Experiences of Promoting Engagement in Game-Based Learning

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Abstract: There is a growing belief that techniques from digital games can improve student engagement in learning, resulting in improved success rates and a more rewarding experience for everyone involved. In practice, of course, success is never guaranteed because of the difficulty of addressing the many factors affecting the outcome. The main purpose of this paper is to clarify those factors as a basis for developing guidelines to help improve the chances of success. The ideas presented are based on the positive experience of using an engagement game in the teaching of first year programming and a more problematic experience of extending the approach to encourage students to seek one-year work placements. The paper starts with a summary of the first year engagement game, outlining its approach, results, and the lessons learned from the exercise. This is followed by the description of a substantially different game for second-year students, who undertake a full-year work placement in their third year of a four-year Computing degree. Again lessons learned from the experience are reported, with suggestions for further experimental work outlined.

Keywords: games-based learning, student engagement, success factors

1 Introduction

Engagement is central to the success of student learning. According to Skinner and Belmont (1993) students who are engaged “...show sustained behavioural involvement in learning activities accompanied by a positive emotional tone. They select tasks at the border of their competencies, initiate action when given the opportunity, and exert intense effort and concentration in the implementation of learning tasks; they show generally positive emotions during ongoing action, including enthusiasm, optimism, curiosity, and interest”. Such engagement is commonplace among those playing digital games so it is not surprising that there is a growing interest in how games techniques might be used within education (Gee, J. 2007; Prensky 2006; Cordova & Lepper 1996; Jonassen et al. 1995; Ricci et al. 1996; Squire & Jenkins 2004).

One approach is to create what is effectively an educational game. That is, the student is presented with a game which when played has an educational benefit. This means tailoring educational material to be used within whatever game framework has been selected (McFarlane et al 2002). Another approach, however, is to wrap a game framework around existing material. This has the significant advantage of being usable for any content, in any context. In effect, it means making a game of the teaching process rather than the teaching materials.

Earlier work (Charles et al. 2008) started with the vision of making education as enjoyable as playing electronic games. In this work, ‘engagement’ was identified as the central issue, leading to a study of the elements relevant to engagement that were commonly found in computer games. Six main factors emerged, which in summary are:

- **Fun**: engagement is easier if the experience is enjoyable. Koster (2004) argues that “fun is just another word for learning”, implying that effective learning is inherently enjoyable. Certainly ‘fun’ improves engagement but surprisingly isn’t given as much attention in the educational literature as might be expected, perhaps because it can be difficult to align with the basic outcome-driven demands of a typical learning process.

- **Social**: engagement is reinforced by the social support of others going through the same experience. When players interact within a game environment there is social interaction though competition or when the players share their experiences (Salen & Zimmerman 2003). Educationally, it is recognised that such social interaction is important in any learning process and so ideally should be facilitated explicitly.

- **Identity**: engagement can be encouraged if everyone has a visible role in the learning environment. In games, a player usually has a visual representation of themselves within a game system. Gee (2003) suggests that this identity deepens personal investment in the game...
and encourages players to interact and engage to a greater extent through the projected character. Usually, there is no equivalent explicit mechanism in education, but identities do develop, particularly if group work is involved (e.g., group identity and team leader).

- **Challenge:** *engagement can build on human competitive drive, enhanced by social pressure.* In practice, ‘challenge’ means rising to meet demanding but achievable goals. Challenge (or conflict) is an intrinsic element in game systems but isn’t always emphasised in education, perhaps because it can be seen as demotivating for students with low expectations.

- **Structure:** *engagement is more likely if objectives and constraints are clear and acceptable.* The rule-bound, goal-oriented structure of games contributes to an engaging experience (Bjork & Holopainen 2005). So, in education, objectives, required levels of achievement, and rules of acceptable behaviour need to be explicit and appropriate.

- **Feedback:** *engagement is reinforced by making achievement explicit.* Feedback in games is important in providing players with timely and relevant information on their progress towards goals and identifying their level of achievement so far. Progress within the game will often be summarised in a map, and achievement indicated though ongoing game statistics, measuring attributes such as player skill, strength and health. Equivalent information is provided in education but tends to be less detailed at university level.

