



Shades of Grey: Playing games in the classroom to enhance student learning

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Although the use of games in education is not new, the recent enhancements to game functionality through technology advancements have led to opportunities for significant changes to teaching and learning delivery methods and approaches.

Shades of Grey is a technology-driven educational game designed to make learning fun whilst also encouraging collaboration between students and interaction with the instructor. The game makes use of web and mobile technologies to test student comprehension of ethical concepts in a team environment.

This paper reports on a research project that interrogated the effectiveness and impact of the Shades of Grey game on a group of students in an Advanced Management Accounting course. The project tested the students' understanding of core course concepts before playing the game, and again afterwards. Students' perceptions of the game were also tested in order to find out whether or not they felt it encouraged them to learn and added benefit to the course.

The Shades of Grey game received very positive feedback from students who enjoyed the experience, felt they learned from it, and wanted to see games used more frequently in their courses. This project's findings have confirmed that further investment in the game's development will be highly worthwhile; importantly, the game can be repurposed to work in many different courses in different environments and discipline areas, making it a valuable and highly flexible teaching resource.

Keywords: educational games, e-learning, collaborative learning, cooperative learning

Introduction

This paper reports on the initial class-testing of a game developed by the authors for enhancing student understanding and appreciation of ethical issues through collaborative revision and testing. This game, called Shades of Grey, draws on a number of benefits from educational game playing. The game combines student engagement, motivation from a fun activity, and short and sharp discussions amongst small groups with the use of web and mobile technology tools. It encompasses some of the standard principles of good practice in undergraduate education, including: the development of cooperation among students; the use of active learning techniques; providing prompt feedback; and emphasis on time management (Chickering & Gamson, 1987). Although it is widely recognised that technology alone will not improve learning (McVay, Murphy, & Yoon, 2008), the affordances provided by technology are important features of this game. In terms of its educational content, Shades of Grey uses ethical problems to challenge students to apply their knowledge of ethical codes of conduct. Gaining a

comprehensive awareness of critical perspectives on ethical issues is especially important for business students as they prepare for their future professional lives (Haywood, McMullen, & Wygal, 2004). The challenge for educators is to effectively engage students in this process of ethical understanding and promote long-term retention of code of conduct principles.

Literature review

Educational game playing

The lecture format has been used as a common teaching method in tertiary education for many years. Due to the cost-effectiveness and low threat to student involvement, the traditional lecture method remains widely used in business classrooms (Cook & Hazelwood, 2002). However, as technology has developed, so too have the variety of tools available for tertiary educators and many of these tools can be applied even in the traditional lecture theatre environment. Importantly, research has indicated that students who are more active and participate in the classroom will usually learn and retain more in comparison to those who are simply listening passively to lectures (Bligh, 2000; Eble, 1983; Kebritchi, 2010). Whilst the use of games is not new in education, the enhancements in games through technology advancements over the last decade have led to changes in delivery methods and learning approaches to the classroom – changes which are largely targeted at increasing active learning.

Cook and Hazelwood (2002) and Johnson & Mayer (2010) have noted that students are motivated to spend more time in class preparation on the days when games are played compared to other times. This provides a great opportunity for game-playing to be used as an instrument for creating interest. McEacharn (2005) identified game playing as a valuable tool for encouraging student preparation for examinations and argued that it supported the student learning experience with the elements of creativity and competition. Further, McEacharn determined that the use of games contributed positively to a student's ability to interact with other team members and developed the student's critical thinking ability. All of these findings strongly demonstrate that games are not gimmicks; on the contrary, they have numerous purposes and benefits such as increasing student interest and motivation to learn and engage in the classroom, as well as heightening the students' enjoyment factor and simultaneously reinforcing their subject matter knowledge.

Introducing games to students in the class setting supports the strategy of having fun while learning. The benefit derived from making the learning process enjoyable results in increased interest from students (Cermignano, Hargadon, & McMullen, 1998; Moreno-Ger, Burgos, Martinez-Ortiz, Sierra, & Fernandez-Manjon, 2008). Digital games can provide improvements in skills and abilities, allowing the learning process to change dynamically and deliver timely feedback (Burgos, Tattersall, & Koper, 2007). Further advantages of business games for accounting students have been identified by Hoffjan (2005), including the ability to recall and improve problem-solving skills, the requirement for student group interaction and cooperation, and learning the process of compromise. Given that these skill sets are requirements for accounting professionals in the workplace when dealing with clients and colleagues, it is vital that students are exposed to them during their studies.

