

## **Achievement Unlocked: Investigating Which Gamification Elements Motivate Students**

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# Achievement Unlocked: Investigating Which Gamification Elements Motivate Students

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*Abstract: Gamification has been used in many different ways to motivate individuals to wholly participate in some activity. One such venue has been in the gamification of learning to promote student interest. In this paper, we describe our efforts to investigate which aspects of gamification students find the most motivating. We present our gamification platform, GamerCard, which was used for four semesters in an upper-level game design course at our institution. We found that some gamification elements that are often thought to be motivating for participants had little to no effect on our course, while elements that specifically targeted making the student's standing in the course more transparent were the most effective.*

## 1. Introduction

Gamification is becoming an increasingly popular methodology for improving motivation and interest in many domains [1]. Gamification involves the application of game mechanics to tasks typically considered to be void of fun. In the classroom, this often materializes as a set of mechanics meant to motivate students to learn more effectively. For example, courses will often challenge students to earn experience points (XP) instead of simply grading assignments, or offer classes/titles (e.g., wizard) to students as they earn various achievements within the course. Courses may even allow students to purchase special items that benefit the student on homework or exams, or provide special skills to the students that can motivate them to think differently about the coursework.

Proponents of gamification intuit that these game elements increase student motivation, provide a more useful mindset for understanding educational progress, and provide useful help and/or feedback throughout the course [1][2][3]. While this is understandable, it is not necessarily the case that game elements lead to improvements in the classroom, and thus care must be taken to study how and in what ways gamification can be useful and/or detrimental to student learning.

It is plausible (and perhaps quite likely) that gamification (or some particular aspects of gamification) might have negative effects on students in the classroom. For example, many gamified classes can have grading systems that are mathematically equivalent to standard courses. The gamified grading systems (including ours) will often frame learning as an accumulation of points, giving the students a sense that they are always moving forward. Standard grading systems, on the other hand, often give students the perception that they begin a course with a full score and are consistently losing points as the course progresses. If a student makes the observation that these systems are mathematically equivalent, the sense of motivation may be lost. It is even plausible that a student could resent an instructor, perhaps feeling like the gamification system is some form of “trickery”.

Additionally, some gamification elements may be engaging but detrimental to learning. For example, many games, especially role-playing games, allow the player to earn experience points by defeating enemies (more difficult enemies lead to more points being earned). Players of this genre will often “grind”, meaning they level up their character by tediously defeating large

amounts of simple, low-level enemies. Suppose a gamified course incorporates a similar mechanic wherein there is a simple assignment that can be repeated over and over again (with slight variation) to earn a small number of points towards a final grade. In theory, a student could fail the exams but “grind” by completing this simple assignment an exorbitant number of times and earn a stellar grade. While this is somewhat of a contrived example, it illustrates that gaming mechanics cannot always be applied directly to a course. Care must be taken by the instructor to ensure that mechanics align well with course and learning objectives, a design feat that is often quite difficult.

It is thus important to identify an intellectual framework for how individual elements of gamification affect the learning experience. We do not wish to imply that this is an area that has gone unstudied, but do claim that it is one that requires further inquiry. It should seem quite reasonable that not all gamification elements will provide positive effects on a student’s learning experience. The particulars of these effects are partly what we wish to study with this work.

The purpose, then, of this paper is to contribute to the understanding of how specific gamification elements affect the classroom environment. This would then be useful as advice to instructors considering gamification as they might be able to more efficiently design their courses, or more prudently select gamification elements to incorporate first into a course. Though the results presented here are admittedly constrained to our student population, our particular course, and our particular system, we attempt to provide reasonable generalizations (though often hypothesized) where possible. We first discuss similar results in the area of gamification generally and within the classroom (Section 2). We proceed to discuss our gamification system, *GamerCard* (Section 3). We then discuss the results of system use within our courses over multiple semesters along with limitations of the study (Sections 4, 5) and conclude with discussion of how instructors might apply these lessons when designing similar courses (Sections 6, 7).

