoyable because we were rewarded by something”.
- “It is very exciting to earn points after watching a video”.

The points that students received also motivated them and 16 students commented that receiving points motivated them to obtain more points. Some comments made by student are listed below:

- “It motivated to work harder to receive more points.”

- “The points want you want to do more considering you want to get more points on the next one”.

A small number of students commented that they did not understand the point system (six students) or that they were not motivated by receiving points (five students) or who were not satisfied by the points they received (four students).

A total of 52 responses were categorized into four themes for interview question 3 and the results are shown in Table 6.

Table 6. Perceptions regarding badges.

Theme	Count	%
Rewarding Experience	24	46
Did not know it existed	16	31
Motivation to work harder	7	10
Don't care about badges	5	13

From Table 6 it can be seen that 24 students commented that receiving badges was a rewarding experience and some comments made by students are outlined below:

- “I felt awesome earning badges, I earned seven.”
- “They were fulfilling because after completing a task they pop up on the screen.”

Furthermore, a number of students (16) commented that they did not know that they could earn badges and five students commented that they don't care about badges. Moreover, seven students commented that badges motivated them to work harder.

A total of 50 responses were categorized into six themes for interview question 4 and the results are shown in Table 7.

Table 7. Perceptions regarding leaderboard.

Theme	Count	%
Motivated to work harder to compete	20	40
Positive Experience	10	20
Did not know it existed	7	14
Tool for comparison	7	14
Did not matter to me	4	4
Negative experience	2	2

Table 7 shows that 20 students commented that the leaderboard made them want to work harder in order to compete with other students. In addition, 10 students had a positive experience with the leaderboard and seven students perceived the leaderboard to be a tool to compare them to others. As with badges, seven students commented that they did not know about the leaderboard and four students commented that the leaderboard did not matter to them. Only two students commented that they had a negative experience with the leaderboard.

7 Discussion

The objective of this study was to investigate how students experience the Khan Academy gamified programming platform and the embedded gaming elements before full-scale implementation of this platform in a first year programming course. The overall experience students had with the Khan Academy platform is very encouraging due to the fact that 38% of students reported that the platform improved their understanding of programming principles and 34% of students reported that they enjoyed using this platform. This finding is in line with research that found that the largest majority of students who were enrolled for the Hour of Code programming intervention on Khan Academy, improved their programming knowledge and experienced the environment as “fun” and “engaging” [33].

Moreover, the results of the study also supports the prediction of the MDAT that users’ experience of game dynamics while using a gamified information system lead to a positive attitude, which inspires them to engage with the system on a deeper level [28]. It was found that the gameful experiences provided by the Khan Academy platform lead to a positive state of mind of students which is evident in the responses that was provided by students in terms of their perceptions of the points, badges and leaderboard used in the Khan Academy platform. More specifically, it was reported by students that the points and badges game elements lead to the rewards game dynamic with 43% of students reporting that the obtaining of points was a rewarding experience, while 46% of students reported that receiving badges was a rewarding experience.

Furthermore, the leaderboard game element generated the competition game dynamic with 40% of students reporting that the leaderboard motivated them to work harder in order to compete and 14% of students mentioned that they used the leaderboard to compare themselves to other students. This finding is in agreement with research conducted by [14] that found that gamification caused students to become more competitive.

Another game dynamic that was generated by the points and badges game elements in Khan Academy platform was the “continuation” game dynamic as portrayed in the expanded MDA framework of Ruhi [26] shown in Fig. 1. According to [26] various game elements in a gamified information system motivate user to complete a task and to continue to the next phase. Students reported that they wanted to continue using the Khan Academy platform with 30% of them stating that they wanted to continue in order to obtain more points and 10% of them saying that they wanted to continue in order for them obtain more badges.

It is important to take note that a number of students reported that they did not understand or was not aware of the various game elements in the Khan Academy platform. A relatively small percentage of students also mentioned that they “did not care about” the game elements. The most important critique that students had towards the usage of the Khan Academy environment is that time was too limited to complete their assignments due in their formal class periods.

