Life's a Game and the Game of Life: How Making a Game Out of it Can Change Student Behavior

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ABSTRACT
There is little argument that creating experiences for students that will increase student success and retention is a goal that is shared by anyone teaching courses. In computing courses, we have seen a lot of focused attention on the first year introductory courses as it has been shown that it is failure in these courses that drives students away from the discipline. In this paper we describe success we have had with first year students through the creation of achievement system for the undergraduate experience. Through the Just Press Play project and its associated achievements, we observed a significant shift in student behavior in relation to our first year students which lead to a greater level of student success in their first course.

Categories and Subject Descriptors
K.3.2 [**Computing Milieux**]: Computers and Education – *computer and information science education.*

General Terms
Human Factors

Keywords
Gamification, student mentoring, CS1, retention

1. OUR STORY BEGINS
Our story begins with a simple question that one student asked innocently enough, "Why can't we get achievements for being awesome?" The student was referring to the idea that achievements in online systems and in life come from doing some particularly structured thing. The faculty members who heard the question felt that the student had the right idea. Student success is based on more than simply completing academic goals, prerequisite courses, and the fulfilling of requirements. Successful undergraduate students also engage with the people and activities on their campus, and use the skills gained in classes in their extracurricular activities.

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From this recognition was born the idea of creating a "gaming layer" for the undergraduate experience. Students could choose to become involved in this game-like experience, which would allow them to receive recognition for activities that as faculty we know are important to their future success. The prototype phase of this gaming layer, which was implemented during the 2011-12 academic year, demonstrated its potential value through the successful of achievement of its key goals. We created an environment that allowed the students to engage with one another and encouraged the student community to come together to enable the academic success of the first year students.

2. RULES OF THE GAME

2.1 Gamification
Gamification is generally considered to be the use of game design elements in non-gaming contexts [10]. While critics have dismissed gamification as a crass attempt to manipulate consumers [3], others have pointed to this use of games as a way to significantly enhance everyday experiences [17]. The difference in perspective arises in large part from the motivation for the use of game design elements in a given experiential context. When that use is intended primarily to encourage participants to engage in activities that they would otherwise find unpleasant for the benefit of the sponsoring organization, the risk of manipulation and exploitation is high. When the implementation is instead intended to improve the experience of the participant, the potential for positive impact is much higher.

A primary concern in developing "gamified" applications is the impact on participant motivation. Research into motivation has shown that using extrinsic rewards can have a damaging effect on individual motivation to participate in activities. These rewards can undermine the intrinsic sense of satisfaction that engaging in creative and productive work can generate. Used well, however, game elements can reinforce intrinsic satisfaction and reward rather than replacing them. Effective gamification allows participants to use the game elements as a reflection of their sense of pride in completing an activity, rather than as a replacement, as noted by Deterding in his "Gamificaton by Design: Response to O'Reilly" essay [8]:

> Indeed, games are full of points, scores, tokens, and so on, and digital games are full of virtual currency and items that players can gain in the course of play. My point is that the "fun", the pleasure of these elements does not come from some extrinsic reward value of those elements, but chiefly from the experience of competence they give rise to.

While the Just Press Play system has frequently been described as an attempt to "gamify" education [4], we saw it instead as a pervasive game [6, 19], one that used not just game elements but also game design principles and an underlying narrative to engage players in a real-world context.

2.2 First Year Computing

Much focus has been paid to the first year computing curriculum in order to ensure a strong foundation experience for students in their study of computing. Two of the main intervention techniques have been innovative curriculum and enhanced student experiences.

Curriculum techniques and innovations have been created, discussed, presented, advocated and/or maligned en masse in the past several years. We have seen the growth in object-oriented curriculums and tools (BlueJ, Alice) [1, 2], media computation [13], robotics [5], Processing and digital art [12], and finally a call for a return to basics [21]. For each of the innovative tools or techniques, various advocates have discussed their successes in the classroom and each has found a place in the pantheon of curriculums for the first year.