## **2. Related Work**

There exist several examples of gamification in education and beyond, some of which we enumerate in this section. We begin with a discussion of gamification framework we used as inspiration when designing our system *GamerCard*. We then enumerate a subset of systems that have been used at other locales.

### **2.1 Reality is Broken**

In her book, *Reality is Broken: Why Games Make Us Better and How They Can Change The World*, Jane McGonigal [4] makes the argument that millions of people escape from reality into the many different fictional worlds of video games. In the United States, 183 million people can be considered “active gamers,” people that have, in survey, responded that they play video games of some kind a few hours a week<sup>1</sup>. Video games have become a multi-billion dollar industry that continues to grow. With all of this interest, McGonigal argues, people are finding some value in what they get out of playing games.

McGonigal then claims that what many gamers find is that “reality is broken” for them in some way and that they find intrinsic benefits by playing games, either by themselves or especially

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<sup>1</sup>[http://www.theesa.com/wp-content/uploads/2014/10/ESA\\_EF\\_2014.pdf](http://www.theesa.com/wp-content/uploads/2014/10/ESA_EF_2014.pdf)

with others. She outlines a list of “Fixes to Reality” that highlight these benefits. A selection of these fixes that we will discuss throughout the paper is provided below:

1. **Unnecessary Obstacles:** Games challenge us with voluntary obstacles and help us put our personal strengths to better use.
2. **Emotional Activation:** Games focus our energy, with relentless optimism, on something we’re good at and enjoy.
3. **More Satisfying Work:** Games give clear missions and more satisfying, hands on work.
4. **Better Hope of Success:** Games eliminate our fear of failure and improve our chances of success.
5. **Stronger Social Connectivity:** Games build stronger social bonds and lead to more active social networks.
6. **Epic Scale:** Games make us part of something bigger and give epic meaning to our actions.
7. **Wholehearted Participation:** Games motivate us to participate more fully in whatever we're doing.
8. **Meaningful Rewards When We Need Them Most:** Games help us feel more rewarded for making our best effort.
9. **More Fun with Strangers:** Games help us band together and create powerful communities from scratch.

In our work in building the *GamerCard* system, we took into account McGonigal’s fixes and included features that would highlight particular fixes to see what aspects motivated students (more detail in Section 3).

## 2.1 Classcraft

Classcraft is a gamification tool that teachers can acquire online and incorporate into any class<sup>2</sup>. There are various packages that the teacher and/or students can purchase for more features such as data analytics and customized gold distribution. It is simple to use, as it does not change the structure of the class itself, but simply adds a layer of gamified elements to the class. The students play in teams of mages, warriors, and healers, with each class able to unlock certain skills to help them or their team progress through the class. The teacher is able to set what these skills can do, as well as the achievements and prizes for contributing positively to class and the punishments for misbehaving.

Classcraft’s primary strength lies in its generality, as it can be applied to any course with any subject matter. It seems this is an important element for any gamification platform, and thus *GamerCard* is also designed to be domain-independent. Classcraft also provides many “out of box” features that are ready to use, making adoption fairly painless. Some of the gaming elements force teachers to use student teams, whose skills complement one another, which may not be appealing to all instructors.

None of the currencies in Classcraft are associated with the students’ final grade in the course, which might lead to a very decoupled experience for the students. In contrast, *GamerCard*’s

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<sup>2</sup> <http://www.classcraft.com/>

incorporation of assignment submissions allows it to keep track of students' progress in the course. We take advantage of this to determine final grades based "experience points." Although both *GamerCard* and Classcraft offer a method of purchasing with in-class currency, the content of the "stores" vary greatly.