Baker et al. have identified some key design implications when introducing games into a learning environment; such as, it is important to ensure the game's problems are challenging but not too difficult because that can cause frustration for students. Keeping problems short and allowing students to skip certain problems have also been suggested as ways to reduce student frustration (Baker, et al., 2008).

Relevance to ethics

The adherence to ethics is at the heart of all business practice, and is a fundamental requirement for members of the professional accounting body. Specifically, the objective of ethics in accounting is to encourage public confidence in the profession and to promote the application and adherence to a code of conduct (Smith, 2003). Ethics is a subject that is covered in many undergraduate courses across multiple discipline areas; in accounting, it is investigated and examined at the professional body level for candidates endeavouring to gain membership. Interestingly, the profession's ethical standing has been criticised by former SEC Chairman, Arthur Levitt, who stated that accounting “is a profession that has lost nearly all public credibility” (Solomon & Bryan-Low, 2003). This damning criticism raises the question of whether more ethics be taught across accounting courses, or whether the approach to the teaching of ethics in tertiary education needs to be transformed. A transformation could

deliver a change that engages students (Haywood, et al., 2004) – something that would hopefully have an impact on their understanding of ethical principles, and therefore on their adherence to these principles as practising accountancy professionals.

Students need to develop critical perspectives on ethical issues (Haywood, et al., 2004). Unfortunately, it is not sufficient for students to know a simple code of conduct; an application of the code is required to necessitate a critical perspective on the issue. There is often no right answer when it comes to ethical issues, and so-called 'grey' areas are common. Therefore, educators have a major challenge when teaching ethics because they are not only responsible for teaching ethical principles but also for encouraging critical thinking on the questions posed. As a result, for students to succeed in ethics comprehension, they need to be fully engaged in the process (Haywood, et al., 2004).

Textbook teaching of ethics can be somewhat dry and boring, and therefore disengaging for the students. For the purpose of accountancy teaching, books generally fail to bring alive the problems that accountants face in business and with their clients. There is also the issue of complexity: an ethical problem often has different levels of complexity, all of which require thorough student analysis and the application of critical thinking. Providing a simple solution, as if there was only one correct answer to an ethical issue, is usually not sufficient (Haywood, et al., 2004).

Feedback provided by the research from Haywood et al. (2004) identifies that a student's critical thinking on the subject of ethics is greatly enhanced through game-playing. A further advantage with the use of game-playing with the topic of ethics is the flexibility that is provided. The game can be readily adapted to suit the specific topic area such as ethics in cost management or ethics in auditing, and so on (Haywood, et al., 2004).

The effect of cooperation and collaboration on learning

It is widely believed that cooperation can enhance the learning outcomes of individuals (Na'im, 2004). It has been shown to improve the performance of all students and is particularly effective for those students who are the least well-prepared (Giraud, 1997). This is because cooperation enhances engagement with activities and promotes learning of the material (Keeler & Steinhorst, 1995). Chickering & Gamson (1987) outlined seven principles for good practice in higher education which included the principle of cooperation among students.

Enhanced learning occurs in a team environment, where collaboration is operating at an intellectual as well as a social level. Students are not working in isolation, rather they are responding to others' ideas and contributing their own to the team for discussion, and as a result their understanding of issues is usually deepened. It has been suggested that collaboration is an extension of cooperation, where participants move beyond the simple division of work and engage together in a coordinated approach to solve a problem (Dillenbourg, Baker, Blaye, & O'Malley, 1996; Scanlon, 2000). Collaboration is frequently taken more seriously by students and is more effective when it is assessed (Swan, Shen, & Hiltz, 2006). This is particularly the case when the assessment is summative and counts towards the student's grade.