However, many believe that it is not just about what you present or how it is presented, or what projects the students work on, but rather that student experience in the classroom plays a large role in creating success for students. Pair programming has been found to be successful in helping students learn to program in the first course/year [16, 20]. Mentoring of students in various ways has also proven to be valuable to first year students [11, 18]. And most recently, the trend of flipping the classroom has made its way into the first year of programming instruction, especially as the advent of massive online education appears to be growing [15].

For each of these ideas, we can find evidence that supports the approach and shows that it helps students to succeed in the course. While this is important to a particular course, the goal of the Just Press Play project was to create an atmosphere for success outside of individual courses and inclusive of them. In a way, we are looking to umbrella the undergraduate experience and support it, not just support one or more particular courses, or particular sets of topics.

3. JUST PRESS PLAY

Begun in 2011, the Just Press Play (JPP) project is a game-based achievement system designed to help students traverse their undergraduate experience. It was designed to address the intellectual, social, and developmental challenges that students face attempting to navigate the waters of earning an undergraduate degree. It also allows for faculty to have a clearer picture of the students' progress on this journey.

In order to facilitate this, JPP provides a web-based networked environment that allows students to identify opportunities, collect recognition for achievements, and build connections with others through both social and creative activities.

In Fall 2011, the prototype version of this system was used in the School of Interactive Games and Media at Rochester Institute of Technology. The primary audience was undergraduate students enrolled in the school's two programs, Game Design & Development and New Media Interactive Design. Graduate students in the department and faculty and staff were also encouraged to participate in the pilot phase, but the main goal of the system was to support the needs of the undergraduate population. No achievements or activities were designed around the graduate student or faculty/staff populations. The pilot study ran until the end of Winter Quarter 2011/2012.

3.1 Project Goals

The JPP prototype had four main goals:

1) Provide students with a clearer sense of their accomplishments in various areas (academic, social, and creative) of their college experience, and provide them with tools to reflect on their range and balance of activities.
2) Increase students' awareness of activities and opportunities outside their academic coursework, from wellness to collaboration to knowledge of the campus and city, and inspire them to sample a range of experiences.
3) Enable students to maintain and share a record of their activities.
4) Provide students with a sense of fantasy, whimsy and playful abstraction in dealing with the stress and growth associated with the transformational nature of undergraduate education

3.2 Core Design Principles

The JPP team has been guided by the following principles in designing the system.

3.2.1 Non-Curricular and Voluntary

The activities within JPP should not be a requirement for any course, and lack of participation in the game should not impose penalties on a student. However, completion of some achievements could require skills typically gained in one or more courses in the curriculum.

3.2.2 Game Activities External to Website

Most of the activities in JPP should take place outside of the context of the website. The website should be used primarily for discovering and validating activities, viewing progress, and communicating and collaborating with other players.

3.2.3 Varied Achievement Types and Contexts

Players should be offered stand-alone, grouped, and/or sequenced achievements within the game. Some of the achievements should be possible to complete independently, while others should require collaboration among students. Some achievements may be repeatable. Achievements can include creative work, social activities, and exploration of physical and online resources.

3.2.4 Accessible to Casual Players

The game is designed to be accessible to both core and casual players. Core gamers are those who are interested in conquering all aspects of the game and who engage fully in the narrative of the play. Casual gamers may elect to do some of the achievements, but will not typically attempt achievements that will require significant effort outside of their existing routine. In order for the project to be truly successful, the game had to appeal to both player types. The barrier to entry could not be too high for casual players, nor for players who chose to join the game well after it had begun in October.

3.3 Achievements and Quests

In the game, achievements were situated on two axes: one representing the balance between creative and cultural activities and technical or skill-focused activities; the other representing the balance between individual and social activities. As players collected achievements, they moved along the axes to show how much they have grown in that quadrant.