These six game engagement elements can be used in both the design of learning materials and in the way that the learning process itself is organised. This paper focuses on the latter case, and in particular, on isolating the factors that affect success; for although games techniques seem to have the potential to improve engagement, the goal of achieving significant improvement in learning can be as elusive as success in any endeavour.

The basic idea was to make students compete for points awarded for desirable behaviour in a way that had a positive educational benefit, without any negative side-effects. It was unclear initially, however, where points should be awarded and what complexity or simplicity was needed to ensure engagement. The work therefore relied on action research (Lewin 1946) in an evolutionary prototyping framework (Crinnion 1991). The strategy was to first do whatever was necessary to create a game that the students would play with reasonable enthusiasm, analyse the educational impact of the game and then tune it as necessary. The belief was that once a basic framework had been identified more rigorous studies could be made of individual engagement factors to better understand their contribution, interdependence, and reliance on context. Such studies would only be worthwhile, however, if it could be demonstrated that significant improvement could be achieved with this approach.

The paper draws lessons from the experience of the authors in using digital games techniques in the teaching of programming to first year undergraduates and in encouraging second year students to obtain a one-year work placement. Section 2 of the paper explains how the first year engagement game was designed and implemented, followed by a discussion of the results achieved. Section 3 then describes how a second year engagement game, to encourage placement activity, was developed for the students advancing from the first year game. Again lessons learned from the experience are discussed and plans for further development of the approach outlined in the conclusions.

## 2 First Year Engagement Game

The experimental introduction of digital game ideas into teaching started in the first year of an undergraduate course in Computing at the University of Ulster in 2007. The experiment covered two first year Java programming modules, delivered in successive semesters: *Software Development 1* (COM158C1) and *Software Development 2* (COM164C2). The modules ran from September to December 2007 and January to May 2008, respectively. These were presented in the previous academic year, 2006-07, by the same person (third named author on this paper), and with the same technical content, so the overall consequences of adding game ideas to improve engagement were expected to be relatively straightforward to identify. This section describes the design of the first year games and the results of running them.

### 2.1 Game Design

Building on the six game engagement elements presented in the introduction, the first year game was designed as follows:
- **Fun:** the authors recognised at the outset that it would be unrealistic to attempt to develop an educational game that was guaranteed to be ‘fun’. So, initially, the objective was simply to have reasonable student participation in the game, with the hope that some would also find it enjoyable. Participation was encouraged by making it clear that this was an experiment, which was necessary anyway for ethical approval of the work. The students were also required formally to agree to be involved in the experiment, which further increased their commitment.

- **Social:** to encourage social interaction, the experiment in the first semester was a group competition. The first module already had a strong tradition of groupwork as a way of also helping to induct students into the university. This framework could be built on directly. Groups were selected carefully and typically took account of the home location of the students involved. Experience also suggested that peer pressure in groups would further encourage engagement. A similar game, based on individual performance was run in the second semester.

- **Identity:** to promote a sense of identity, the groups could choose their own names; also, in the first semester, this sense of identity was reinforced by displaying the relative performance of each group on a plasma screen at the entrance to the computing department. In the second semester, students were shown their individual scores, indicating their position in the class, and the top and bottom scores.

- **Challenge:** The first semester was divided into two halves, with a simple introductory game run in the first half to help introduce the game and give a chance for it to be refined. Table 1 identifies the final elements of the game created. This shows rewards for ‘good behaviour’, such as attending regularly and scoring well in required practical work. Additional points could also be obtained by taking on a range of optional, more demanding tasks, such as completing an individual online quiz or the group analysis a technical topic and explaining it to the rest of the class. Similar individual challenges were set in the second semester. Note that, for the group game, the points awarded were normalised to take account of different group sizes.

<table>
<thead>
<tr>
<th>Element</th>
<th>Score</th>
<th>Possible Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>10 Points for each of the lectures, lab class and tutorial</td>
<td>200</td>
</tr>
<tr>
<td>Contribution to Tutorial</td>
<td>10 Points for every question answered correctly (Maximum of 10 points per student per tutorial)</td>
<td>50</td>
</tr>
<tr>
<td>Outstanding Achievements</td>
<td>10 Points awarded at lecturer’s discretion</td>
<td>50</td>
</tr>
<tr>
<td>Online Revision Quizzes</td>
<td>10 Points awarded for each quiz a student completes successfully; further attempts not rewarded with points but the student who obtains the highest score on their first attempt awarded a further 20 points</td>
<td>210</td>
</tr>
<tr>
<td>Group Assignment</td>
<td>25 Points group mark</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>15 Points individual mark</td>
<td></td>
</tr>
<tr>
<td>Exam Revision Questions</td>
<td>10 Points awarded to each question completed by group, max of 2 questions per group</td>
<td>20</td>
</tr>
<tr>
<td>Group Presentations</td>
<td>20 Points awarded for a presentation, max of 2 presentations per group</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>590</td>
</tr>
</tbody>
</table>