## **2.2 Role-Playing in Computer Science**

Toth and Kayler also provided a gamification layer within Operating Systems, Computer Networks, and Architecture courses [5]. They decided to bring the gamification not only into the class, but also out of class by having physical treasure hunts to reward students. These hunts often incorporated a narrative aspect to further immerse students into the role-playing. Students found the treasure hunts entertaining and it allowed them to bond more with their teammates. While these extracurricular events are effective, they are difficult to implement and assume students know about role-playing games. Systems like *GamerCard* and Classcraft can be more easily applied without putting a large burden on the instructor and students who are unfamiliar with fantasy role-playing games.

Much like *GamerCard*, the gamification in these classes included both quests and experience points, but narrative was also a major factor for Toth and Kayler's system. The need for an engaging narrative is grounded in the level of immersion needed to keep the role-playing meaningful. Since *GamerCard* does not focus on role-playing, the quests are not as contextualized. One might argue that such narrative is effective, but would make a system more difficult to incorporate into a variety of courses, as extraneous effort would be demanded of the instructor to come up with activities relevant to the existing syllabus.

## **2.3 Gamification of Game Design**

Other universities are trying out similar gamification strategies. O'Donovan et al. have experimented in gamifying a game development course at the University of Cape Town, and have so far found that their Steampunk themed system has improved students' understanding and their engagement in class [6][7]. The narrative of this class is that a device has been stolen, and the students must solve puzzles and answer daily quizzes in order to find clues and eventually recover the device. Comparing the success of certain gameplay elements, they found leaderboards to be highly motivating, "with [the in-game currency of] Steam Points and ranks following, and progress bars, the end prize and badges found to be least motivating".

Each student earns experience points as they progress through the class and complete assignments and these points determine their final grade. To encourage class attendance, O'Donovan et al. offered XP for showing up each day, with "ad hoc" points depending on the quality of the discussion that ensued. While this scheme resulted in a high attendance rate, our focus is more on increasing the amount of in-class participation so we used our "in-game currency" of Victory Points, or VP, as a reward for speaking up in class. These Victory Points do not directly affect students' grades in the class, but instead contribute to the students' leaderboard scores and serve as an in-class currency.

## **3. *GamerCard***

In this section, we will describe the various aspects of *GamerCard*, our gamification platform that we used over the past two years. *GamerCard* was used in four upper-level CS courses from Spring 2014 through Summer 2015.

### 3.1 Layout and Design

We designed *GamerCard* to look and behave similar to a typical quest log / status screen from a modern video game. One of the advantages of this design choice is that all pertinent information is available all on one screen at a glance. In the main *GamerCard* screen shown in Figure 1, a student can see their grade, assignments upcoming, assignments being graded, returned assignments, along with all of the other gamification elements, such as achievements, victory points, and title.

