Using gamification to develop academic writing skills in dental undergraduate students

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Abstract

Objectives: To assess the satisfaction of first-year dental students with gamification and its effect on perceived and actual improvement of academic writing.

Methods: Two first-year classes of dental undergraduate students were recruited for the study which extended over 4 months and ended in January 2015. A pre-intervention assessment of students' academic writing skills was performed using criteria to evaluate writing. The same criteria were used to evaluate the final writing assignment after the intervention. Students' satisfaction with game aspects was assessed. The per cent change in writing score was regressed on scores of satisfaction with game aspects controlling for gender. Perceived improvement in writing was also assessed.

Results: Data from 87 (94.6%) students were available for analysis. Students' overall satisfaction with the gamified experience was modest [mean (SD) = 5.9 (2.1)] and so was their overall perception of improvement in writing [mean (SD) = 6.0 (2.2)]. The per cent score of the first assignment was 35.6 which improved to 80 in the last assignment. Satisfaction with playing the game was significantly associated with higher percentage of improvement in actual writing skills [regression coefficient (95% confidence interval) = 21.1 (1.9, 40.2)].

Conclusion: Using gamification in an obligatory course for first-year dental students was associated with an improvement in academic writing skills although students' satisfaction with game aspects was modest and their willingness to use gamification in future courses was minimal.

Introduction

Scientific writing is a required competency in undergraduate health professions education (1). In dental education, academic writing is used to develop and assess critical thinking, problem-solving and self-assessment and to demonstrate grasp of subject matter knowledge (2). Writing improves the understanding and recall of information and facilitates application of concepts to professional practice (3). This is why training is included to develop academic writing skills in educational programmes (1, 3–7). However, developing these skills seems to be an area of dental education that receives less focus compared to other skills. This is partly due to the traditional devotion to technical skills in dental education and partly due to the difficulty of assessing these skills objectively, efficiently and repeatedly to enable monitoring of progress (8). In addition, students may find academic writing training to be less engaging than other subjects that directly develop their professional skills.

Recent studies show that a number of professional programmes including engineering, management and health care are incorporating gamification as a strategy to improve students' engagement and interest in promoting self-learning (9–14). Gamification, based on experiential learning theory, can be defined as introducing game elements in a non-gaming context to increase students' engagement and motivation (15). The key features of a game are the presence of a defined goal, set rules to achieve this goal, feedback on performance during attempting this achievement and voluntary participation so that

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players are not forced to attempt each task (16). Gamification uses gamelike techniques such as points, instant feedback, badges, leader boards, onboarding and others (15). Badges identify and reward individual achievements and good performance and therefore are not randomly awarded. When players receive badges, they may feel less inclined to pursue the task if no further reinforcements are offered. Thus, badges should not be used alone and must be accompanied by other game mechanics. Points allow players to assess their own performance and progress through the game. Ideally, points systems should be developed so that earlier tasks are easier to perform and players progress through subsequent stages of the game with added difficulty giving the player increasing challenges. Showing the accumulated points on a progress bar helps players assess the points they still need to reach the set target and win the game. Challenges motivate players to keep playing. They represent the narrative and the simulated environment that link game elements and provide meaning to the game. Challenges should be varied and available to attempt if players want but should not be forced upon them so that the completion of a particular single challenge is not a condition to stay in the game (17). Leader boards show a comparison of players' achievements through points allowing them to match their performance against their peers (9,18).

Gamification has been shown to successfully increase student's motivation to learn. An example of a gamified classroom was the Multiplayer Game Design course at Indiana University in Bloomington (19). The class was designed as a multiplayer game, where students divided themselves into 'guilds' and competed against several guilds or worked cooperatively as teams for a common task. Game elements were introduced in the traditional classroom by changing passing tests and examinations to 'fighting with monsters' and making presentations or reports to 'quests'. Students were awarded experience points instead of grades. Just like in a game, students started at zero points and worked their way to collect experience points to get an A+ grade.

The first year of the Bachelor of Dental Surgery programme, College of Dentistry, University of Dammam, includes a course that aims at developing students' academic writing skills. Over the years, students rated this course poorly citing their inability to understand how academic writing relates to their professional career as dentists. Feedback from instructors indicated difficulty in keeping students engaged in spite of several efforts with resulting unsatisfactory achievement of learning outcomes. The objective of this study was (i) to assess students' satisfaction with gamification used in an academic writing course and (ii) to determine the perceived and actual improvement in academic writing skills associated with students' perception of this learning experience.

