GradeCraft: What Can We Learn From a Game-Inspired Learning Management System?

Caitlin Holman
University of Michigan
School of Information
3330G North Quad, 105 S. State St.
Ann Arbor, MI 48109-1285
+1 (734) 644-3674
cholma@umich.edu

Stephen Aguilar
University of Michigan
School of Education & USE Lab
Suite 4215, 610 E University Ave
Ann Arbor, MI 48109-1259 USA
+1 (734) 764-8416
aguilars@umich.edu

Barry Fishman
University of Michigan
School of Education
Suite 4215, 610 E University Ave
Ann Arbor, MI 48109-1259 USA
+1 (734) 764-8416
fishman@umich.edu

ABSTRACT

Game-inspired courses were developed in an effort to increase student engagement, and to provide students with more personalized learning experiences. We designed a gamified gradebook, GradeCraft, to clarify the embedded complexities of these new grading systems, and to enhance the game experience for students. GradeCraft contributes to the Learning Analytics community by capturing information that would be inaccessible in traditional grading systems such as: what types of assignments students choose to complete, how they weight those assignments, how often and how accurately students model their course grade, and how successfully assignments are completed by students individually and the class as a whole across a structured grading rubric. We hope GradeCraft will give instructors new insight into student engagement, and provide data-driven ideas about how to tailor their course to student needs.

Categories and Subject Descriptors

K.3.1 [**Computers and Education**]: Computer Uses in Education – *collaborative learning, computer-assisted instruction, computer-managed instruction*

General Terms

Management, Measurement, Design, Theory

Keywords

Learning analytics, syllabus design, game-inspired instruction, gamification

1. INTRODUCTION

Good games typically inspire players to spend large amounts of time and effort achieving in-game success. Well-designed games succeed because they tap into our deep-seated desire to learn and be engaged. They give players multiple ways to succeed, maximize choice, and mitigate the cost of failure [2]. Common elements of gamification—the process of making "real" world contexts more "game-like"—include awarding points, levels, leaderboards, and badges.

Educators over the last decade have been inspired by the depth of content learned, and the high-intensity effort that gamers choose to put in when engaged in a good game [4]. The similarities that exist inherently between games and school are clear: both have clear goals at the outset, set specific challenges to be conquered, require practice to succeed, and use assessments to test whether material has been properly learned. This led to the question of whether school itself could be made into a good game.

We are currently seeing the first wave of such courses at our university. These game-inspired, or "gamified," courses aim to increase student choice while mitigating the negative impact of failure. Gamification elements we have seen include: using points and incremental levels instead of grades; awarding badges to recognize achievements and skill-acquisition; allowing students to redo certain assignments as many times as necessary to succeed; and giving students the ability to select what types of assignments they will take on and how much those assignments will be worth.

Given the complexities and choices inherent in a well-gamified grading system, it can be difficult for students to quickly and intuitively grasp the options available to them. To alleviate this issue we developed GradeCraft, a gamified gradebook designed for the sole purpose of reifying game-inspired grading systems. This design brief describes the current application and the Learning Analytics potential of GradeCraft.

1.1 Case Study: Videogames & Learning

GradeCraft was initially created to support the gamification of an elective class on Videogames & Learning at a large American university. The goal of this course is to examine the learning and motivational theories that operate within—and inform the design of—videogames. Rather than treat this content abstractly, the grading system designed for this course infuses the design principles that operate within games. The course has a set of required assignments in addition to a series of optional assignments. While completing *all* of the assignments is possible, it would involve more work than is necessary to do well in the course. The overabundance of assignment options is an example of giving students more routes to success—a key videogame principle.

These assignments are divided into three categories: "Grinding" assignments are those typically characterized as necessary for learning the content, but are not always as engaging as other assignments, including attendance, weekly reading reactions, blogging, and team activities; "Learning from playing a game" assignments are those that center on students reflecting and commenting on a commercial videogame they have chosen to play throughout the term—their "game text"—and are required

for all students; "Boss Battle" assignments are longer, more complex, and require a certain level of content mastery to complete successfully. As a result, the "Boss Battles" occur near the end of the term. Optional assignments in this course can be seen either as assignments that students complete to exceed the course's main requirements—because they want an "A+," perhaps—or as assignments that students complete in order to regain points that were lost as a result of missing a class, missing a reading reaction, or simply performing unsatisfactorily on a required assignment. This latter possibility is an example of the grading system mitigating the cost of "failure."