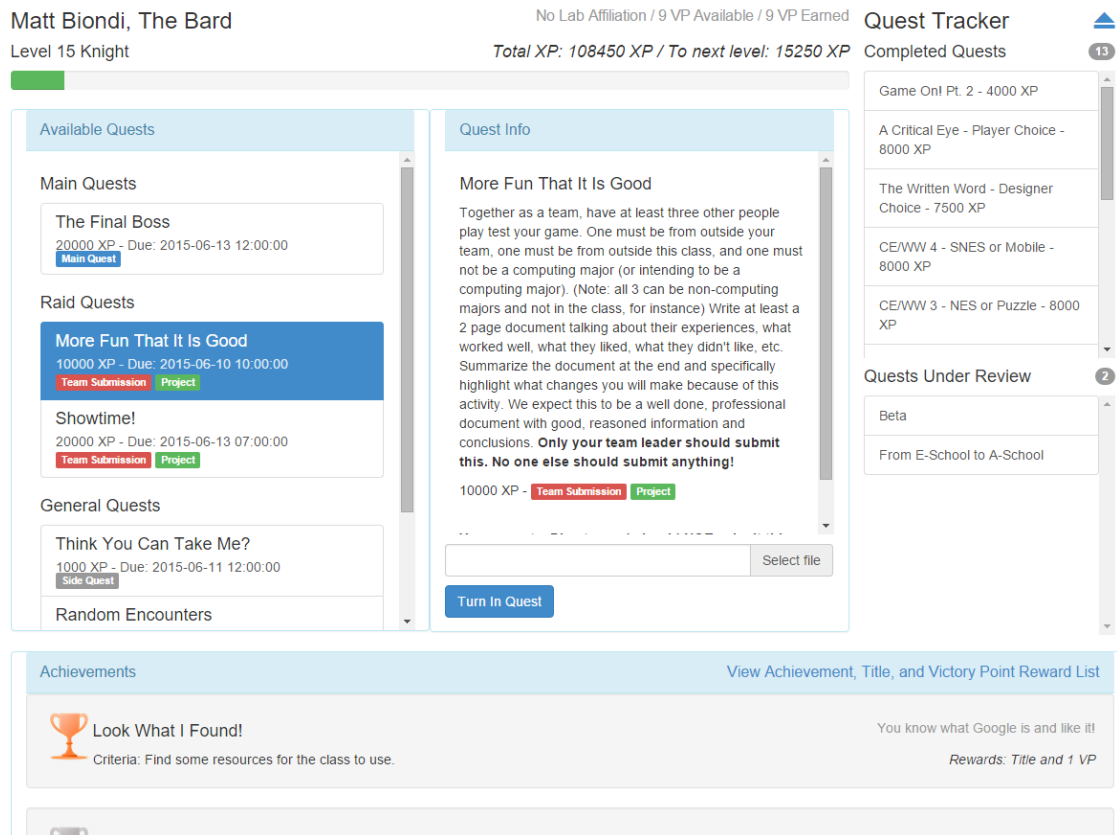


Figure 1: GamerCard main screen

We used McGonigal's "Fixes to Reality" as a basis for nearly all of the gamification elements we incorporated into *GamerCard*. The overall *GamerCard* screen, for example, is based around the fix of *More Satisfying Work*, which discusses how games give us clear and identifiable goals to work toward. Here on the main *GamerCard* Screen, the current status of all of the course's assignments are available for the student to view instantly.

### 3.2 Experience Points

One of the most commonly implemented gamification aspects in a classroom setting is the use of experience points. In a typical game, experience points (or XP) are used as a measure for the progression of a character or player toward their next goal or level of understanding. The most common implementation is found in role-playing games, where characters earn XP from defeating challenges to become more powerful and can then attempt more difficult obstacles.

A standard 100-point grading system for a class is a natural fit for XP. It is relatively easy to take the normal grade distribution for a class and multiply every assessment by a factor and then

have the students earn XP instead of getting a percentage. For instance, we used a factor of 200 to make the maximum score in the class to be 200,000 XP. A typical test was worth 15,000-20,000 XP, or around 10% of the overall grade which is close to what it was without using XP.

While this change may seem trivial and simply obfuscates a student's grade, the difference is in the student mentality toward XP and how XP is presented by the instructor. For example, a typical student might view a test as starting with a grade of 100 and then desperately trying to not lose points. However, with XP, we emphasized that all students started the test with 0 XP for that assessment and it was up to them to choose which questions they wanted to answer in order to earn the XP they needed. In reality, we did not modify the assessment in any substantive way, but the students view the test as more of a positive "let me see what I can earn" as opposed to a negative "I have to avoid getting deductions."

The use of experience points follows McGonigal's fix of *Better Hope for Success*, in which games help to remove some of the fear of failure. By trying to change the mindset of students to more of a positive idea of earning XP as opposed to losing percentage points, we attempted to remove some of the barriers some students face when taking tests.

### **3.3 Quests**

Following from McGonigal's fixes of *Unnecessary Obstacles* and *More Satisfying Work*, we framed all of the assignments for the class as quests that earned XP. Quests were intended to provide some extra color and embellishment around assignments, hopefully making them more interesting. This technique has been used with success also in other gamification platforms and experiences [10]. The main difference we added to our system was the addition of quests that were not required to complete the course. In effect, these were extra credit assignments and experiences, but they were presented as more activities that not only could earn XP, but other gamification rewards, such as victory points, achievements, and titles.