Materials and methods

Design and setting

A quasi-experimental pre-test–post-test design was used to study the experience of a group of students who were followed up from before the intervention till the educational intervention was concluded. The study was conducted in the College of Dentistry, University of Dammam, Saudi Arabia, in the first semester of the academic year 2014–2015. Approval for the study was obtained from the Research Unit in the College (EA2014015).

Sample

Participants were 92 first-year dental students in two segregated classes (47 males and 45 females) enrolled in an obligatory Academic Writing course in the Bachelor of Dentistry (BDS) programme. The average age of students was 20 years. Prior to admission to the BDS programme, all students had successfully completed a mandatory, ten-credit English-language course during the preparatory-year studies.

Intervention

Students played the role of an organisation specialised in supporting dental researchers to help them publish (DentLit; Fig. 1). It had branches in nine cities (nine groups in each class). A branch consisted of divisions carrying specific tasks and represented by a division head. The five division heads in each branch selected a branch manager (group leader). The mission of the branch was to increase the revenues of DentLit by supporting dental professionals through providing services entailing academic writing.

The divisions of Technical Support, Editing and Proofing in addition to Legal (Table 1) managed the tasks which were to write a brief paragraph about the following five topics: caries in Saudi Arabia, global oral cancer situation, fluoridated milk and caries prevention, flossing and gingivitis, and soft drinks and caries. There were two other divisions: Customer Service and Media that were not included in this study.

A task started by receiving a question from a virtual dental researcher posted by DentLit CEO (instructor) on the organisation communication system (learning management system (LMS)) followed by declaration of interest by concerned branches (students' groups). Tasks were addressed and submitted on the LMS followed by delivering feedback on performance by the instructor in the following organisation meeting (session) in the company headquarters (class). Each branch received fees (points) for delivered tasks (assignments) that were deposited in the branch's account (course grade centre on LMS) before the next task.

Game elements

- Storyline: Students were encouraged to use game terms. The DentLit scenario was maintained on the LMS and in class.
- Feedback: Students received feedback on their performance in class by discussing their assignments. Feedback was given immediately following the task. It was anonymous so that students will not be embarrassed and focused on acknowledging best practices and addressing problems.
- Points system: Greater weight was assigned to easier tasks performed at the beginning of the course to reduce the tension created by the need to acquire points to pass the course. For each task, all students in a group received points. Additional points were given to division heads who

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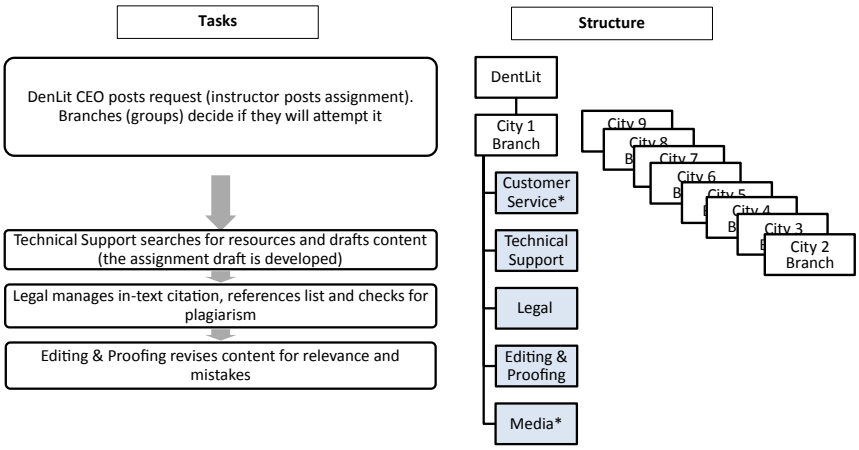

*Fig. 1. Structure and tasks in DentLit. DentLit has branches in cities 1–9. Each branch has five divisions (blue boxes). The tasks of two divisions (marked by *) are not addressed in the study. Each division has a head. All heads per branch select a branch manager (group leader). Each branch carries out the tasks outlined to the left. DentLit CEO is the course director.*

did well in a task (such as getting points that were above the class average for a task). Branch managers got additional points for good branch performance (getting consistently high points for assignments). The points system was structured so that extra assignments (and points) were available and a group could select one assignment and not attempt it. This aimed at maintaining students' free choice corresponding in game concepts to having the freedom to collect points through pursuing different tasks.