- **Structure:** the basic rules of the game, as summarised in Table 1, evolved over the first half of the semester. The aim was to keep the game simple but it also needed enough structure to be interesting. The rules had to be acceptable to the students for them to engage but it was also important to avoid behaviour that was counterproductive by setting limits on certain activities.

- **Feedback:** group performance was presented weekly, showing the breakdown of points for each element. This information was accessible through each student’s virtual learning environment (WebCT) and was also displayed publicly, as indicated above in the discussion of ‘identity’.
This description shows that the six game factors are inter-connected, but looking at them individually helped ensure that each contribution was addressed adequately.

2.2 Game Results
The underlying motivation for this work was to help students achieve their potential. The main measure of success, therefore, was the extent to which overall pass rates improved. In practice, the results for the 2007-08 class exceeded all expectations. In the first semester, every student taking the exam passed at the first attempt, though some had left the course earlier in the year. This had never been achieved before and indeed with a programming module, initial failure rates of about 25% were more common. In the second semester, the results were less spectacular, but the failure rate was still less than 10%. More importantly, the results now followed a normal distribution rather than the bipolar pattern that had often occurred before, which suggested that there was no longer a group at the bottom end expecting to fail. The bipolar pattern can be seen in Figure 1 for the 2006-07 cohort, shown against results for the 2007-08 group.

Another consequence of the game was that class and laboratory attendance increased by about 5%, which undoubtedly contributed to engagement and success overall. A third, unexpected benefit was that the performance of the students improved in all first year modules they studied, suggesting that there had been a beneficial change in their approach and study skills. Unfortunately, as these modules changed in other ways it is too early to be certain that this was a general effect.

On entry to second year, the students who took part in the first year experiment were asked to complete a questionnaire. 25 statements were presented, inviting agreement or disagreement on a 5-point scale from strongly disagree (1) to strongly agree (5). Suggestions for improvement were also invited and there was space for other comments. 49 questionnaires were completed. In terms of the six game engagement elements, the questionnaire revealed the following:

- Fun: In the context where 90% of the class said they enjoyed playing games, 70% of the students agreed or strongly agreed that playing this engagement game made studying the module more enjoyable, with most of the remainder having no opinion either way. Further evidence of enjoyment is that over 60% felt encouraged to spend more time on the module and over 70% felt the game could be run successfully in second year, which they were just starting. 70% also believed that the game helped them obtain better results overall.

- Social: 75% agreed or strongly agreed that the game helped them work better in a group, with over 85% believing that the game helped others improve their performance. Disappointingly only 45% felt that the game encouraged them to help weaker students in the group. When asked about their preference for a group over an individual game the class was divided equally, though over 50% expressed a clear preference for gathering points for the group rather than themselves.

- Identity: 70% agreed that the public display of results using the plasma screen encouraged them to try and gain more points as they knew other people could see their progress in the game. About 45% believed that presenting the results publicly embarrassed some groups, but pressure from discomfort is part of the game and the benefits seem to justify this aspect of the game.
• **Challenge:** 65% of the students agreed that the feedback received from the games-enhanced modules encouraged them to take on challenges that they would normally avoid. Three in the class (6%) felt that they had less time to spend on other modules but as indicated earlier, the other modules showed improved performance in relation to earlier years. Over 90% agreed that the level of challenge in the game was ‘about right’.

• **Structure:** There was general agreement that the rules of the game were clear (85%) and that the allocation of points was largely fair (85%), though one person wanted the number of points more directly matched to the effort involved.

• **Feedback:** Nearly 90% agreed that the visual representation of their performance helped them to better understand their achievements within the module. As might be hoped, students were keen to see the effect of any points they earned reflected immediately in the public display rather than having it updated weekly. Ways of speeding up feedback are discussed in a later section.

