Key Attributes of Engagement in a Gamified Learning Environment

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Successful computer games and effective educational environments share many similar key attributes relating to instruction, goals, feedback and interaction. Unfortunately, many educators find it difficult to implement strategies in their curriculum to compete with the engagement of computer games. The recent surge in the popularity of *gamification* may hold the key and provide a framework by which teachers can implement simple strategies to increase engagement in their classrooms. To contribute to this domain about the affordances of gamification in education, this paper argues that the key attributes of engagement are the same whether they are in an education or game setting. It also extends a previous study that revealed a five dimensional model of gamified curriculum factors and examines each with respect to student engagement. The conclusion is the amount of engagement in the gamified classroom is dependent on the individual student's playfulness and acceptance of innovative and dynamic pedagogies.

Keywords: Gamification, Pedagogy, Games-Based Learning, Curriculum, Student Engagement.

Introduction

The fundamental core mechanics of games elicit immersion and engagement in participants in the same way as well-structured learning tasks. Games are engaging because they have the potential to satisfy basic psychological needs for competence, autonomy and relatedness (Przybylski, Rigby & Ryan, 2010). Instructional design has much to learn from engagement strategies employed in computer games (Dickey, 2003).

Soon after the personal computing revolution in the early 1970s, educators recognising the potential that technology and computer games had to engage, began the edutainment movement. Unfortunately, the premise for this crusade was fundamentally flawed with computer games being used as the sweetener for delivering educational content. Thus implying that games were fun, and education was not. This lead to the popular metaphor of edutainment likened to chocolate-dipped broccoli (Bruckman, 1999). Many of these games provided drill and practice exercises fitting with behaviourist learning theory and were little more than multiple-choice quizzes paired with fancy graphics and animated characters. Indeed, educational games (and now serious games) have grown-up a lot since and evolved into interactive learning platforms that consider a range of learning theories from constructivism to social-cultural and situated learning Egenfeldt-Nielson, 2005). However, with such a vast array of game genres and educational requirements it seems ludicrous that any one game type or application will meet all classroom needs and elicit the desired engagement and motivation educators are seeking. Yet, there are continued and prolific research efforts focussed on the use of specific games applied in isolated and small studies. The results of which do not contribute to knowledge in the domain as they cannot be reproduced or generalised.

Videogames themselves are not the solution to educational problems. However, when a curriculum is constructed with the properties of games in mind, learning may be improved (Gros, 2007). More recently, the gamification movement has assisted educators in articulating the exact characteristics of a games-based curriculum structure; however, the very idea extends much further back. In the early 1970s, points and reward systems were being employed in schools under the guise of the token economy (Kazdin & Bootzin, 1972). Like early edutainment, the token economy operated under a behaviouralist system with tokens being awarded to students for good behaviour in class that could later be exchanged for rewards. This practice still exists today (de Byl, 2013). Beyond this, the types of mechanisms employed in gamification have existed in one form or another in a variety of industries including: frequent flyer programs, loyalty reward cards and happy hours (Bell, 2010).

Beyond the obvious abhorrence of many in the computer games industry, and the criticisms of many associated academic's with the gamification movement (Bogost, 2011; Pavlus, 2010; Robertson, 2011), the fundamental principles of gamification - points, levels, rewards, leaderboards, quests and customisation - can guide instructional design. Educators, now more desperate to generate engaging and immersive learning experiences, are borrowing ideas and mechanics from games. In the past, teachers have focussed primarily on the application and development of specific games for classroom use, with a distinct goal to reinvigorate the classroom, and return students attention back to the content of the class. However, educational researchers should place less emphasis on the narrow-focused skills, perspectives and educational content offered by existing computer games (Gros, 2007). Instead, it is the structural elements of computer games that should be used to enhance the educational experience as a whole. However, it is perceived gamification delivers educators an easily implementable set of mechanics that can integrate into existing curricula with very little effort or disruption to existing practices and procedures.

This paper discusses how gamification aligns and can be used within curricula, to demonstrate the affordances of a gamified pedagogy. In addition to this, a comparison of engagement factors inherent in the fundamental game mechanics on which gamification relies has also been generated. The research herein aims to reveal the affordances of gamification discovered in its use as a pedagogical tool in classes offered at Bond University. It begins with an examination of existing applications of gamification in the classroom followed by a comparative analysis of how the key attributes of engagement is critical to the success of both games and educational experiences. Next, a study that reveals the factors that may affect the successful integration and adoptions of gamification in a curriculum will be presented. The paper concludes with closing discussions and suggestions for further work.