The Shades of Grey game

The Shades of Grey game involves groups of students competing against each other through a series of ten multiple choice questions based on short ethical problems. The multiple choice questions each have four possible answers, with each answer being assigned a different positive or negative score contributing to their team performance. The game is operated by a facilitator who guides the student teams through the questions displayed on a projector screen, which they can see simultaneously on the mobile computing device (netbook in this case) that has been assigned to their team. The facilitator allows a short period of time for team discussion on each question; after which, the teams each need to agree upon their answer which they submit through their mobile device. All teams are immediately provided with general question feedback both on the big screen and on their mobile devices. As teams progress through the game, the facilitator can show a scoreboard on the projector screen displaying each team's current position (score), which relates to a fictitious position within the company for each team.

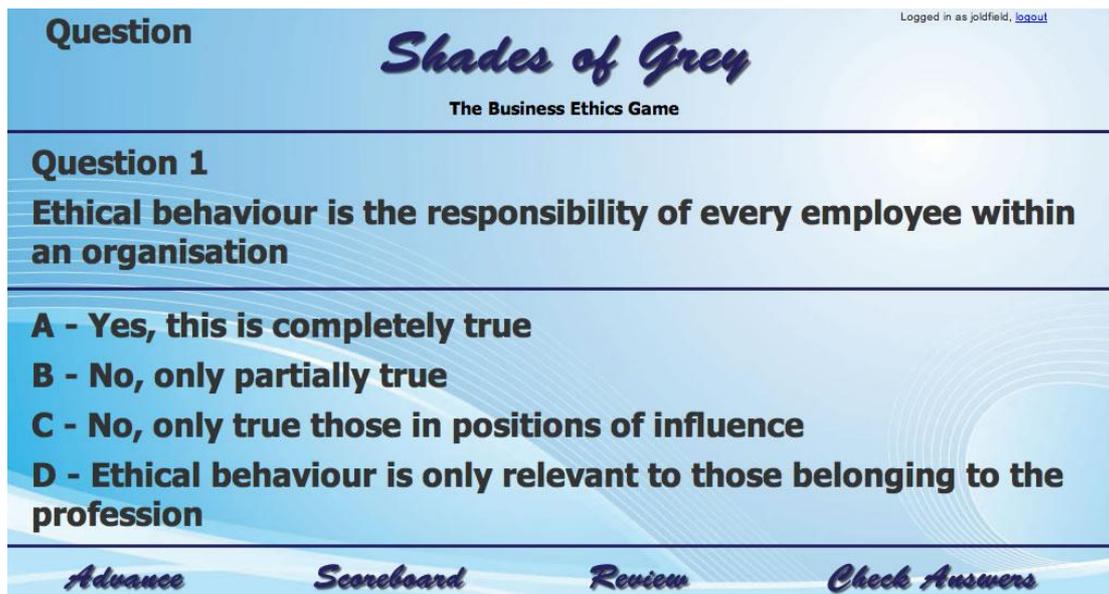


Figure 1: Screenshot from the Shades of Grey game

Method

Testing of the effectiveness of the Shades of Grey game took place during a scheduled class of an Advanced Management Accounting course. The students knew in advance that a significant portion of the class would be devoted to revision through the use of a game. At the beginning of the class students were given an outline of what the game was about, what was involved with the research and why it may be worth their while to participate. It was made clear that participation was completely voluntary and there were no penalties for non-participation. A number of students (approximately ten) decided at this point that they would prefer to work independently at the back of the room instead of participating. The remainder of the students were split into groups of five or six based on where they were sitting in the classroom.

Prior to playing the game, students were individually tested by a series of multiple choice questions to establish the base-level of their understanding of the topic area. These questions were designed to be similar in nature to the content involved and questions included in the Shades of Grey game. The test involved ten multiple choice questions and students were allowed ten minutes to complete this formative test. Upon completion of this pre-test, student groups were each allocated a netbook with a browser window open, showing the Shades of Grey student log-in. The facilitator then briefly explained the process and protocols for the game to ensure each of the student teams followed the rules and did not struggle with the technology involved. At this stage one of the project's researchers was available to troubleshoot any computer problems, or other problems related to playing the game, if necessary.

