‘Blended’ and ‘flipped’ pedagogies are becoming more common features of classrooms as the technological revolution continues. While the appropriate use of technology in the learning environment can serve to motivate some students, significant problems surrounding student motivation and engagement remain. As such, the gamification, or the application of typical elements of game playing (e.g., point scoring, competition with others, levelling-up), of the learning process is increasing. In an attempt to motivate adolescent Year 9 students to undertake extension work in a course, we gamified Year 9 science. As a result of the gamification, 17% of students completed some extension material and two students completed significant amounts of extra work to achieve the highest level possible in the game. The accumulation of game points, or stars, throughout the course also enabled an analysis of student work output compared to traditional test and exam results. This analysis showed a strong positive correlation.

INTRODUCTION

The video game industry is a leader in entertainment. Australia’s video and computer games industry had a very strong year in 2014, hitting $2.46 billion in revenue, an increase of 20% over 2013 (Curry, 2015). In fact, in 2014, video games (£2.452bn) were once again the biggest entertainment industry in the United Kingdom, eclipsing the earnings of both music (£1.03bn) and movies (£2.18bn) (Dring, 2015).

Games are also seen as a component of family entertainment. The majority, or 56%, of parents, say video games are a positive part of their child’s life. Sixty-eight percent of families with children under 18 at home believe game play provides mental stimulation or education, and more than 50% believe games help them to spend time together. Fifty-eight percent of parents whose children are gamers play games with their kids at least monthly, and among parents who play with their children, 88% believe video games are fun for the entire family (Curry, 2014).

While the main emphasis of these game-related statistics is entertainment, people are finding that game functions can be applicable in everyday life. Gamification is the concept of applying game mechanics and game design techniques to engage and motivate people to achieve their goals. Although games have long been considered a source of entertainment, through the lens of gamification, they can now be seen as a means of engaging students to acquire and develop a deeper understanding of academic subjects.

Just as Lee and Hammer (2011) suggest, schools already have several game-like elements. For example, ‘badges’ are an intrinsic component of our classrooms. Teachers award points for completing assignments; over the course of the semester these points add up and get
converted into ‘badges’ (commonly referred to as grades); at the end of the academic year students who collected the right ‘badges’ get to level-up. By awarding these points, educators are extrinsically motivating students to perform whether they like it or not. In fact, students can be observed ‘gaming the system’ regularly to increase their points scored with questions such as: “Is this going to be on the test?”

If we consider that our education system is already a game, to a degree, then why not try to amplify the motivational aspects of the game by increasing the amount of gamified elements? As the gaming industry and the gamification of other aspects of life (shopping reward cards, personal fitness badges, etc.) continues to grow, perhaps educators will need to gamify their instruction to engage and motivate the next generation of students.

AIM

The aim of this action-research-based case study was to see if it was possible to have some Year 9 students complete voluntary extension tasks in addition to their regular curriculum content using the motivational elements of games. The voluntary extension tasks were not assessed in a traditional way; they were not reported on, and the content of the extension material was not included in any tests or examinations. Thus the research examined ways to increase the motivation of students to complete more school-related work for non-traditional rewards. It was hoped that the game structure would provide students with an avenue to intentionally demonstrate and increase their levels of grit and determination by advancing in the game.

METHOD

With the discovery that by ‘flipping’ the delivery of classroom content, students were able to obtain higher grades (Barlow, 2012) the focus shifted to the varying levels of motivation of the students in class. When all relevant course-based content is readily available to all students at any time in multiple formats (audio podcasts, written notes, explanatory videos) a teacher’s focus can move from, ‘How do I ensure all students are paying attention?’ to, ‘How can I assist all students to individually pursue their own learning at higher levels?’

In an attempt to motivate all students to pursue higher levels of task completion and/or completion of voluntary additional learning activities, we gamified the entire Year 9 science curriculum. Podcasts and videos had already been created for the students to learn from in a ‘flipped classroom’ environment, so this media now had to be interwoven with elements of game playing along with text-based content and all student-learning tasks. To achieve this, an interactive electronic book for iPad™, Year 9 Science Gamified, was created.

Importantly, the gamified book contains two units of study that were not tested, or discussed in class. There was also no practical work done in class relating to these units and finally they were not reported on. They are extension units of work composed of numerous subtasks.

To apply typical elements of game playing to the Year 9 science curriculum, each task a student could complete during the year was assigned with a point, or in this case a star. To ensure that the flipped classroom pedagogical approach was maintained, students were required to summarise the content of the multimodal text to attain stars. Traditional lower-order type questions were not included in the course but instead a focus was placed on higher-order, research-based thinking and creative tasks for the ‘Questions’ stars. All traditional extended project work and practical work tasks were also allocated stars, although the completion of these tasks involved student choice in an effort to increase student ownership. Overall a total of 100 stars in 2015 (64 total stars in 2014) were possible to collect in Year 9 Science Gamified.
Another element of game playing, levelling-up, was laid over the top of the completion of work, or attainment of stars. Twenty different levels are included in the ‘game’; the levels follow the story of an evolutionary path from ‘Self-replicating molecule’ to ‘Nobel Prize Winner’. Both the attainment of stars and levelling-up via the evolutionary story were designed to increase the motivation of students to complete as many tasks as comprehensively as possible.