- Badges: The LMS did not support the display of badges. However, superior performance was recognised and credited during class discussion.
- Leader board: Points were posted on the LMS immediately after grading the assignment and before the next assignment was announced. Bar graphs were used to show cumulative points of all groups so that students would know their level in relation to others.

Independent variable and study outcomes

Independent variable: satisfaction with game aspects

An online questionnaire was administered after the third assignment. It assessed students' satisfaction on a scale from 1 (least satisfied) to 10 (completely satisfied) with game aspects. The questionnaire had 10 statements investigating satisfaction with awarding of points, acknowledging good performance, allowing task selection, allowing the monitoring of personal progress, enabling collaboration, enabling competition, storyline through DentLit theme, playing own role, playing game and use of game aspects in future courses. The internal consistency was checked using intraclass correlation coefficient and a score was calculated by averaging all items, and it potentially ranged from 1 to 10.

Outcome 1: perceived improvement

At the end of the course, students responded to another online questionnaire on a scale from 1 (did not improve at all) to 10 (completely improved) assessing their perceived change in writing. There were six statements evaluating perceived improvement in searching for references, assessing the relevance of retrieved references, using references to support writing, plagiarism management (detection using Turnitin® if a high similarity score is calculated and avoidance through rephrasing the similar content so it is expressed in the student's own words), and critical and analytic thinking to develop written text in addition to developing written text relevant to a specific topic. The internal consistency was assessed and an overall score was developed by calculating the average of the six statements. The overall score thus ranged from 1 to 10.

Outcome 2: actual improvement

Criteria were developed to assess writing (Table 1). Plagiarism was not one of the criteria because if detected, the assignment was rejected altogether and the group received no points at all. The overall score was calculated by adding the points producing a score potentially ranging from −1 to 5. The assignments were evaluated using the criteria in Table 1 by two instructors after their agreement in scoring was established (kappa statistic = 0.95). The internal consistency of the six criteria was also assessed using Cronbach's alpha. Actual per cent change in the score of writing between the first and last assignments was calculated as:

$$[(\text{Score in last assignment} - \text{score infirst assignment})/\text{scoreinfirstassignment}] \times 100.$$

Analysis

The difference between the first and last assignments in the per cent of students fulfilling each of the evaluation criteria was assessed using the McNemar test, whereas paired *t*-test assessed the difference in total scores. Actual per cent change was used as outcome in univariate models to assess its relationship with satisfaction with game aspects controlling for student gender.

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TABLE 1. Course objectives, DentLit branches carrying tasks and assessment methods

		Assessment of impact	
Course objectives addressed in study	Branch carrying tasks	Perceived Statements in questionnaire	Actual Evaluation criteria [points]
1. Searching for and finding relevant references	• Technical support	1. Do you feel that your ability to search for evidence improved? 2. Do you feel that your ability to assess the relevance of references improved?	Citing references [+1]
2. Selecting proper references to support writing	• Technical support • Legal	2. Do you feel that your ability to assess the relevance of references improved? 3. Do you feel that your ability to use references to support writing improved?	Cited references are relevant [+1]
3. Developing relevant content to cover specific topic	• Technical support • Editing and Proofing	5. Do you feel that your ability to analyse and think critically to develop written text improved? 6. Do you feel that your ability to develop written text addressing a specific topic improved?	Proportion of irrelevant to total content 'x' [1 − x]
4. Adding references in written text	• Legal	3. Do you feel that your ability to use references to support writing improved? 4. Do you think your ability to detect and avoid plagiarism improved?	Proper in-text citation [+1]
5. Revising written content for mistakes (spelling, punctuation and grammar)	• Editing and Proofing	6. Do you feel that your ability to develop written text addressing a specific topic improved?	Presence of mistakes [−1]
6. Preparing references' list following specified citation styles	• Legal	3. Do you feel that your ability to use references to support writing improved? 4. Do you think your ability to detect and avoid plagiarism improved?	Correct references list [+1]
Number of events		Once at the end of semester	Five assignments
Range of score		Each statement was scored on a scale from 1 (did not improve at all) to 10 (completely improved). Overall score is average of six statements, ranging from 1 to 10	Points added, overall score ranges from −1 to 5