Quests, made up of collections of achievements, were also a part of the system. Some quests required completing a sequence of achievements, while others allowed players to choose a subset of achievements from a large collection. Completing a particular quest awarded the player that quest's achievement.

To earn an achievement, the player would complete the required task or tasks and then be awarded the achievement in the game through one of three mechanisms: collectible cards, location checkins, or administrative assignment. Collectible cards were used for achievements associated with specific individuals or events. These cards had the name of the achievement as well as photos, descriptions, or trivia related to the specific person or event. The card also included a unique 25-character alphanumeric code that players needed to enter on the website to register their achievement with the system. For some achievements, going to a particular place was important. Once there, the players would check in with an RFID tag to indicate their attendance and register them for the achievement. For other achievements, administrators of the game awarded the achievement to all eligible users at the appropriate time.

3.4 Pilot Phase

The pilot phase of the JPP project began in October 2011. Registration in the system was only available to the students within the IGM department for the pilot phase. Launch day, October 14, 2011 saw the registration of 155 players in the game. By the end of the first week, 384 students had registered in the system. By the end of the fall quarter (mid-November 2011), there were 423 users. Out of the 423 registered participants, 261 had completed the apprentice level and could really be considered full players of the game. To complete the apprentice level, a player needed to sign up for the game, pick up an RFID key fob and interact with at least one faculty or staff member within the department to earn some achievement.

These numbers were very encouraging for us. Our school had just over 700 undergraduate students, and the registration numbers for the pilot indicate that over 60% of those students registered for the experience and nearly 40% completed the tutorial phase and participated actively in the game. We found that a higher percentage of freshmen and sophomores participated compared to juniors and seniors, but since one of our goals was to engage those populations early in their academic careers, those numbers were indicative of a successful launch.

During the pilot, there were several different types of achievements that the students could earn. Almost all involved interactions with other people in some way, be it faculty/staff or other students.

Students could engage with faculty and staff in a number of ways. Achievements could be earned for students simply attending an instructor's office hours, or meeting with their academic advisor. The department held a number of faculty/student mixers throughout the year and attendance at the events earned you an achievement.

Faculty and staff could also choose to have a collectible card, associated with a unique achievement. If a student completed the relevant requirements, they earned the special faculty/staff achievement and a collectible card for that faculty/staff member. Because those achievements were intended to increase informal and playful interactions with faculty and staff, the achievements were generally not academic in their content. Some of the achievements included:

- Simply using "the magic word" ("please") when asking for the achievement.
- Making the faculty member laugh.
- Doing a little dance for the faculty member.
- Showing a faculty member a picture of the player eating pie.
- Showing a faculty member a picture of the player on a boat.
- Finding the hidden achievement card in a faculty member's office.

Increasing our students' engagement in extra-curricular social activities was also an important part of the project's goal. Students could earn achievements for attending a variety of on-campus events and checking in with the JPP representative at the event. This included sporting events, concerts, and lectures.

Having students create a social experience with their peers was another popular set of achievements. For example, the achievement entitled "The Last Supper" was awarded if a student went out for dinner off campus with at least 12 other people, took a picture, and submitted it online. Students could also organize and participate in a flash mob; one of these was successfully completed around Halloween to Michael Jackson's Thriller, while a second in February involved the creation of a giant human-powered Rube Goldberg machine in the college's atrium. The students help to organize, make costumes for, and practice these events. In each case, someone "leaked" the news to the university press and the event was well attended both for participants and spectators.

Overall, by the end of the winter quarter (in March) and the end of the pilot, the game had 283 active players (those who had completed the tutorial), who had collectively completed 3,504 achievements (an average of 21.6 achievements per player). The highest number of achievements collected was 49.