### **3.4 Victory Points**

In a gamification system for a class, it can be limiting if the main reward structure for the course is only XP, as that could make it more difficult to balance how XP is given out so that the grades in the class do not become artificially inflated. ClassCraft, for instance, uses an action point system that allows students to trade in these points to get some added benefit in the class, such as referencing their notes during a test.

To provide another reward structure that is separate from the grade of the course, we used victory points. Victory points (VP) are named after a common element of many board games, in which VP are used as a measure of how close someone is to completing the game. Unlike XP, VP does not carry the connotation of increased abilities or skills, but is more like steps down a path.

The physical representation of VP in our class was colored chips that could be handed out whenever a student asked a good question, answered a good question, helped another student, came to office hours, etc. In general, we were liberal with awarding VP for any action that would be in the student's best interest of the course as a whole. Anecdotally, students commented that they were more likely to answer questions asked by the instructor in class when he was holding VP in his hand, ready to hand it out.

VP could be exchanged for various types of rewards, most of which had no definitive effect on the student's end grade in the class. For example, they could choose to add a title to their name on their *GamerCard* or have more time to check out a resource from the instructor.

However, there were some VP rewards that had a measurable effect on the student's grade in the course, such as earning a curve on the next test. These rewards were intentionally priced so high, though, that only if students in the class worked together to earn enough VP as a class could they purchase this reward for all of them. McGonigal's fixes of *Stronger Social Connectivity*, *Wholehearted Participation*, and *Meaningful Rewards When We Need Them Most* all helped guide this design. If students are working together to achieve a reward that they all share, then they all have a stake in their classmates answering questions well or participating more fully in the class.

### **3.5 Achievements**

Another common gamification aspect is the use of achievements. Ironically, achievements actually came out of the gamification of playing games – meta-goals that players could accomplish when playing a game or set of games within an established system. For example, Xbox achievements earned from playing various Xbox games all add together to give a player their gamer score, which is used in the community as an indication of overall gaming prowess.

Achievements in our course were given out for completing meta-goals in the class, such as earning a certain number of VP and reaching a particular level based on XP to attending special class sessions or contributing reference materials for the other students to use.

### **3.6 Leaderboard**

While students were working together to earn VP to purchase the class-wide rewards such as bonus points on a test, there was still a fair amount of competition between students as to who was earning the most VP to contribute to the reward. By the request of the students, a more prominent leaderboard was added in the latest version of *GamerCard*. Anecdotally, while this addition did not affect many of the students, the top 5-10 students on the leaderboard were constantly trying to earn more VP than the others. This aspect addressed McGonigal's fix of *More Fun With Strangers*, as students that didn't normally know each other were now competing against each other.

### **3.7 Titles and Classes**

Titles and classes refer to embellishments that students could earn that were attached to their name whenever it was displayed on their *GamerCard* or on any leaderboard listing. A title was displayed immediately after a student's name. For example, a student that found a useful resource for the rest of the students to use, such as an online tutorial, could earn the title *the Gatherer*. Classes refer to a student's experience in the course. Students could earn new titles by reaching a certain amount of XP or by choosing to build their project on a particular platform.

## **4. Results**

In the end of semester course evaluations for the four semesters that we used *GamerCard*, we asked the students a number of questions regarding their experience with *GamerCard* and the gamification of the course as a whole. Students were not required to complete the course evaluations, so this data represents a sample of the opinions from students in the course.



Two of our primary questions were “Which gamification aspect of the course was most motivating for you?” and “Which gamification aspect of the course motivated you the least?” The results from these questions are presented in Table 1.