Multivariate regression model was developed with the same outcome and satisfaction with the ten aspects as independent variables controlling for gender. Regression coefficients, 95% confidence intervals and partial eta-squared were calculated. Statistical analysis was carried out using SPSS version 17.0.

Results

Of all 92 students, 80 (87%) responded to the game aspect satisfaction questionnaire and 76 (82.6%) responded to the perception of improvement survey. The first assignment was submitted by 87 (94.6%), whereas all students submitted the last assignment. The actual per cent change was calculated for the 87 students with grades in the first and last assignments.

Figure 2 shows the scores for satisfaction with game aspects. The highest scores were for timely awarding of points and enabling collaboration (mean = 7.4 and 7.1), whereas the lowest scores were for using game aspects in future courses, playing own role and playing the game in general (mean = 4.1, 4.8 and 4.9). The internal consistency of all statements measured by intraclass correlation coefficient (ICC) was 0.89. The mean (SD) overall score for satisfaction with game aspects was 5.9 (2.1).

Figure 3 shows the scores for perceived improvement. The greatest improvement was perceived to be in detecting and avoiding plagiarism followed by searching for evidence and using references to support writing (mean = 7.1, 6.5 and 6.3). The statements had very good internal consistency (ICC = 0.89). The mean (SD) overall score was 6.0 (2.2).

Students showed significant actual improvement by the end of the course as measured by the criteria assessing their writing ($P < 0.0001$ for all; Table 2). In some criteria, students showed full improvement such as in using references and in-text citation (100% in the last assignment). Other criteria showed marked improvement such as reduction in mistakes, reduction in the proportion of irrelevant content, using relevant references and developing proper references list. The internal consistency of the assessment criteria (ICC) was 0.63, and the per cent score improved from a mean of 35.6% in the first assignment to 80% in the last assignment. The mean (SD) actual per cent change score was 142.0 (135.3). In the first assignment, 77 students were involved in plagiarism. In the last assignment, only five students were involved (88.5% and 5.4%).

The amount of variation in the actual per cent change score explained by satisfaction with individual game aspects was

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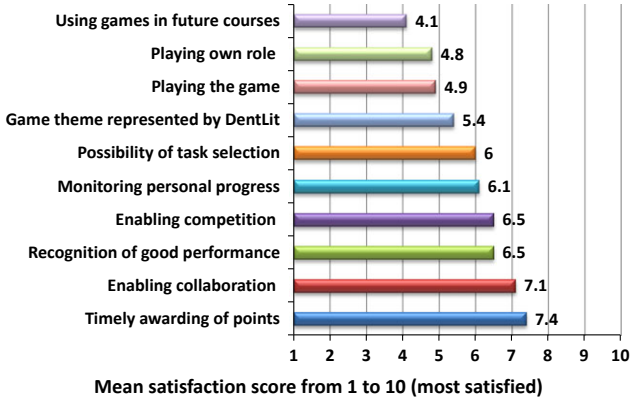

Fig. 2. Satisfaction with game. Satisfaction assessed on a 10-point scale from 1 (least) to 10 (most satisfied) for each of ten game aspects, mean score for all students per aspect shown.

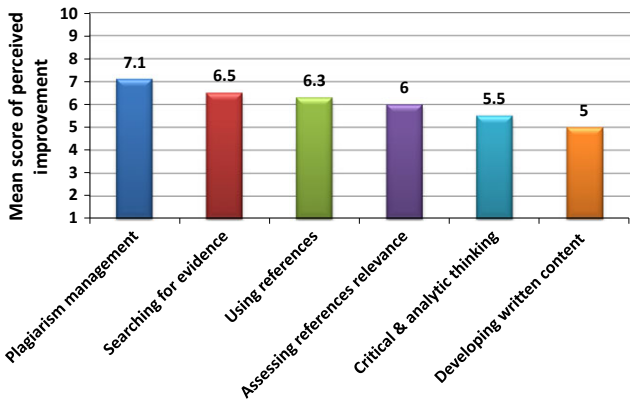

Fig. 3. Perceived improvement of skills. Perceived improvement of writing skills assessed on a 10-point scale from 1 (least) to 10 (greatest perceived improvement) for each of six skills, mean score for all students per skill shown.