Related Work

Gamification entered popular culture at the beginning of 2010 and has since penetrated into a plethora of domains including: business, marketing and education. Whether supported or opposed, what it does is bring together a selection of popular student engagement mechanics under the one umbrella term making them more accessible to educators.

Throughout the past two years, gamification has flourished in applications from weight-loss and exercise to teaching programming languages. Its popularity has even found it a place on the Gartner Hype Cycle. As of 2011, it has been situated in the trigger phase of the cycle; the first phase in which a new or novel technology, breakthrough or product launch gains significant attention. Early-adopter academics are inherently intrigued and eager to adopt new technologies with specific potential for education application, which provide opportunities to further engagement, motivation and loyalty in their student cohort. As such, gamification has been experimentally applied in a variety of classroom situations.

Cronk (2012) implemented a reward-based system to improve college student in-class participation and engagement in the form of a virtual tree that would grow in response to points assigned in class. This study reported an increase in student in-class participation. In an attempt to integrate game mechanics into an engineering curriculum, researchers at St. Cloud State University and the University of Wyoming implemented a points-based system that allowed students to progress through three levels. Through the use of rapid feedback mechanisms, the researchers found students motivated to engage in the given tasks (Thamvichai & Supanakorn-Davila, 2012). One of the most thorough applications of gamification in the classroom is that of Sheldon (2011). His classroom takes the form of a massively multiplayer game in which students are divided into guilds and compete in quests to gain experience points (XP). In the end, XP translate into traditional letter grades. Although there is no formal research presented for Sheldon's structure, the students do report favourably to the classes in the end of semester class evaluations.

Inspired by Sheldon's work, de Byl (2013) developed a gamified curriculum in which XP was awarded instead of grades, the ability to level-up by completing extra-curricula work and weekly team-based content revision quizzes. From a study of student engagement on the curriculum, de Byl (2013) identified five orthogonal dimensions which influenced students in her gamified curriculum; playfulness, alternative pedagogies, instrumentalism, status and performance. The playfulness dimension considers students who are playful, and those who are not. Its revelation is not unexpected given that play is the foundation on which gamification relies. Playfulness as a dimension of gamification suggests this reward system may provide students with acceptable mechanics keyed at deep and independent motivated learning as play itself is considered an experience with intrinsic motives (Henricks, 1999).

The second dimension, alternative pedagogies, at its extremes includes students who prefer traditional teaching methods (such as lectures and tutorials) and those open to more novel pedagogies (such as action-learning and games-based learning). Lectures remain the most fundamental teaching practice throughout the majority of education institutions around the world, although there are significant amounts of literature criticising this pedagogical technique. At its core, gamifying the curriculum is essentially a revival of the token economy method; this means the barriers typically encountered when implementing new technologies need not be applied.

Instrumentalism encompasses both students who are single minded and require the shortest path to success and those who are happy to explore and take instruction on a daily basis. Instrumentalist students respond well to a clear plan of the course and knowing exactly what to do and when in order to achieve the best grade possible. By breaking down tasks into equal-weighted activities (worth XP), gamification can provide students with a clear plan for students to follow, which according to Skinner & Belmont (1993) offers instrumental support.

The fourth dimension, status, ranges from students who prefer to know where they sit with respect to grades in the overall class, to those less concerned. Finally performance, the fifth dimension, relates to a student's ability to perform at their best. In order for students to succeed, they must know 1) what good performance is; 2) how their current performance rates with respect to good performance; and, 3) how to turn their current performance into good performance (Sadler, 1989). Gamified systems make performance data available giving players options to gain more points and to reach higher levels.

The data collected for the original five dimensional model of a gamified curriculum was based on a student engagement survey, although the effect of the gamified curriculum on student engagement was not analysed or presented in that study. To contribute to the literature and understanding of the affordances of gamification in education, this paper continues with an elucidation of engagement in education and games followed by an investigation into the influences of the five dimensions of a gamified curriculum on student engagement.