From the results obtained so far it can be concluded with confidence that introducing game engagement elements into teaching:

• provides a more enjoyable learning experience;

• increases student participation in the learning process;

• improves basic desirable behaviour, such as students attending lectures regularly and completing coursework effectively;

• encourages personal development through students taking on additional challenging tasks; and

• promotes effective group work.

Also, the visual display of feedback has a positive impact on how students interpret their progress and the public display of that information leads to enhanced performance.

Having established that, with suitable care, game engagement techniques can be beneficial to learning, the next stage was to see how well the approach could be transferred to a different situation. To help interpret the results it was decided to use the same cohort of students in their second year of study. An area that seemed particularly suitable was the process that students go through in seeking a work experience placement. This is discussed in the next section.

### 3 Second Year Engagement Game

Students on a Computing degree at the University of Ulster are expected to spend the third year of a four-year programme in a full-year work placement, which they obtain during their second year of study. Traditionally, this has been a difficult area for engagement, with students often slow to apply for work, resulting in delay or failure to secure a placement.

The basic process is that each student prepares a CV (résumé), completes a mock interview and then applies for placement opportunities accessible electronically through a locally developed web-based placement management system, **Opus**. Employers can offer job descriptions for inclusion in Opus, and once visible, further communication is exchanged directly between the students and the organisations involved. Thus, through Opus, students receive and submit application forms, are informed about interviews and receive notification of interview results.

#### 3.1 Game Design

In designing a game around placement employment, the following assumptions were made:

• Following on from their experience of the engagement games in first year, students would welcome another game as the questionnaire results suggested that over 70% believed that a similar game could be run successfully in second year. The greatest benefit had been gained when the students were in groups so this approach would be adopted again.

• The game should improve the existing process as it would raise the profile of placement activity, including public display of information, and add urgency to each stage. Previously, students had sought placements individually. A group structure should provide additional encouragement and support. The main measure of success would be the percentage of students placed by the end of the academic year.
Having had the first year experience, and finding it both enjoyable and beneficial, the students would be largely self-organising and begin the game immediately, driving its progress.

An early start was likely as the first stage was CV approval and the students had already developed a CV in their first year.

In first year there were small prizes awarded as an incentive to take part in the game (e.g. most improved group). For the placement game it was assumed that being offered interviews and jobs would be sufficient encouragement.

It was recognised that game strategies, such as trying to obtain job interviews and offers with no intention of taking them up, would be a problem for the University. It was believed, however, that the students would not engage in such behaviour because of the effort involved. Nevertheless, the rules of the game were devised to minimise such risks.

On paper, the game didn’t sound as much ‘fun’ as the first year experiment but it was believed that the students would welcome the increased support available and participate to a reasonable extent.

As in first year, the class was split into teams and a member of academic staff was assign as a ‘coach’ to each team. The coaches had the responsibility of approving achievements and awarding points through a web-based support system. The system also gave coaches and students a visual summary on their performance individually and within their team. Again, like the previous year, results were also displayed publically on a plasma screen at the entrance to the Department.

The aim of the game was to encourage the members of each team to work together to secure placement positions. The game was intended to run throughout second year, with the overall objective being to have all students placed before the end of Semester 2; the first team to secure positions for all its members would be the ‘winner’. The game rules and sub-goals were structured around the main tasks that are required to obtain a placement, as indicated in Table 2. The points were set to encourage students to obtain a placement as quickly as possible.

<table>
<thead>
<tr>
<th>Element</th>
<th>Score</th>
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</thead>
<tbody>
<tr>
<td>CV</td>
<td>50 points for each CV (approved by the coach)</td>
</tr>
<tr>
<td>Mock Interview</td>
<td>Up to 100 points according to performance (Week 6, marked by interviewers)</td>
</tr>
<tr>
<td>Placement Applications</td>
<td>100 points for each job application (confirmed by coach), with a 200 bonus (per person) for any application submitted by Week 9 of Semester 1</td>
</tr>
<tr>
<td>Interviews</td>
<td>200 points for each interview offered and attended (confirmed by coach)</td>
</tr>
<tr>
<td>Placement Appointments</td>
<td>2000 points for a job secured by 1 Dec 2008 (confirmed by coach), reduced by 200 in each successive month</td>
</tr>
</tbody>
</table>