Student groups then took part in the Shades of Grey game, answering questions on ethical matters as they competed in their teams against their classmates to gain the highest score and prove their ethical comprehension. The game consisted of questions that were based around a different ethical issue or scenario. The facilitator introduced each of the questions to ensure that there was never any confusion with the question itself. Students were able to read the question off the projector screen or they could see the same question on the netbook screen directly in front of them. Teams were given between two and three minutes to discuss each question. During this time, the teams were encouraged to discuss the ethical issues raised by the question and try to come to a consensus on the best possible answer. When the team was happy with their preferred answer, they selected it on their netbook. Once all teams had selected their answer, the facilitator clicked the 'proceed' button on the main screen and the teams were then allowed access to the question feedback.

For each of the ten questions, more than one of the answers was at least partially correct. Each answer had a score assigned to it which was somewhere between -10 and +10. These scores were applied at the end of each round to the teams' total score. At various points throughout the game, the facilitator took a

'time out' to display the scoreboard showing the every team's progress. Essentially, they were competing against each other and trying to move their team up the corporate ladder. Every five points gained the team another step up this ladder, improving their status and role within a fictitious company. These roles ranged from the low-end (where they were responsible for cleaning the company cars) to the highest level possible (where they were CEO of the company). This part of the game was deliberately introduced to provide some humour in the game for the participants, and also to encourage team unity as they competed against their classmates. At the end of the ten questions, the winning team was awarded a chocolate bar for each member. Playing of this game with the ten questions took approximately 30 minutes of class time.

At the conclusion of the game, students were again asked to individually take the test that they had completed before the game. This post-test was completed under the same conditions as the pre-test with up to ten minutes time allowance. After this was done, students who were happy to participate were then given a brief survey designed to investigate their perceptions of the whole Shades of Grey experience.

Results

Of the 22 students who took part in the Shades of Grey game, all 22 also took part in the pre-test and post-test activities, as well as answering the perceptions survey.

Student survey

The survey results provide insight into the students' perceptions of the value of the Shades of Grey game to their learning. This survey was split into two parts, the first part comprised of nine questions against which students were required to provide a score on a Likert scale between 1 and 5. At the low-end of the scale, 1 represented 'Totally disagree' and 2 represented 'Disagree'. In the middle of the scale, 3 represented 'No Opinion'. At the high end of the scale, 4 represented 'Agree' and 5 represented 'Totally Agree'.

Closed rating questions

Table 1: Closed rating survey question results

Question No.	Question	1	2	3	4	5	Average
1	I feel the group activity helped me to improve my answers to the test	0	2	2	10	8	4.1
2	Competing in a team made the game a more valuable learning experience	0	0	1	9	12	4.5
3	I find it easier to concentrate on the learning when actively involved	0	1	2	10	9	4.2
4	I find it easier to learn when I'm having fun	0	0	2	13	7	4.2
5	I feel that my classes would be more interesting if they included learning games	0	1	1	11	9	4.3
6	I was motivated to learn by playing the game	0	2	4	8	8	4
7	I enjoyed this learning activity	0	1	0	10	11	4.4
8	I feel that the technology used enhanced the game	0	0	3	10	9	4.3
9	I feel that the technology used enhanced the learning experience	0	1	6	7	8	4

Open-ended questions

The second part of the survey was comprised of two open-ended questions asking the students what they liked best and worst about the learning experience. This offered students the opportunity to express their opinions of the game in their own words. As the participation was anonymous, they were free to write exactly how they felt about the game without any concern about repercussions.

The question that asked what the students liked best about the activity prompted eighteen responses. The responses have been categorised into the following themes: Technology (3 responses), Group Activity (7 responses), Interactivity (1 response), Interesting and Fun (3 responses) and Prizes (4 responses). When asked what they liked least about the activity, students provided ten responses which have been categorised into the following themes: Losing and Mistake Making (3 responses), Simplicity and Lack of Pace (4 responses), Missing out on Prizes (2 responses) and Using Revision Time (1 response).

Pre- and post-testing

A total of 22 students sat the pre- and post- multi-choice tests. It was felt that any change in student understanding from the pre-test to the post-test should give an indication of the effect of the game on their learning. Eight of the students (36%) achieved a positive change in the score after playing the game. Four of the students (18%) actually scored less after playing the game and ten students (46%) registered the same score.