**Table 1. Most and Least Motivating Gamification Aspects.**

Semester	Total Enroll	Responses	Achievements	Titles	Classes	VP	Quests	GamerCard	XP
			Most/Least	Most/Least	Most/Least	Most/Least	Most/Least	Most/Least	Most/Least
<b>Spring 2014</b>	61	24	0/8	0/4	0/10	4/0	4/0	6/0	<b>10/2</b>
<b>Summer 2014</b>	19	6	0/1	0/1	0/1	1/2	1/0	1/0	3/1
<b>Spring 2015</b>	59	24	0/4	0/7	0/7	3/4	3/1	1/1	<b>17/0</b>
<b>Summer 2015</b>	23	12	0/3	0/1	0/5	3/2	4/1	3/0	2/0
<b>TOTALS</b>	162	66	0/16	0/13	0/23	11/8	12/2	11/1	<b>32/3</b>

#### 4.1 Experience Points

One interesting indication from these results is that students overwhelmingly felt that the XP grading system was the most motivating gamification aspect. Comments in the end of course evaluations supported this result:

- “XP is great and made plenty of sense. It feels much more like progress than normal grades.”
- “I’m firmly against grading, but if it has to be done, an XP system is the way to go. It was motivating and actually caused me to put in more effort than I’ve put in any other class in the past.”
- “XP was awesome. I am not someone who calculates their grade in a class, and this was great because it meant I didn’t have to. Instead of messing with percentages, I was completely aware of where I stood and how well I had to do on the rest of the assignments. All classes should use the XP system.”

Not all students were positive on the XP system. Several more commented that they system felt “gimmicky” and that, due to unfamiliarity with such as system, it even made it harder for a few students.

We find this result to be overall particularly interesting because as mentioned in previous sections, the XP system is the most transparent of the gamification aspects and requires the fewest changes to a course. The only change we made to the course for this system was to use the percentage that an assignment contributed to the overall end of course grade by a constant factor to show that some assignments were simply worth more XP than others and contributed more to the course grade. This small change seemed to have a positive effect on students in that they did not have to do any extra calculation on their own beyond adding up the remaining XP available in the course and comparing it to their own standing.

#### 4.2 Victory Points

One of the more controversial aspects with the students was victory points and their rewards. We believe the split opinions here come from attempted changes to the VP system for the Spring

2015 semester. An additional feature was added to *GamerCard* to allow students to purchase their VP rewards without having to meet with the course staff. However, due to a technical flaw in the system, the system did not work as intended and students became frustrated. Some sample comments regarding victory points are below:

- *“The VP system could have been improved a bit, such as by allowing more opportunities for VP outside of class.”*
- *“The VP system was effective at encouraging class discussion. In my opinion, the system can be improved by adding a counter that shows the points needed to advance to the next level.”*

### **4.3 Quests and *GamerCard***

Students were generally positive regarding the use of quests as assignments and how they were displayed on *GamerCard*. Students reported that having all assignments for the semester available in one list on *GamerCard* was a good resource and allowed them to plan out their efforts during the semester.

### **4.4 Achievements/Titles/Classes**

In comparing *GamerCard* to other gamification systems (such as Fitocracy [8] or even karma rating systems for online discussion sites such as Reddit), the almost unified opinion that these aspects were the least motivating was a surprising result. Services such as Fitocracy and other games like Chore Wars [9] have successfully used relatively cosmetic changes such as these to great success when users can show off their achievements to others. *GamerCard* had several areas where a student’s achievements, titles, and classes were available for them and others to see, however, other than a small minority, students were at best ambivalent and at worst actively tried to disable these features.

## **5. Limitations**

A few clear limitations exist within this work. Most notably, our students have some identifying characteristics and thus our results might over-fit to our student body. For example, the students were mostly upper-classmen (third or fourth year) and mostly computer science majors. Additionally, the students are a self-selecting group in that they all chose to take a course in game design, and thus are mostly interested in the subject of gaming already and also chose to fill out the end of semester course evaluation. In the future, it will be important to study *GamerCard*’s effects on courses that are not focused on gaming in any way and solicit the opinions of all students if possible.