8 Conclusions

The objective of this study was to pilot test the Khan Academy gamified learning platform before a full scale implementation thereof. The results indicate that the Khan Academy environment provided various benefits to students including an improvement of programming knowledge and providing an enjoyable environment for students. In addition, students perceived the points, badges and leaderboard game elements of the Khan Academy environment in a very positive light and these game elements successfully managed to generate game dynamics of rewards, competition and motivation to continue using the platform.

Implications of this study is that educators that want to implement gamified learning environments in their courses must ensure that students are aware of the game elements in the gamified environment, and that the students understand the operation of the game elements. Educators should therefore use various means (hardcopy and softcopy formats) to communicate the progress students are making towards their accumulation of points, badges and their position on the leaderboard. Students also mentioned that they were not given enough time to complete gamified assignments. The Khan Academy platform can be accessed via the internet from any location, but it is a very data intensive application so educators wanting to implement this platform in their courses should ensure that students without internet access at home get enough “lab-time” to complete assignments.

A limitation of the current study is that the population of the study was limited to the Free State province in South Africa. Recommendations for future research would consequently be an appeal to researchers in institutions all over South Africa to investigate the MDAT framework in gamified educational settings in order to validate the original [23] and the expanded MDAT frameworks [26].

References

1. A. Akhtari, “Back to basics: The fundamentals that everyone forget about gamification,” 2018. <https://www.mrgamification.com/en/gamification-basics/> .
2. A. Suh, C. Wagner, and L. Liu, “Enhancing User Engagement through Gamification Enhancing User Engagement through Gamification,” *J. Comput. Inf. Syst.*, vol. 58, no. 3, pp. 204–213, 2018.
3. J. Simões, R. Redondo, and A. Vilas, “A social gamification framework for a K-6 learning platform,” *Comput. Human Behav.*, vol. 29, no. 2, pp. 345–353, 2013.
4. K. Seaborn and D. I. Fels, “Gamification in theory and action: A survey,” *Int. J. Hum. Comput. Stud.*, vol. 74, pp. 14–31, 2015.
5. F. Fui-Hoon Nah, Q. Zeng, V. Rajasekhar Telaprolu, A. Padmanabhuni Ayyappa, and B. Eschenbrenner, “Gamification of Education: A Review of Literature,” *LNCS*, vol. 8527, pp. 401–409, 2014.
6. M. Ortiz, K. Chiluzza, and M. Valcke, “Gamification in Higher Education and Stem: a

- Systematic Review of Literature,” in Proceedings of Edulearn2016: the 8th annual International Conference on Education and New Learning Technologies, 2016, no. July, pp. 6548–6558.
7. C. Pilkington, “A Playful Approach to Fostering Motivation in a Distance Education Computer Programming Course : Behaviour Change and Student Perceptions,” *Int. Rev. Res. Open Distrib. Learn.*, vol. 19, no. 3, pp. 282–298, 2018.
 8. B. E. Wiggins, “An Overview and Study on the Use of Games , Simulations , and Gamification in Higher Education,” *Int. J. Game-Based Learn.*, vol. 6, no. 1, pp. 18–29, 2016.
 9. M.-S. Kuo and T.-Y. Chuang, “How gamification motivates visits and engagement for online academic dissemination - an empirical study.,” *Comput. Human Behav.*, vol. 55, pp. 16–27, 2016.
 10. K. F. Hew, B. Huang, K. W. Chu, and D. K. Chiu, “Engaging Asian students through game mechanics: Findings from two experiment studies,” *Comput. Educ.*, vol. 92, pp. 221–236, 2016.
 11. C. Morillas Barrio, M. Muñoz Organero, and J. Sánchez Soriano, “Can gamification improve the benefits of SRSs in learning?,” *IEEE Trans. Emerg. Top. Comput.*, vol. 4, no. 3, pp. 429–438, 2016.
 12. P. Buckley and E. Doyle, “Gamification and student motivation,” *Interact. Learn. Environ.*, vol. 24, no. 6, pp. 1162–1175, 2016.
 13. I. Yildirim, “The effects of gamification-based teaching practices on student achievement and students’ attitudes toward lessons.,” *Internet High. Educ.*, vol. 33, pp. 86–92, 2017.
 14. J. Sánchez-Martín, F. Cañada-Cañada, and M. A. Dávila-Acedo, “Just a game? Gamifying a general science class at university Collaborative and competitive work implications,” *Think. Ski. Creat.*, vol. 26, pp. 51–59, 2017.
 15. L. De-Marcos, A. García-Cabot, and E. García-López, “Towards the Social Gamification of e-Learning: a Practical Experiment,” *Int. J. Eng. Educ.*, vol. 33, pp. 66–73, 2017.
 16. J. A. Stansbury and D. R. Earnest, “Meaningful gamification in an industrial/organizational psychology course,” *Teach. Psychol.*, vol. 44, no. 1, pp. 38–45, 2017.
 17. M. Sailer, J. U. Hense, S. K. Mayr, and H. Mandl, “How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction,” *Comput. Human Behav.*, vol. 69, pp. 371–380, 2017.
 18. U. Cakiroglu, B. Basibüyük, M. Güler, M. Atabay, and B. Y. Memis, “Gamifying an ICT course: Influences on engagement and academic performance,” *Comput. Human Behav.*, vol. 69, pp. 98–107, 2017.
 19. J. Dias, “Teaching operations research to undergraduate management students: The role of gamification,” *Int. J. Manag. Educ.*, vol. 15, pp. 98–111, 2017.
 20. D. Song, P. Ju, and H. Xu, “Engaged Cohorts: Can gamification engage all college students in class?,” *Eurasia J. Math. Sci. Technol. Educ.*, vol. 13, no. 7, pp. 3723–3734, 2017.
 21. D. T. A. Lin and M. Kaur, “Kahoot! It: Gamification in Higher Education,” *Pertanika J. Soc. Sci. Humanit.*, vol. 26, no. 1, pp. 565–582, 2018.
 22. B. Kim, “Game Mechanics , Dynamics, and Aesthetics,” 2015.