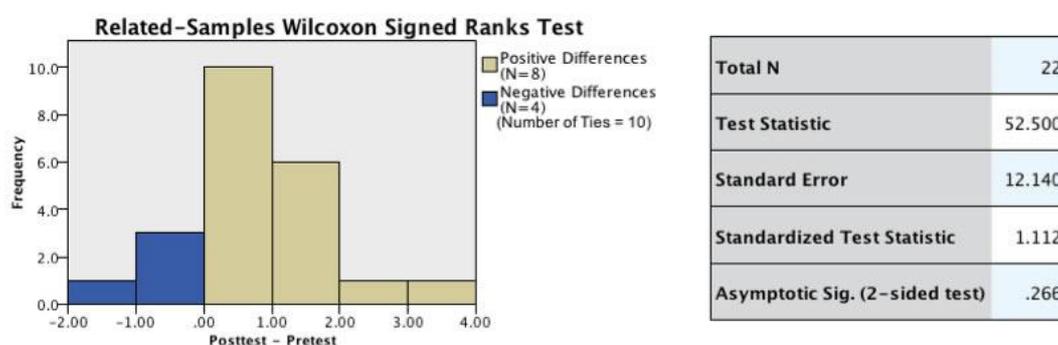


Figure 2: Related-Samples Wilcoxon Signed Ranks test results

Analysis of the student pre- and post-test data via the Kolmogorov-Smirnov test has revealed that it is not normally distributed, $D(22) = 0.25$, $p < 0.05$. Therefore the data requires a non-parametric testing method to look for a significant change in the scores. The Wilcoxon signed-rank test has been selected as the most appropriate test for this situation, as it is a non-parametric test for comparing two related conditions and therefore suitable for the purposes of this project's analysis. Interestingly, the results of the Wilcoxon Signed Ranks test ($z = 1.112$, $p > .05$) show that there is not a significant difference in the students scores pre and post-playing the game.

Discussion

Closed rating questions

Two different aspects of the students' experience with playing the Shades of Grey game were captured through this research. Firstly, the students' perceptions of the experience have been analysed based on their survey results. Overall the student surveys have projected a positive perception of the Shades of Grey game experience. The student perception questions have been grouped by theme for further discussion and the following paragraphs will look further into each theme.

Question 1 and 2 involving collaboration

Question 1: 'I feel the group activity helped me to improve my answers to the test'

Question 2: 'Competing in a team made the game a more valuable learning experience'

Strong average Likert scores for both questions 1 and 2 reflect and endorse the findings of research that has been conducted into cooperation in education (Giraud, 1997; Keeler & Steinhurst, 1995; Na'im, 2004). The bulk of the students felt that the group aspect of the exercise helped them to learn, something which matches the findings of Keeler & Steinhurst (1995) who also believe it to improve student engagement. Most students also believed that the group collaboration directly contributed to improvements on their individual test score, as found by Na'im (2004). The nature of the game

encouraged collaboration as opposed to simple cooperation. Because the students were working together in the same place on a series of ethical problems, they were strongly encouraged by the situation to collaborate rather than simply splitting up the task (Dillenbourg, et al., 1996; Scanlon, 2000).

Questions 3, 4 and 7 being actively involved and having fun

Question 3: I find it easier to concentrate on the learning when actively involved

Question 4: I find it easier to learn when I'm having fun

Question 7: I enjoyed this learning activity

The average Likert scores for questions 3, 4 and 7 were strong (all above an average of 4), indicating that the students felt that playing the game was an enjoyable experience and the active involvement helped their learning. The responses to these questions are strongly supported by existing research such as that by Bligh (2000) and Eble (1983) which stress the importance of active participation over passivity in learning. Improved interest and enjoyment in the classroom can generate a number of benefits (Cermignano, et al., 1998), including improved attendance which would likely have a long-term effect.

Questions 5 and 6 benefits of playing games

Question 5: I feel that my classes would be more interesting if they included learning games

Question 6: I was motivated to learn by playing the game

Average Likert scores of 4 or more were again recorded for questions 5 and 6, showing support for the use of the game and interest in having games used in other courses. These student responses support research findings on the effect of learning games on student motivation, particularly when preparing for lessons and examinations (Cook & Hazelwood, 2002; McEacharn, 2005).