## **6. Discussion and Recommendations**

From these results and comparing our gamification aspects with the “Fixes to Reality” proposed by McGonigal, we can provide some recommendations for faculty interested in incorporating gamification aspects into their courses. First, and most importantly, is that gamification is not a “one size fits all” endeavor. Gamification aspects that have been shown to be quite effective with some activities with a certain population had little, if any, effect on our course. Further, sometimes the simplest changes can have the greatest impact. A great deal of effort was put forth by the staff to incorporate achievements, titles, and classes (designing, balancing, and programming into the system), whereas the change from percentage-based grading to XP was almost trivial. The power in the XP change was that it attempted to simplify and remove stress from grading, something that many college students struggle with and obsess over. We thus

recommend such a change in any course considering gamification. Some students do notice that the grading systems are functionally equivalent, and thus some care can be taken, if desired, to alleviate this by allowing students to redo quests (perhaps for diminishing XP), complete quests multiple times, etc. This could be considered a “more-strict” translation of a game’s mechanics, in which a player is always allowed to play until the game is won.

Mechanics such as achievements, titles, and classes are naturally intrinsic rewards and thus require some self-motivation. These techniques are more likely to work well when the end goal of the activity is further away and there are fewer milestones or checkpoints, such as losing weight using Fitocracy. We posit that because the quests in the course are already somewhat finely grained, these mechanics did not add a significant feeling of progress towards a student’s goal (a good grade in the course). In addition, many students remarked how these mechanics were purely aesthetic, and thus success might depend on somehow coupling these systems directly to a successful outcome (i.e., the student’s grade).

## 7. Conclusions

In this paper, we discussed the *GamerCard* system created for use in an upper-division game design course to evaluate what aspects of gamification were motivating to students. We found that basic changes, most notably an XP based grading system, increased student understanding of their standing in the course and were the most effective at motivating students. More traditional gamification elements that added cosmetic or intrinsic rewards were essentially ignored by the class over many semesters. In future work, we plan to test *GamerCard* with other courses to determine if these results hold for other student populations.

Additionally, we plan to discuss redesigns of our achievements, titles, and classes systems to be more tightly coupled to a student’s grade in the course. We then hope to study how these design changes affect student perception of the course, motivation within the course, and learning within the course.

## 8. Acknowledgements

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## 9. References

- [1] Deterding, Sebastian, et al. "From game design elements to gamefulness: defining gamification." *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*. ACM, 2011.
- [2] Zichermann, Gabe, and Christopher Cunningham. *Gamification by design: Implementing game mechanics in web and mobile apps*. "O'Reilly Media, Inc.", 2011.
- [3] Kapp, Karl M. *The gamification of learning and instruction: game-based methods and strategies for training and education*. John Wiley & Sons, 2012.
- [4] McGonigal, Jane. *Reality is broken: Why games make us better and how they can change the world*. Penguin, 2011.
- [5] Toth, David, and Mary Kayler. "Integrating Role-Playing Games into Computer Science Courses as a Pedagogical Tool." *Proceedings of the 46th ACM Technical Symposium on Computer Science Education*. ACM, 2015.
- [6] O'Donovan, Siobhan. "Gamification of the games course." *Acesso em 17* (2012): 1-8.

- [7] O'Donovan, Siobhan, James Gain, and Patrick Marais. "A case study in the gamification of a university-level games development course." *Proceedings of the South African Institute for Computer Scientists and Information Technologists Conference*. ACM, 2013.
- [8] Jurgens, David, James McCorriston, and Derek Ruths. "An Analysis of Exercising Behavior in Online Populations." *Ninth International AAAI Conference on Web and Social Media*. 2015.
- [9] Friedberg, Leora, and Anthony Webb. "The chore wars: Household bargaining and leisure time." *Unpublished manuscript*. Charlottesville, VA: University of Virginia (2005)
- [10] Xu, Yongwen. "Literature review on web application gamification and analytics." *Honolulu, HI* (2011): 11-05.