small (partial eta-squared ranging from 0 to 0.06; Table 3). The only factor that had a significant association with per cent change in univariate regression was satisfaction with playing the game (regression coefficient = 11.9, 95% confidence interval = 0.5, 23.3). The same variable was significantly associated with the outcome in multivariate regression (regression coefficient = 21.1, 95% confidence interval = 1.9, 40.2). The amount of variation explained by this variable in multivariate regression increased from partial eta-squared of 0.06–0.08. There was a significant association with gender, with males scoring about 20% less than females. The amount of variation explained by gender was far greater than any other variable (partial eta-squared = 0.40).

Discussion

This study addresses the use of gamification in an academic writing course for dental students. Introducing gamification as an educational strategy involves integrating game elements, such as working in teams, feedback, points, leader boards, badges and a storyline throughout the course (15, 18, 19).

The findings of our study need to be interpreted in the proper context. The students had just joined the BDS programme, and the transition to higher standards of performance compared to the preparatory year could have left the students little room to appreciate game aspects. The greatest satisfaction was with timely awarding of points which provides feedback needed for learning to occur amongst novices who are just starting their training. There was less satisfaction with playing the game and using game aspects in education. This might be understandable as these students have grown in the age of computer games and virtual environments. The programme level might explain that the best perceived improvement was in detection and avoidance of plagiarism. It is safe to assume that before the course, students had a very limited idea about plagiarism. The magnitude of actual change in writing skills might have been smaller if students at a higher programme level were included.

The results must also be interpreted in view of the fact that the course was mandatory. Because of this, there was no real choice to participate or not to participate. The choice was rather limited to selecting one task vs. the other. Students' concern for grades in such a mandatory course might have affected their satisfaction with game aspects. By contrast, in another study conducted amongst Egyptian dental undergraduate students (20), role-playing and peer-assisted learning were used to train students on generic skills in an extra-curricular, non-mandatory activity. The mean score for enjoying the experience was higher (8.8 out of 10). Some factors that might explain the differences between the two studies include whether the educational experience was obligatory or not and more advanced programme level amongst Egyptian students compared to our study. In addition, the students in our study were more similar to the general student body although they were not randomly selected, whereas the Egyptian students were self-selected volunteers who have chosen to participate in the intervention.

Our study extended over a semester of 4 months. This time would have allowed the novelty effect to wear out and might have further lowered the satisfaction scores. Other studies reporting higher satisfaction with games in educational settings ran for shorter durations (21). Examples include the Geriatric Medication Game which was used in 3-h laboratory to change the perceptions and attitudes of first-year pharmacy students towards older adults (22). In another study, game playing was used to improve pharmacology knowledge amongst third-year medical students during a 6-week clerkship (23).

Dicheva et al. (24) reported that there were many studies on using gamification in education, but the majority described only few game mechanisms and dynamics. It is difficult to separately assess the effect of different game aspects on writing in our study. These aspects were used at the same time and they mutually affected each other. For example, timely awarding of points could have affected how students perceived the recognition of good performance and served also to enable monitoring of performance. We tried to disentangle the satisfaction with game aspects but do not claim that this isolates their individual effects. Although students' satisfaction with playing the game was low, this was the only factor that significantly affected actual improvement in writing. This is similar to the results of

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TABLE 2. Actual improvement in academic writing skills over the course period

Criteria evaluating writing	First assignment (n = 87)	Last assignment (n = 92)	P value
1. Presence of mistakes: n (%)	72 (82.8%)	20 (23.0%)	<0.0001*
2. Proportion of irrelevant content: mean (SD)[1]	0.45 (0.23)	0.05 (0.12)	<0.0001*
3. Using references to support writing: n (%)	72 (82.8%)	87 (100%)	<0.0001*
4. Using relevant reference: n (%)	56 (64.4%)	81 (93.1%)	<0.0001*
5. Using in-text citation: n (%)	30 (34.5%)	87 (100%)	<0.0001*
6. Developing proper reference list: n (%)	36 (41.4%)	66 (75.9%)	<0.0001*
Per cent score: mean (SD)[1]	35.6 (18.3)	80.0 (21.3)	<0.0001*