Questions 8 and 9 the impact of technology

Question 8: I feel that the technology used enhanced the game

Question 9: I feel that the technology used enhanced the learning experience

As with the other closed questions, the average Likert scores were 4 or more for questions 8 and 9. Most of the technological elements of the game existed in order to make the game run as smoothly as possible. The electronic submission of team answers ensured that teams were not able to see other teams' answers until after grading had taken place. The digital scoreboard on the overhead projector and the mini-scoreboards on the netbook screens made it very easy for the students to get feedback on their answers and to review their progress. The Likert scores suggest that these technological elements were well appreciated by the students.

Open-ended questions

The overall response to the open-ended questions – asking students what they liked best and worst about the learning experience – was predominantly a positive one. Not all students responded to these questions which is common with surveys of this nature.

Of the positive open-ended comments, the Group Activity was the most commonly recurring theme. Seven student responses were made about the positive impact that the game's group approach had on their class. The following are examples of the group-related comments that were made by students:

Group discussion to broaden my knowledge.
The team work to discuss questions.

It seems that, as has been discovered in previous research, the game gave some of these students a stronger than usual incentive and a mechanism for working in groups, which in turn improved their engagement with the course material (Chickering & Gamson, 1987; Keeler & Steinhurst, 1995).

Three positive student responses were made about the game being Interesting and Fun. This was an important aspect of introducing the game to this classroom, as making the experience fun and creating interest in the activity are some of the key aspects of educational game playing (Cermignano, et al., 1998; Cook & Hazelwood, 2002). The following comment is an example of the student feedback:

The process is interesting and relaxing.

Students also made three positive responses about the effect that Technology had on the game activity. Whilst the literature around the effect of technology on such games has not been specifically targeted, the technology used by the Shades of Grey game was designed to enhance the game experience, to make it responsive, interactive, and interesting. One of the positive technology comments is shown below:

The use of notebooks to enhance the game.

The two other themes found in the positive responses related to Interactivity (one response) and Prizes (four responses). Interactivity is one of the contributing factors to making the game fun and engaging. The prize aspect of the game was seen as an additional way of securing engagement from the students. Although there was no summative assessment component to the game, the idea of offering a prize is a form of encouraged formative assessment which should help motivate students and cause them to value the experience (Swan, et al., 2006).

The ten responses to the question of what students liked least about the Shades of Grey activity can be categorised into four themes. The first of these themes was the Simplicity and Lack of Pace of the game. One of the most constructive student comments offered the following perspective:

Some answers could be answered differently, but no opportunity exists to provide a reason for selecting an answer.

This comment has prompted ideas from the game developers for future revisions to the game mechanics. The number of comments around the game's simplicity have also indicated that a more complex game scenario would be welcomed by students and could in fact encourage deeper levels of collaboration between the students leading to an improved learning experience (Dillenbourg, et al., 1996).

Three students commented on Losing as being one of the negative aspects to the the game. It is difficult to determine from the data gathered if this actually means that the students would prefer not to have played at all, or if they were simply disappointed with their team for not winning. However, given the high Likert average scores for the students' opinion of the game, it is likely that the latter is correct in this case. Two students commented on the lack of prizes for those who did not win, and one student commented on the fact that playing the game used up some of their revision time. It is extremely important that any classroom activity is seen by the students as being valuable to their learning, particularly as examinations get closer. Perhaps, in this case, the student did not place a significant value the game as a revision exercise, or perhaps they simply did not realise that they were revising while playing the game. It is difficult to know without further investigation.

The second aspect of the students' Shades of Grey experience in this Advanced Management Accounting course was pre- and post-testing of their ethical knowledge. While the scores were anonymous and the data was not linked to specific participating individuals, they were recorded in such a way that they could be compared on a student-by-student basis, pre- to post-testing. Based on the literature reviewed, it had been assumed that overall the students would improve their performance in the post-test after having played the Shades of Grey game (Bligh, 2000; Eble, 1983; Hoffjan, 2005; McEacharn, 2005). However, only eight of the 22 students (36%) did achieve an improvement in their scores after playing the Shades of Grey game. The majority, approximately half of the students, had no change between their pre- and post-testing results. In a small number of cases (four), students actually scored less on their post-test than they did on their pre-test. The students were not aware of their scores at any time, and it may be the case that they second-guessed themselves in their responses to the post-test questions, or perhaps they had become confused by the ethical cases involved with the game which unsettled their thinking on the topic.