Data was collected in five ways in order to measure the effectiveness of a gamified classroom:

**Part 1**—The attainment of stars was measured throughout the 2014 year-long science course in order to measure student work output and completion of extension work.

**Part 2**—Students were surveyed over a two-year period to ascertain perceptions of teacher quality and the perception of the gamified classroom. In 2013, students were taught in a flipped, blended classroom environment while 2014 and 2015 saw the introduction of gamification in addition to flipped and blended pedagogies.

**Part 3**—Students were asked to provide anonymous feedback on their thoughts about the gamified classroom.

**Part 4**—Student test and exam results from Semester 1 2014 and 2015 were collected to ascertain any correlation with the amount of work/stars completed by students.

**Part 5**—Anecdotal evidence was also collected during the gamified classroom experience.

**RESULTS**

**Part 1. Completion of additional or extension work**

<table>
<thead>
<tr>
<th>Amount of extension work (stars) completed by students</th>
<th>2013 (%)</th>
<th>2014 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some extension work completed</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>All of the extension work completed</td>
<td>0</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 1: Percentage of students completing extension work.
Part 2. Student survey

Students ranked the following sixteen statements on a five-point scale, higher is better. The results were averaged to provide a measure of student perception of teacher effectiveness:

This teacher knows the subject well. This teacher makes learning interesting. This teacher explains new content and concepts in a number of ways. This teacher is really interested in my progress in class. This teacher presents the course in a logical way. This teacher helps me to be well organised. This teacher encourages me to reach high academic standards. This teacher is fair. This teacher is a good role model to students. This teacher manages our class well. This teacher gives me regular and timely feedback on my work. This teacher encourages me to reflect on my performance. This teacher uses different ways to help me learn. This teacher shows me respect. This teacher encourages respect amongst students in the class. This teacher challenges me to think in different ways.

<table>
<thead>
<tr>
<th>Question</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average score out of 5</td>
<td>4.29</td>
<td>4.17</td>
</tr>
</tbody>
</table>

Table 2: Student perception of teacher effectiveness.

<table>
<thead>
<tr>
<th>Do you think that the ‘gamified’ way we have learnt science this year with the videos, interactive electronic book and stars is a better way to learn than more traditional classes that have more lectures?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of student responses</td>
<td>14</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 3: Student perception of the gamified classroom.

Part 3. Anonymous student feedback

**Student A:** “I think the system is awesome as kids have to learn for themselves, they can’t have any excuses. It is very fun and enjoyable the quizzes are helpful, and you have even catered to different people’s learning via videos. It’s awesome. Don’t change it.”

**Student B:** “I really enjoy the iBook, with the videos and stars I think I learn a lot more. It is also a lot easier to revise, as there is always a Mr Barlow on my iPad so I can find out what I need to know. I like the competitive side of the stars. I am achieving a lot more in science this year than any other. I also find the way you can go at your own speed a lot more helpful.”

**Student C:** “I think it was a very effective teaching and learning technique, because it not only automatically sets us goals (to get stars) but is also fun.”

**Student D:** “You two are great science teachers and you know a lot about what we are learning, I kind of feel that with the new way learning with the stars instead of textbook, it’s more up to us to learn by ourselves and figure the questions out by ourselves. I don’t really learn that much from you two yourself.”

**Student E:** “I think sometimes it would be nice to have less questions that say ‘research,’ because in my experience, some questions have answers difficult to find, and often are confusing answers.”

**Student F:** “I find the gamified really suites my learning. I find it easier to study and learn new content and a lot more fun. It’s a great use of technology and a really great idea.”

**Student G:** “I think because we don’t want to do all the work and want to do the minimum we don’t learn all that we should.”

**Student H:** “I do not like this way of teaching. I feel like I’m not learning since there is no lectures from the teachers and we aren’t really learning at all. Bring back the old way of teaching with doing lectures and writing class notes TOGETHER as a class.”
Part 4. Academic results compared with star attainment

Figure 3: Overall average of three tests and one examination result during Semester 1 2014 versus star attainment (correlation coefficient = 0.63).

Figure 4: Examination result versus star attainment during semester 1 2015 (correlation coefficient = 0.66).

Part 5. Anecdotal evidence
After an end-of-unit test in a traditional classroom we had never had a student go back to past questions and complete them so they could accrue more stars.

DISCUSSION

Part 1. Completion of additional or extension work
Prior to 2014, not one single student ever completed any of the extension tasks available in Year 9 science. With the addition of the motivational elements of gamification in 2014, four students from a class of 23, or 17%, completed some extension material. Two of these students, or 9%, completed every single available star to achieve the level of “Nobel Prize Winner”, illustrating significant levels of grit and determination. There was very clear evidence to suggest that implementing the motivational aspect of stars and levels increased the proportion of students who completed some or all of the available extension material.