The criteria of evaluation correspond to those in Table 1 evaluating course objectives #5, 3, 1, 2, 4 and 6, respectively. Points for criterion #2 were subtracted from the sum of the points given to criteria 1, 3 to 6 to give total score. Per cent score is the total score *(100/5).
[1]Paired t-test was used for comparison; otherwise, the McNemar test was used.
*Statistically significant at $P \leq 0.05$.

TABLE 3. Regression analysis for the effect of satisfaction with game on actual per cent improvement in writing (controlling for gender)

	Univariate		Multivariate	
	Regression coefficient (95% CI)	Partial eta-squared	Regression coefficient (95% CI)	Partial eta-squared
Timely awarding of points	−0.06 (−12.5, 12.4)	0	−6.2 (−24.7, 12.3)	0.008
Acknowledging good performance	3.5 (−7.7, 14.6)	0.01	6.2 (−9.6, 21.9)	0.01
Allowing task selection	5.1 (−6.0, 16.1)	0.01	4.4 (−10.0, 18.9)	0.006
Enabling collaboration	0.1 (−11.4, 11.6)	0	−7.5 (−25.3, 10.2)	0.01
Enabling competition	1.2 (−10.4, 12.8)	0.001	0.7 (−17.1, 18.5)	0
Game theme represented by DentLit	5.9 (−5.0, 16.9)	0.02	2.3 (−16.3, 20.9)	0.001
Playing own role	7.8 (−1.8, 17.4)	0.04	5.0 (−10.1, 20.1)	0.007
Playing the game	11.9 (0.5, 23.3)*	0.06	21.1 (1.9, 40.2)*	0.08
Monitoring personal progress	4.0 (−8.2, 16.3)	0.01	−6.1 (−25.4, 13.3)	0.007
Using games in future courses	2.7 (−8.4, 13.9)	0.004	−11.7 (−31.2, 7.8)	0.02

Univariate and multivariate models control for the effect of gender [univariate regression coefficient (95% CI) of males vs. females = −21.8 (−26.9, −16.6), partial eta-squared = 0.44; and in multivariate regression = −19.2 (−24.9, −13.5), partial eta-squared = 0.40].
95% CI, 95% confidence interval.
*Statistically significant; confidence interval does not contain zero (null value).

the study conducted amongst Egyptian dental students where simulation score significantly affected the perceived usefulness of the educational intervention to develop generic skills (20).

The greatest amount of variation in actual per cent improvement was explained by gender with females performing better than males. This result continues a general trend in our school where the study was conducted. Since the college started accepting them, female students have scored about one letter grade higher than male students in most courses. Thus, this difference does not relate exclusively to improvement in writing skills but rather reflects better level of academic performance. For example, the study targeting the Egyptian students' generic skills showed no significant gender difference in perceived improvement (20). Pending confirmation from future studies conducted amongst dental students in different settings, controlling for the effect of previous/general academic performance, this factor needs to be interpreted with caution.

The magnitude of actual change in writing indicates that gamification did work. The students might not have liked the gamified course much, but this did not prevent improvement from happening. Our findings need to be confirmed by studies with experimental design, as without a concurrent control (such as a group using traditional, classroom-based face-to-face lectures), it is difficult to ascribe the improvement solely to the gamification of the course. The evidence our study provides is that satisfaction with game aspects, not gamification itself, was associated with actual improvement of writing skills. However, based on performance of previous students in the same course and the absence of other interventions targeting writing at the same time, it can be practically concluded that there is no other explanation for the improvement. Our results are similar to studies showing positive effects of gamification. Nevin et al. (14) used gamification-based software to increase the knowledge of medical residents at the University of Alabama over an academic year. They incorporated several features such as voluntary participation, rules, immediate feedback, team and individual participation, leader boards and badges. The authors reported 11.9% increase in knowledge retention because of the game with a significant increase in the percentage of correct answers. Dominguez et al. (25) showed that an experimental gamified group did better in the final scores than the control group in a course to train university students in use of ICT.