Aligning Engagement Theories in Education and Games

Student engagement is defined as "an individual's involvement with the educationally relevant activities and conditions that are instrumental to their learning." (Coates, 2006). The compulsion to include game mechanics in education is great among educators who want to engage and motivate today's students. When one sees how technology and computer games grab and maintain the attention of players, it is of little wonder teachers are looking for their holy grail in the same domain. The factors contributing to successful student engagement are strongly aligned with those presented in games.

Figure 1 presents the key attributes from the theories that apply to instructional design and game design. These attributes are prolific and common in key literature across both domains, and taken from Lepper & Malone (1987), Csikszentmihalyi (1990), Jones et.al (1994), Schlechty (1997), and Furlong & Christenson (2008).

Those considered to offer the greatest benefits in terms of engagement, shown in Figure 1, include:

- focused goals that give participants[7] a purpose for being involved in the system[8] and interacting with it;
- challenging tasks that are scaffolded and customised to a participant's skill level as to not be too easy or too difficult to achieve;
- clear instruction to provide rules, guidelines and scope to the system;
- rapid feedback to maintain constant communication with participants about their status and behaviours

[7] The "Participant" in this context refers to both students and players.
[8] The "system" may either be educational, or game-based.

within the scope of the system;
- affirmation of performance that communicates constructive quantitative and qualitative measures to participants about their progress toward their goals;
- social networking that allows inter-participant negotiation of knowledge for testing understandings;
- safety from failure such that the system constitutes a safe-haven in which participants are free to learn from mistakes without real-world repercussions;
- curiosity and novelty that provide intrinsic motivation to explore and push the boundaries of the system, and;
- fantasy to aid in suspension-of-disbelief and the use of imagination to create authentic problem-solving environments not elsewhere accessible to participants.