4. THE GAME CHANGER

4.1 Challenge Issued

Of all of the achievements, the most interesting and encouraging to us from an educational and student experience perspective came was the *Undying* achievement. This achievement was devised because historically, no more than 85% of our freshmen pass their introductory programming course. While that level of success is actually quite high for such a class, the team felt that it provided an interesting target for an achievement. The intent of the achievement was to engage the student community as a whole to help the freshmen pass the class. Thus, the achievement would be granted to *all* players if the freshmen had a passing level of 90% for the first course. By taking this approach, we did not single out students who had done poorly in the class, nor did we limit the impact of their success to simply those who had done well.

4.2 Student Response

Soon after the achievement was announced, discussion ensued in the department's Facebook group about it. When a freshman posted late in the quarter about having difficulty with one of the concepts, an upperclassman responded by exhorting his classmates to help the freshmen, so that everyone would be able to earn the achievement.

Two students in particular, took the lead and decided to organize a study session for the final exams. In doing so, they first approached the department leadership for permission, and asked for help finding space to hold the study session. Also, they approached the faculty teaching the first course via email for help.

> Hi Prof. XXX,
> YYY (cc'd on this email) and I are arranging a study session for people in GSD I the weekend before finals. We were wondering if we could meet with you at some point this week or next to get an idea of what you have covered in your class this quarter, and what you are expecting your students to know for your final. If you could let us know when you are free to meet, that would be great.
>
> Thanks.
> --
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First year faculty were eager to help with this endeavor and the study sessions drew a large number of the students from the introductory course.

The final passing percentage for the first-quarter programming class was a record-breaking 91%. While it is not possible to prove a direct causal relationship between our game and the increase in the number of successful students in the course, we can show a direct relationship between the game and the emergence of peer tutoring sessions, which in turn have been shown to be a highly effective mechanism for increasing student performance [22].

4.3 Seasons Change

While the acquisition of the *Undying* achievement was something that the students valued, the real value of the exercise became clear to us in the following quarter when the upperclassmen once again approached the faculty about organizing study sessions. The upperclass students had found that organizing and running the study sessions was an intrinsically rewarding activity, and they wanted to continue offering this peer support to the new students. They went on to run study sessions for midterms and finals in the winter quarter, with an increasing number of upperclass students attending each session to assist with the tutoring.

Once again, in winter quarter the passing percentage of students in the freshman programming class was well over 90%. Many of the students participating in the tutoring, however, expressed no interest in the achievement, finding that the reward of helping other students was the real value in this activity.

5. LEVEL UP

While the pilot project was successful in many ways, most notably in increasing information interactions between students and faculty, and in encouraging peer tutoring in our programming courses, there were a number of technical problems with our implementation that hindered adoption by students and restricted our ability to implement content. Achievement redemption via lengthy alphanumeric code entry had a very negative impact on participation, and resulted in many students participating in activities but not bothering to actually record that in the achievement system; this, in turn, made our participation statistics far less accurate. We also encountered significant problems in implementing the RFID readers for checkins around campus, which reduced student trust in the reliability of our infrastructure and limited our ability to assign achievements for many activities.

During the summer of 2012, we rebuilt the technical infrastructure of the system, and implemented a significant number of changes to the overall game mechanics and presentation of content. Most notably, this included a shift from code entry and RFID scanners to the use of QR codes associated with individual players that can be scanned by any admin with an Android or iOS mobile device [14]. Version 2 of Just Press Play launched in late August of 2012, and we are already seeing much higher levels of participation and engagement, as well as much more accurate recording of player participation.

We plan to test the new version of the system with other departments at RIT, as well as other educational institutions, during the 2012-13 academic year, with a long-term goal of making the software and a set of best practices for content available in an open-source format to other educators.