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Other studies also reported positive outcomes when gamification was used to train participants on assessing document relevance and in learning AutoCAD (26, 27).

It can be argued that offering students opportunities to practise, giving them feedback and creating a collaborative and competitive environment are best practices in education that have been used before the term gamification was even coined in 2002 (28, 29). This is true and it supports the usefulness of gamification that relies on all these aspects simultaneously. One more factor remains: the storyline. This is difficult to explain out of the gamification context. The question remains: Should gamification be used in other courses? Should the intervention be repeated? The students' response was 'No'. However, before a final decision can be made, further studies are needed to investigate the use of gamification in relation to other learning domains and including students at higher programme levels. Assessing the effect of gamification on knowledge and possibly cognitive skills would also add to our understanding of the usefulness of the technique. In addition, there is a need to consider the alternatives. If gamification is not used, what can be used instead? The answer might be a modified version of game aspects, possibly with less emphasis on the storyline and more on the points, leader board, badges or one with a different storyline. Another possibility is adding more technology support for gamified courses to attract the Internet generation.

Conclusion

Our study reports on the use of gamification in a traditional didactic obligatory course, to develop academic writing skills in dental students. The results show significant improvement in actual writing although students' overall satisfaction with game aspects was modest. Satisfaction with playing the game was significantly associated with improvement of writing. Further studies assessing the effect of gamification in other courses addressing other learning domains are needed.

Conflict of interest

The authors declare no conflict of interest.

References

1 Rawson RE, Quinlan KM, Cooper BJ, et al. Writing skills development in the health professions. Teach Learn Med 2005: 17: 233–238.

2 CODA Commission on Dental Accreditation (CODA), American Dental Association. Accreditation standards for dental education programs. 2013. Available at: http://www.ada.org/~/media/CODA/Files/predoc.ashx. Accessed January 6th, 2016.

3 Kolb P. Implementation of Writing Across the Curriculum (WAC) learning approaches in social work and sociology gerontology courses. Gerontol Geriatr Educ 2013: 34: 212–223.

4 McMillan LR, Raines K. Headed in the "write" direction: nursing student publication and health promotion in the community. J Nurs Educ 2010: 49: 418–421.

5 Salamonson Y, Koch J, Weaver R, et al. Embedded academic writing support for nursing students with English as a second language. J Adv Nurs 2010: 66: 413–421.

6 Tarrant M, Dodgson JE, Law BVKK. A curricular approach to improve the information literacy and academic writing skills of part-time post-registration nursing students in Hong Kong. Nurse Educ Today 2008: 28: 458–468.

7 Tesh AS, Hyde YM, Kautz DD. A writing intensive introductory course for RN to BSN students. Nurse Educ 2014: 39: 6–7.

8 Holtzman JM, Elliot N, Biber CL, Sanders RM. Computerized assessment of dental student writing skills. J Dent Educ 2005: 69: 285–295.

9 Lee JJ, Hammer J. Gamification in education: What, how, why bother? Acad Exchange Q 2011: 15: 1–5.

10 Barata G, Gama S, Jorge J, Gonçalves D. Engaging engineering students with gamification. In: Games and virtual worlds for serious applications (VS-GAMES), 5th international conference, Sept 2013. IEEE. Available at: http://web.ist.utl.pt/gabriel.barata/wp-content/papercite-data/pdf/barata2013a.pdf. Accessed January 6th, 2016.

11 Fishman BJ, Deterding S, Vattel L, et al. Beyond badges & points: Gameful assessment systems for engagement in formal education. Gameful Learning symposium 2013. Available at: http://teach.its.uiowa.edu/files/teach.its.uiowa.edu/files/cft_GBL_GLS_Beyond_Badges.pdf. Accessed January 6th, 2016.

12 Leba M, Ionică A, Apostu D. Educational Software based on Gamification Techniques for Medical Students. Recent Advances in Computer Engineering, Communications and Information Technology. Proceedings of the 8th WSEAS International Conference on Computer Engineering and Applications (CEA'14), Tenerife, Spain, January 10–12, 2014. P225–230. Available at: http://www.wseas.us/elibrary/conferences/2014/Tenerife/INFORM/INFORM-32.pdf. Accessed September 9th, 2016.