Part 2. Student survey
In 2013, the class of Year 9 science students had access to flipped classroom resources including videos and audio podcasts. In this year, the overall perception of teacher effectiveness was 4.29 out of 5. So the students thought they had a good teacher. Interestingly, when teacher involvement was reduced and autonomous student-centred learning experiences were increased beyond a flipped classroom, the perception of teacher effectiveness went down to 4.17. So the less involved the teacher was at the front of the room and the less the teacher guided students as an entire class, the worse they thought of the teacher’s performance. This speaks to the ingrained perceptions that students, and the wider society, have about what teachers should be doing in a classroom. The perception persists that teachers should be at the front of the room guiding all students through the same experience at the same time, instead of moving around the room assisting students when they need it.

In answer to the anonymous question, “Do you think that the ‘gamified’ way we have learnt in science this year with the videos and the interactive electronic book that was not to be handed in for formal traditional assessment. In a gamified classroom we repeatedly found that many students would go back to past questions and complete them so they could accrue more stars.
and the stars is a better way to learn than more traditional classes that have more lectures?” 14 out of 17, or 82%, of students responded that they preferred the gamified classroom to a more traditional classroom. This illustrates a clear student preference to a gamified classroom model.

Part 3. Anonymous student feedback

The anonymous student feedback provides some interesting information.

Student A obviously enjoyed the gamified experience but they were also aware of the far greater level of differentiation made possible by the gamified model.

Student B referenced the flipped model, the capacity for and their enjoyment of anytime/anywhere learning. They pinpointed the motivating factors of the stars and also highlighted the differentiated nature of the course, finding the ability to ‘go at your own speed’ more helpful to their learning.

Student C also referenced the motivating aspect of the stars and found this enjoyable.

Student D referred to both teachers involved in the trial and has really defined a true student-centred classroom in their own words. They are not learning directly from the teacher(s) but they are learning by themselves and figuring things out for themselves.

Student E has picked up on the higher-end nature of the questions involved in the course. Questions that are demanding more of each student in terms of their thinking and effort required when discovering the answers.

The learning style of Student F was catered too by this approach and they also highlighted the positive effects of blending technology into the process.

The comments of students G and H provided equally important feedback, in that the approach was not favoured by all. Despite the attempt to motivate with the stars, some students still struggled to be motivated (Student G). Student H struggled to come to terms with the teacher being less prominent out the front of the classroom and directing the passage of learning. They valued the lecture-based component of learning.

Part 4. Academic results compared with star attainment

Figure 3 and Figure 4 both show extremely similar patterns. The more stars a student completed, the higher their scores in traditional assessment items. The Pearson’s Product-Moment Correlation coefficient for Figure 3 was 0.63 and for Figure 4 it was 0.66. These both illustrate a strong correlation between the amount of stars accrued (work completed) and student’s performance on traditional academic testing. If we consider the results of part 1, that students completed more schoolwork in a gamified classroom, together with this evidence that more work correlates to increased academic performance, we would theorise that the gamified classroom improves traditional academic results. This was not analysed as part of this case study but may be worthy of further research.

Part 5. Anecdotal evidence

Having students return to finish off work that they didn’t quite complete weeks or even months ago was an unexpected side effect of this case study. The process was always very student-driven too. Students would come and double check to see which stars they needed to do from the past unit, past term, etc. to enable them to attain as many stars as they possibly could. The acquisition of stars certainly provided motivation for some students to complete work that they would not have done in a more traditional classroom.

The continual tracking of student ‘star’ attainment in class also resulted in the teacher spending the majority of their time working with individual or small groups of students, providing constant formative feedback.

Students in class constantly ask: “Can I get a star?”, which provides opportunity for routine checking of student work quality and accuracy prior to awarding a star. In fact, the checking of stars required a very large proportion of the teachers’ time in the gamified classroom. To provide individual formative feedback to the majority of students in every lesson is very time consuming.

CONCLUSION

This case study illustrates that by introducing the mechanics of games into the
classroom environment, with stars, levels, competition and goals, it is possible to increase the motivation of students to complete a greater quantity of schoolwork.

There was a marked increase in the number of students who completed extension work. There was an increase in the number of students who returned to earlier incomplete work to finish it off. Students were also given considerably more formative feedback enabling on the spot regular guidance for improved work.

By engaging students with a fun and authentic experience that challenges the participant to take control and explore their understandings, while providing meaningful feedback to aid the learning process in a social and collaborative way, we have seen students more excited and motivated to learn.

REFERENCES


**Tim Barlow** is a graduate of Monash University and spent the first eight years of his career working as a geneticist. He moved into education in 2005 and is now a science teacher at St Leonard’s College, Melbourne, Australia. His blog (http://mrbarlow.wordpress.com/) has had almost two million hits. His textbooks, including *Year 9 Science Gamified*, can be downloaded from the iBooks Store.

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