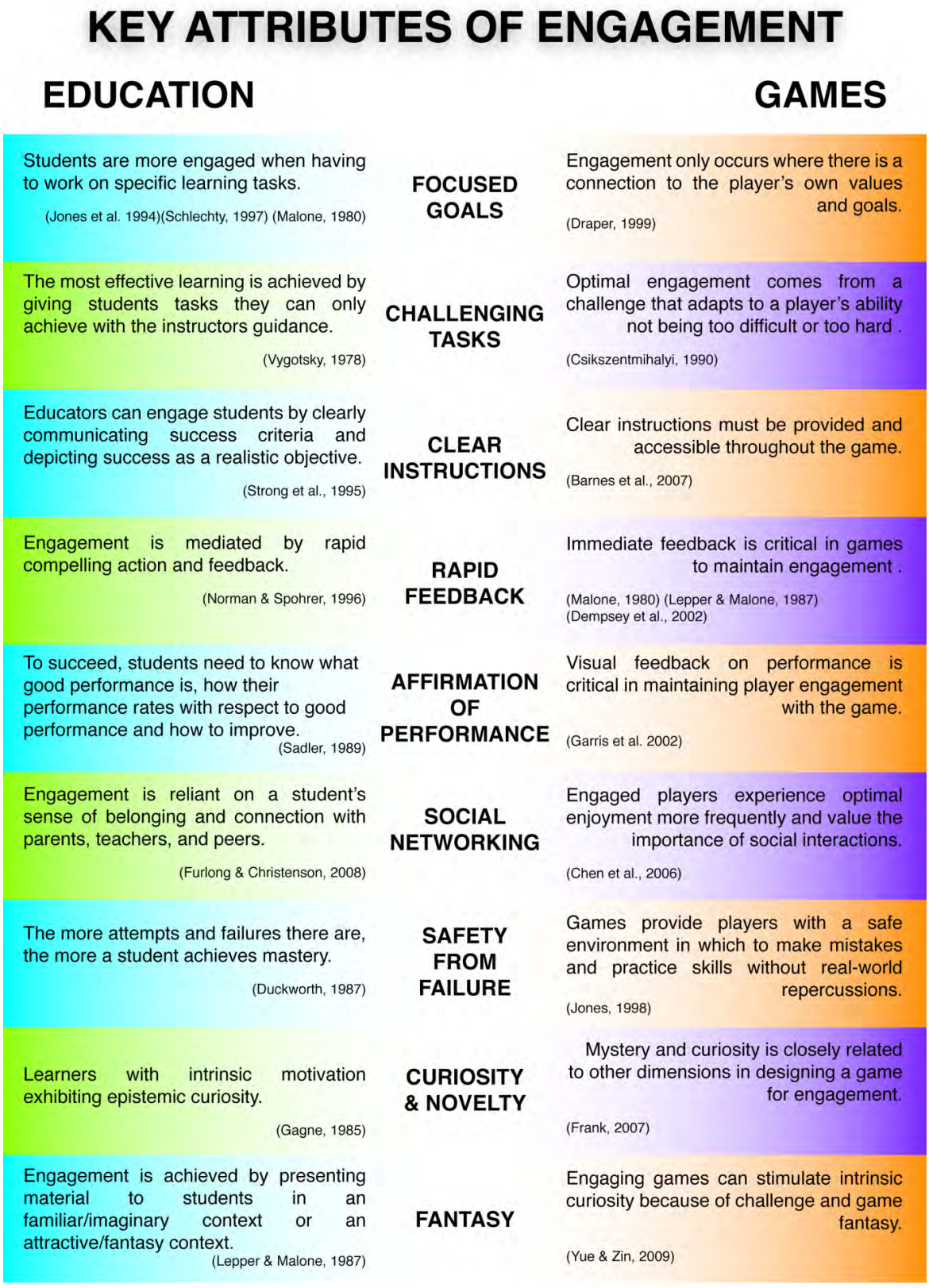

Figure 1: The key attributes of engagement common to the domains of education and games.

The Study

Method

The study included four courses across two semesters of undergraduate students studying topics such as 3D Modelling, Animation and Game Design and Development; 31 students in total. The classes were run using de Byl's gamified curriculum structure presented in Section 2. At the end of the semester all students were surveyed to establish the effect the course structure had on their engagement. Questions for determining engagement were extracted from the National Survey of Student Engagement (NSSE) (www.nsse.iub.edu). The concept of a gamified curriculum was assessed using the survey, thereby benchmarking its efficacy. The survey consisted of sixteen questions measured on a five-point Likert scale, where "1" indicated strong agreement with the question, through to "5" indicating strong disagreement.

Results

The study in (de Byl, 2013) revealed the five factors described in Section 2 with an initial dataset from 22 students. With the addition of the new data presented here, the same five factors remained constant. Although the study uses a small dataset, a Kaiser-Meyer-Olkin (KMO) test result of 0.643 measuring the sampling adequacy indicates it is satisfactory for factor analysis and a Bartlett's test of sphericity result of 0.00 concludes the strength of the relationship among variables is strong.

Embedded within the survey were 6 questions aimed at gauging student engagement. The mean response for individual engagement was correlated with each of the gamified curriculum dimensions. The R^2 results for each dimensions effect on engagement are displayed in Table 1.

Table 1: Correlation between each gamified curriculum dimension and student engagement.

Dimension	R^2
Playfulness	*0.7*
Pedagogy	*0.7*
Instrumentalism	0.0
Status	0.0
Performance	0.3

Analysis & Discussion

The most significant correlation with student engagement was found between the playfulness and alternative pedagogy dimensions. This positive relationship, shown in Figure 2, suggests the most engaged students in the gamified classes were those that were playful, and preferred learning with alternative pedagogies. Interestingly, there was no significant correlation between the playfulness and pedagogy dimensions themselves ($R^2 = 0.2$) indicating the playful students were not necessarily the ones that preferred alternative pedagogies and vice versa.

These results are encouraging for the use of gamification in education. As the goal of gamification, in general, is to engage those who wouldn't otherwise play games, it is the nature of gamification itself to tease out playfulness even in those who wouldn't otherwise participate. While play is more commonly associated with early childhood learning rather than tertiary education, the evolution of play in children points towards a place and need for the types of playful experiences gamification can build throughout a curriculum. In children, play is linked with cognitive development (Vygotsky, 1978); from infancy through to preschool it is focused on the use of objects during social interaction - for example, playing with plastic tea sets. After the age of 4, children begin role-playing and using props and other objects for symbolic purposes, such as playing 'sword-fighting' where they use sticks or rolls of paper as swords. As children grow older, play begins to take structure and becomes defined by goals and rules - gradually transitioning towards actual gameplay.