13 Ong DLT, Chan YY, Cho WH, Koh TY. Motivation of learning: an assessment of the practicality and effectiveness of gamification within a tertiary education system in Malaysia. In: World academy of researchers, educators, and scholars in business, social sciences, humanities and education conference, 22–25 July 2013, Cape Town, South Africa. Available at: http://eprints.sunway.edu.my/185/. Accessed January 6th, 2016.

14 Nevin CR, Westfall AO, Rodriguez JM, et al. Gamification as a tool for enhancing graduate medical education. Postgrad Med J 2014: 90: 685–693.

15 Deterding S, Dixon D, Khaled R, Nacke L. From game design elements to gamefulness: defining gamification. In: Proceedings of the 15th international academic mindtrek conference: envisioning future media environments 2011; 9–15.

16 Morris BJ, Croker S, Zimmerman C, Gill D, Romig C. Gaming science: the "Gamification" of scientific thinking. Front Psychol 2013: 4: 607.

17 Miller AS, Cafazzo JA, Seto E. A game plan: Gamification design principles in mHealth applications for chronic disease management. Health Inform J 2016: 22: 184–193.

18 Sillaots M. Gamification of higher education by the example of course of research methods. In: Popescu E, Lau RWH, Pata K, Leung H, Laanpere M, eds. Advances in web-based Learning–ICWL 2014. 13th International Conference, Tallinn, Estonia, August 14–17, 2014. Proceedings 106–115. Available at: http://link.springer.com/chapter/10.1007%2F978-3-319-09635-3_11. Accessed January 6th, 2016.

19 Sheldon L. The multiplayer classroom: designing coursework as a game. Cengage Learning 2012. US.

20 El Tantawi MM, Abdelaziz H, AbdelRaheem AS, Mahrous AA. Using peer-assisted learning and role-playing to teach generic skills to dental students: the health care simulation model. J Dent Educ 2014: 78: 85–97.

21 Hamari J, Koivisto J, Sarsa H. Does Gamification Work? – A literature review of empirical studies on gamification. In: Proceedings of the 47th Hawaii international conference on system

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sciences, Hawaii, USA, January 6–9, 2014. Available at: http://gamification-research.org/2013/09/does-gamification-work-a-look-into-research/#sthash.lORZV5dO.dpuf.
22 Chen AM, Kiersma ME, Yehle KS, Plake KS. Impact of the Geriatric Medication Game® on nursing students' empathy and attitudes toward older adults. Nurse Educ Today 2015: 35: 38–43.
23 Shiroma PR, Massa AA, Alarcon RD. Using game format to teach psychopharmacology to medical students. Med Teach 2011: 33: 156–160.
24 Dicheva D, Dichev C, Agre G, Angelova G. Gamification in education: a systematic mapping study. Educ Technol Soc 2015: 18: 75–88.
25 Domínguez A, Saenz-de-Navarrete J, de-Marcos L, et al. Gamifying learning experiences: practical implications and outcomes. Comput Educ 2013; 63: 380–392.
26 Eickhoff C, Harris CG, deVries AP, Srinivasan P. Quality through flow and immersion: gamifying crowdsourced relevance assessments. In: Proceedings of the 35th international ACM SIGIR conference on research and development in information retrieval, August 12–16, 2012, Portland, Oregon, USA. ACM 871-880. Available at: http://prb.tudelft.nl/sites/default/files/sigirfp016-eickhoff.pdf. Accessed January 6th, 2016.
27 Li W, Grossman T, Fitzmaurice G. GamiCAD: a gamified tutorial system for first time autocad users. In: Proceedings of the 25th annual ACM symposium on user interface software and technology, October 7–10, 2012, Cambridge, Massachusetts, USA. ACM 103-112.
28 Werbach K, Hunter D. For the win: how game thinking can revolutionize your business. Philadelphia: The Wharton School, University of Pennsylvania, 2012.
29 Stott A, Neustaedter C. Analysis of Gamification in Education. Technical Report 2013-0422-01. Available at: http://clab.iat.sfu.ca/pubs/Stott-Gamification.pdf. Accessed January 6th, 2016.

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