- <https://journals.ala.org/ltr/article/download/5630/6948>.
23. R. Hunicke, M. LeBlanc, and R. Zubek, "MDA: A Formal Approach to Game Design and Game Research," in Proceedings of the AAAI Workshop on Challenges in Game AI, California, USA, 2004, pp. 4–9.
 24. A. Suh, C. Wagner, and L. Liu, "The effects of game dynamics on user engagement in gamified systems," Proc. Annu. Hawaii Int. Conf. Syst. Sci., vol. 2015–March, pp. 672–681, 2015.
 25. Bunchball, "Gamification 101: An Introduction to Game Dynamics," 2018. <http://www.bunchball.com/gamification101>.
 26. U. Ruhi, "Level Up Your Strategy : Towards a Descriptive Framework for Meaningful Enterprise Gamification," Technol. Innov. Manag. Rev., vol. 5, no. 8, pp. 5–16, 2015.
 27. Bunchball, "Gamification 101 : An Introduction to the Use of Game Dynamics to Influence Behavior Gamification 101 : An Introduction to the Use of Game Dynamics to Influence Behavior," White Paper, 2010. <http://jndglobal.com/wp-content/uploads/2011/05/gamification1011.pdf>.
 28. J. Hamari, J. Koivisto, and H. Sarsa, "Does gamification work? - A literature review of empirical studies on gamification," in Proceedings of the Annual Hawaii International Conference on System Sciences, 2014, pp. 3025–3034.
 29. Khan Academy, "Khan Academy Environment," 2019. <https://www.khanacademy.org/>.
 30. R. Kumar, Research Methodology a step by step guide for beginners. Thousand Oaks, California: Sage Publications Ltd, 2014.
 31. M. R. Harwell, "Research Design in Qualitative/Quantitative/ Mixed Methods," in The SAGE Handbook for Research in Education: Pursuing Ideas as the Keystone of Exemplary Inquiry, 2nd editio., C. F. Conrad and R. C. Serlin, Eds. Sage, 2011, pp. 147–182.
 32. D. Ezzy, Qualitative Analysis: Practice and Innovation. London: Routledge, 2002.
 33. G. Nel and L. Nel, "Motivational Value of Code.org's Code Studio Tutorials in an Undergraduate Programming Course," Commun. Comput. Inf. Sci., vol. 963, pp. 173–188, 2019.