The overall percentage change in the pre-test scores to those recorded after the game had been played was 4%. Admittedly this is only a small increase overall, but it is worth noting that some students in fact achieved gains between 25% and 60% in their scores.

After performing a Wilcoxon Signed Ranks test, it is clear that there is a large amount of uncertainty around the results from the pre- and post-testing exercise. With a Significance value of 0.266 under this analysis, the above-mentioned 4% increase is shown to be insignificant. Nonetheless, while the pre- and post-test results are less significant than originally hoped, it is believed that further testing may provide evidence of a more compelling improvement. Of particular note is the fact that, given the time constraints of the class itself and also out of consideration for the students precious revision time, the tests were comprised of only ten questions. Over a larger test, differences in scores would be more evident, as there would be a larger range of possible scores. Additionally, a larger student sample size should reveal more about the game's effect on students, and therefore a repeat of this study over a larger population would also be worth considering. One final point to consider is that perhaps the degree of learning from playing the game is not fully evident until the students have had an opportunity to reflect on the experience.

Conclusion and future work

The literature shows that the classroom-based learning experience is greatly enhanced for students by providing an environment that encourages and supports active student engagement; that uses computer technology as part of the experience; and that has elements of fun to make the experience more enjoyable for the students.

The Shades of Grey game can be used during a class as an ice-breaker for a topic area or as a capstone activity for the course. It requires group collaboration (often between students who are not known to each other at the start of the semester). For the purpose of the team activity, students must be allocated into groups; a group size of 5-6 students encourages discussion and thinking amongst all group members, which increases opportunities for participation and involvement by all students. Upon submission of their answers, students are provided with immediate feedback and are able to reflect and discuss in their groups.

Based on the positive feedback from students in the survey conducted as part of this research project, further investment in the Shades of Grey game seems justified. As a result of the feedback from the student survey, informal feedback from colleagues and general reflection by the researchers, a number of ideas have surfaced for improvement.

Interest in the game has been high from many educators who have either seen it or simply heard of it. Many lecturers are interested in making use of the game in their own courses, which will help to justify the time spent developing it. One key area of the game's technical functionality that requires further development is the improvement of the user interface, specifically to allow facilitators to easily develop their own question sets and to be able to extract the results from the game on its conclusion. This latter requirement is important because it could help lecturers to adjust their teaching according to the students' performances in the game to better support their students' learning needs.

When dealing with ethical scenarios, it quickly becomes apparent that there is never just one correct answer. This caused considerable difficulty when points were being assigned to answers in the Shades of Grey game in this Advanced Management Accounting course. The initial method of dealing with this situation was to assign degrees of correctness to answers by providing differing scores for different answers, rather than simply having one right and three wrong answers. An improvement to this method seems to be to allow a challenge system to the game. It is proposed that if a team does not agree with the scoring of the answers provided for a question, then they could challenge the answer. After arguing their justification for the challenge, the facilitator could then make a decision as to whether or not additional points can be awarded.

Finally, to add more variety to the game and provide a superior sense of realism, another possible improvement that is envisaged is that the question types could be expanded to include multimedia-based questions. Important aspects of educational games include graphics, sound and story line (Amory, Naicker, Vincent, & Adams, 1999), meaning that the inclusion of multimedia should improve the learning experience. For example, students could view a video or listen to an audio clip of an ethical problem and then decide on their course of action. It would be interesting to see whether students perceive any difference between a solely text-based game and one with multimedia elements, and if the introduction of multimedia contexts has a positive effect on the game's learning outcomes.

Further research and evaluation of the game's usefulness and potential is planned. Testing with larger student groups across different subject areas and in different institutions should provide a much clearer picture of the teaching and learning value of Shades of Grey and other games like it. It is felt that the current testing methods did not offer enough opportunity for changes in scores as there were only ten questions used. It also failed to measure the cooperation (discussion) between the students in their groups. Measuring this may provide more insight into the value of the game's ability to encourage discussion. With a revised interface, modified testing instruments and wider audience, future research should generate much stronger evidence of the game's worth.

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