### 3.2 Game Results

At the time of writing, the game is still in progress, but some preliminary results can be reported. Again these are presented in terms of the six game engagement elements:

- **Fun**: As indicated in the previous section, the placement game was not expected to be as enjoyable as the first year game and so it turned out. One issue was that many students were anxious about putting themselves through an interview process and failing. This meant they delayed involvement which simply increased their anxiety. Also, the progress of the game was much slower than in first year so it didn’t develop the same level of enthusiasm. A more serious oversight was failing to see that the academic coaches were also stakeholders who needed to find the experience enjoyable and be fully engaged. Much more time should have been spent discussing the game with them and indeed involving them in the design of the game itself.

- **Social**: Because of inadequate preparation of the coaches, they largely left the students to organise themselves. In practice, some groups, with strong leaders were successful but many drifted along and, more importantly, weaker members of groups were given little encouragement. It was also disappointing to see that those who succeeded in finding
placements tended to withdraw from the game rather than stay and help others. Regular team meetings to review progress are essential and need to be built into the structure of the game in future.

- **Identity**: The groups by default adopted the identity of their coach, which was a problem as the coaches were insufficiently engaged. When the team results were first presented publicly, the coaches with low performance points were unhappy with the resulting pressure but it was difficult for them to make a difference at that point as they had not built a sufficiently strong relationship with their team. As performance across a team was variable, it was decided to show the individual breakdown of points halfway through the year. This seemed to have little effect on the effort of weaker students and also tended to take pressure off the coaches.

- **Challenge**: Finding a placement is difficult because many employers see the process as a way of recruiting permanent staff in the longer term and so put the students through a full recruitment evaluation. Also, in the current economic climate, there were fewer placement opportunities available than usual, with some employers withdrawing during the year, even after job offers had been made. This meant that some students had to make more applications than necessary in previous years and also deterred those at the weaker end of the class from applying for any jobs.

- **Structure**: The basic structure of the game seemed reasonable overall, but its rules and organisation need a significant overhaul to better encourage desired behaviour among students and coaches. A full detailed review of the game will be undertaken before it is repeated next year.

- **Feedback**: The frequency of positive feedback promoting competition was missing, with teams rarely being aware of those in opposing teams who were securing jobs. The undoubted success of each student obtaining a job should have been celebrated publicly.

Despite these issues, however, the students did show signs of improved engagement with twice as many job applications submitted up to May 2009 as in the same period in the previous year. As a result, the students secured a similar number of jobs in a very difficult job market. On that basis, the game can be considered a ‘success’ though, clearly, there are many opportunities for improvement. These suggest that level of engagement in the game and its overall effectiveness can be increased significantly, though suitable refinements.

4 Conclusions

The experiences described in this paper have convinced the authors of the benefits of using game engagement techniques in third level education. These techniques seem particularly effective in first year teaching but also have a role in second year, and may even be beneficial for final year students.

The initial success in introducing the techniques in first year programming, however, was perhaps misleading, as it gave the impression that the existence of the game itself was sufficient to improve student performance. In contrast, the second year placement game was a reminder that the elements of such games need to be designed carefully to create the required experience and so ensure full engagement. The second year game also drew attention to the importance of the interests and experience of the academics involved in the process. In the first year experiment, the lecturer was a champion of game engagement techniques and had a strong interest in the personal development of students. The game therefore built directly on the already effective way that she organised and delivered the modules. In the second-year game the six academics involved had widely varying backgrounds, and significantly different levels of interest in the experiment. Also, there was little existing support practice on which to build the game. It is very encouraging, therefore, that it showed signs of improvement in such unpromising circumstances and in the context of difficult economic conditions.

Overall, the results of these experiments have confirmed the value of trying to improve engagement in education through the recognition and adoption of techniques used in the design of digital games. They also have begun to clarify where and how these techniques should be used and the necessary conditions for their successful introduction. It is expected that many more lessons will emerge from planned further attempts to apply these techniques, both in new areas and in refining the existing experiments. Many have shown interest in this work and so an immediate priority is to package the
technology support for the process game into a learning object that others can use experimentally. The goal of this work is to produce a flexible generic tool that can be used in virtually any educational context.

References


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