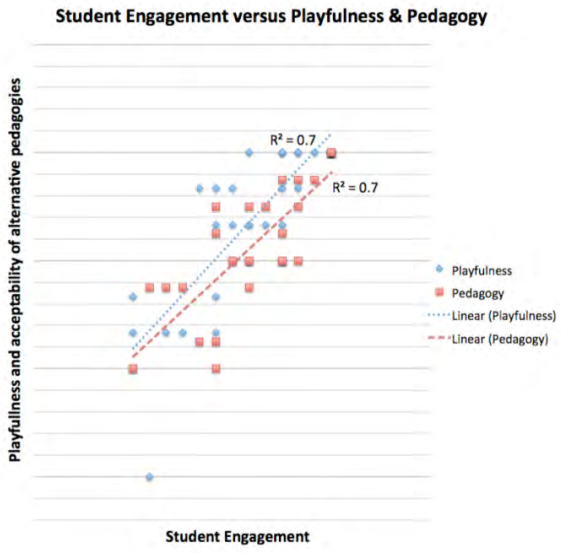

Figure 2: Student Engagement versus Playfulness & Pedagogy

Although education systems provide goals and rules of their own, they are not considered fun or playful. By implementing gamification atop an existing curriculum, content does not need to be compromised. Engagement can be increased through playful approaches to learning. Furthermore, playful learning matches several learning styles, each with their own strategies for implementation (Rice, 2009) and is integral in all learning environments first alluded to by Plato (Grube & Reeve, 1992) and reiterated more recently by Dickey (2003) and Kohler et al. (2012).

In a tertiary education environment the results of the study also suggest the need for alternate approaches to pedagogy in order to deliver playful learning experiences. Traditional educational systems lack meaningful forms of engagement, and although they present a method for knowledge transfer they do not consider all learning styles and preferred learning environments. Gamification is one way to explore further pedagogies without massive disruption to the underlying curriculum.

With respect to the research question presented at the beginning of this paper, the study herein reveals that gamification can support engagement in the classroom. It does so by affecting student engagement with respect to the dimensions of playfulness and alternative pedagogies from de Byl's five factors model. In the study, engagement was found to positively correlate with students' desire for a playful learning environment and alternative approaches to traditional lectures.

Conclusions & Further Work

Gamification may be perceived as a movement in its infancy however its roots are embedded strongly in the history of play, learning and games. The computer games industry feels that gamification cheapens its profession by not revealing the true depth of mechanics or an appreciation of the complexity of the design process. Indeed, while the game mechanics encompassed by gamification number few and essentially represent a mere facade of computer game points and reward systems the gameplay elements and mechanics in a AAA title number in the hundreds. Gamification has brought forward an opportunity for educators to provide a comprehensive framework by which playful learning in the context of serious adult level content can be realised. It does so with no disruption to effective pedagogical practice and provides the means to engage students in otherwise dry topic areas.

Furthermore, given the nature of the game mechanics of gamification it is not difficult to see the alignment between such a points-reward based system and an educational one. Marks students receive for completing assignments can be seen as points, and grades as levels or badges. Problem-solving activities and independent study align with quests and challenges. Unfortunately, if education is already considered gamified, it is indeed a weak example. Although education systems are structured on the surface as gamified, they differ in the amount of transparency with respect to goals, points, status and levels. In gamification, a player knows where they stand at all times and what they need to do next in order to progress to the next level. In the education system,

assessment items may be marked on unequal scales, the amount of effort required to achieve each mark unbalanced, and in many cases students are in competition with each other for grades.

The motivation to include game mechanics in the curriculum is great among educators who want to engage today's students. However, without a thorough understanding of what a gamified curriculum looks like, how it can best be applied and why it might engage and motivate students, it cannot be effective. In addition, the way in which it affects the learning experience also needs further investigation. The results of the study presented herein suggest gamification mechanics can provide an engaging meta-layer atop existing educational content for playful and open-minded students. It should be noted however, the students in the study were from games and multimedia focused classes and it could be said these students may present naturally as more playful and open to alternative ways of learning. To determine the usefulness of gamification across academic disciplines and learning styles a more thorough investigation is required.

As Crawford (2011) states, "the fundamental motivation for all game-playing is to learn. This is the original motivation for game-playing, and surely retains much of its importance." Like it or loathe it, gamification is useful for inciting engagement, motivation and competition when used in the correct setting and for the correct purpose. With educators desperate to reignite their students' passion for learning, the application of some very fundamental ideas for interactivity and engagement, now embodied in what we now know as gamification, may help them reclaim their classrooms.

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