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7. REFERENCES

[1] Alice website. Retrieved September 5, 2012 from http://www.alice.org

[2] BlueJ website. Retrieved September 5, 2012 from http://www.bluej.org

[3] Bogost, I. 2011. Gamification is Bullshit. Retrieved September 5, 2012 from http://www.bogost.com/blog/gamification_is_bullshit.shtml

[4] Cheston, D. 2012. College as a Video Game? *The John William Pope Center for Higher Education Policy*. Retrieved September 5, 2012 http://www.popecenter.org/commentaries/article.html?id=2726

[5] Cowden, D., et al. 2012. A C-based introductory course using robots. In *Proceedings of the 43rd ACM technical symposium on Computer Science Education* (Raleigh, NC, USA, February 29–March 3, 2012). SIGCSE '12. ACM, New York, NY, USA, 27-32.

[6] Davies, H. 2007. Place as media in pervasive games. Proceedings of the 4th Australasian conference on Interactive entertainment (2007), 1–4.

[7] Deci, E. L. and Ryan, R. 2002. *The handbook of self-determination research*. University of Rochester Press, Rochester, NY.

[8] Deterding, S. 2011. Gamification by Design: Response to O'Reilly. *Gamification Research Network*. Retrieved September 5, 2012 from http://gamification-research.org/2011/09/gamification-by-design-response-to-oreilly/

[9] Deterding, S. 2012. Gamification: designing for motivation. interactions. 19, 4 (Jul. 2012), 14–17.

[10] Deterding, S. et al. 2011. Gamification. using game-design elements in non-gaming contexts. In *Proceedings of the 2011 annual conference extended abstracts on Human factors in computing syste*ms (2011), 2425–2428.

[11] D'Souza, D. et al. 2008. Transforming learning of programming: a mentoring project. In *Proceedings of Tenth Australasian Computing Education Conference* (Wollongong, Australia, January 2008). ACE2008. 75-84.

[12] Greenberg, I., Kumar, D. and Xu, D. 2012. Creative coding and visual portfolios for CS1. In *Proceedings of the 43rd ACM Technical Symposium on Computer Science Education* (Raleigh, NC, USA, February 29–March 3, 2012). SIGCSE '12. ACM. New York, NY, 247-252.

[13] Guzdial, M. et al. 2010. Variations on a theme: role of media in motivating computing education. *Proceedings of the 41st ACM Technical Symposium on Computer Science Education* (Milwaukee, WI, USA, March 10-13, 2010). SIGCSE '10. ACM. New York, NY, 66-67.

[14] Lawley, E. 2012. Ch-ch-ch-ch-changes: Revising the JPP User Experience. Retrieved September 6, 2012 from http://games.rit.edu/~thinkplay/2012/07/ch-ch-ch-ch-changes-revising-the-jpp-user-experience/

[15] Martin, F. 2012. Will massive open online courses change how we teach?. *Commun. ACM* 55, 8 (August 2012), 26-28.

[16] McDowell, C. et al. 2006. Pair programming improves student retention, confidence, and program quality. *Commun. ACM* 49, 8 (August 2006), 90-95.

[17] McGonigal, J. 2011. *Reality Is Broken: Why Games Make Us Better and How They Can Change the World*. Penguin Press.

[18] Miller, A. and Kay, J. A mentor program in CS1. In *Proceedings of ITiCSE 2002* (Aarhus, Denmark, June 24-26, 2002). ITiCSE '02. ACM. New York, NY, 9-13.

[19] Montola, M. et al. 2009. Pervasive games: Theory and design. Morgan Kaufmann.

[20] Nagappan, N. et al. 2003. Improving the CS1 experience with pair programming. In *Proceedings of the 34th ACM Technical Symposium on Computer Science Education* (Reno, Nevada, USA, February 19-23, 2003). SIGCSE '03. ACM. New York, NY, 359-362.

[21] Reges, S. 2006. Back to basics in CS1 and CS2. In *Proceedings of the 37th ACM Technical Symposium on Computer Science Education* (Houston, Texas, USA, March 1–5, 2006). SIGCSE '06. ACM. New York, NY, 293-297.

[22] Topping, K.J. 1996. The effectiveness of peer tutoring in further and higher education: A typology and review of the literature. Higher education. 32, 3 (1996), 321–345.