These options, while plentiful, proved difficult for students to keep track of. Navigating which assignments were necessary to develop mastery in the course became a complicated task, and GradeCraft was introduced to help visualize what was required, what was possible, and how students were currently doing. Badges were used to designate skills the instructor wanted students to learn, but did not contribute value towards the final grade. Initially badges simply had a title and description, like "Writer" – "Writes well in assignments," but this proved too vague for students to know if and when they had earned the badges. Badge criteria were developed in response to this need.

1.2 Case Study: Introduction to Political Theory

GradeCraft is currently deployed in a political science course at a large American university. The professor, hoping to increase student motivation and encourage mastery-driven learning, designed the following gamified grading system:

Forty percent of students' final grade is "traditional" in that it consists of a core set of requirements: attending lectures, writing weekly reading reactions, and attending teaching assistant led discussion sections. This set of requirements was designed to provide both a core set of common assignments, as well as a common course experience.

The remaining sixty percent of a student's grade is determined by two student-driven decisions:

First, students must choose what types of assignments will make up the remaining sixty percent of their grade. There are four assignment types to choose from during the term—traditional essays, an open-ended group project, an open-ended individual project, and contributing to the class blog. Students are encouraged to work on two of the four assignment types, but are allowed to select any number.

Second, students are given the freedom to determine how each of the four assignment types is weighted. This decision is operationalized by giving students six points to "spend" on any assignment type they wish. These points determine the weight of each assignment they attach to. A student can, for example, assign all six points to academic essays. Doing so amounts to the student choosing to focus only on writing essays at the cost of other assignment types. The value of assignment types lacking at least one multiplier is in turn halved.

Finally, students are awarded badges that either recognize or incentivize certain behaviors. These badges are valued at up to twenty-five percent of the student's grade.

The remainder of this design brief will explore how these choice-driven grading systems are reified through the GradeCraft's student and instructor interfaces as well as explore the implications for the kind of data collected by GradeCraft.

2. GRADECRAFT

GradeCraft allows for three types of users: students, teaching assistants, and instructors. For the purposes of this paper we will collapse the teaching assistant and instructor roles, as they are functionally similar. At its core GradeCraft is a comprehensive dashboard that allows students to see their course performance in a single view, much like the dashboard of a videogame. Instructors can view each student, section, and class performance across a variety of metrics.

We will illustrate the new analytic possibilities through a series of hypothetical situations, beginning with reviewing what a student sees in GradeCraft.

2.1 The Student Perspective

Upon logging into GradeCraft, a student sees their current score, a chart of the points they have earned so far in the course, and a chart of the points that are available to earn throughout the entire course.
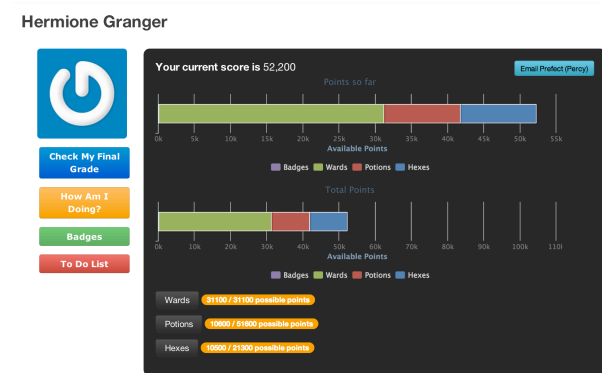

Figure 1: Student Dashboard

The dashboard shows the student what level they have currently achieved in the course. These descriptions are intended to be both informative and empowering; they reflect a growth model of learning—students are shown that their current progress can be altered through effort and forward planning.

On their dashboard students can see which badges they have earned, markings that reflect how far along they are at completing unearned badges, and which badges their classmates have earned. They can notify instructors that they have completed a specific task on the path to earning a badge.

Figure 2: Understanding Badges

Learning objectives exist as criteria on a student's dashboard, allowing them to visualize how successfully they have achieved the instructor's intended goals for the course. This does not affect their grade directly, but it should help both the student and the instructor understand whether the student has learned the core material.
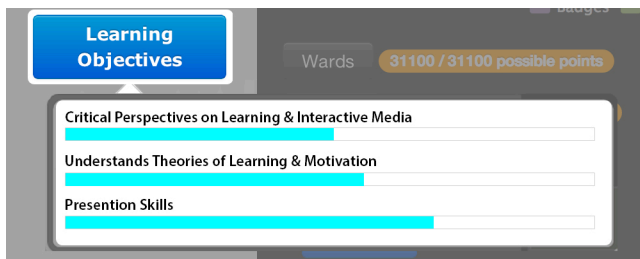
Figure 3: Visualizing Learning Objectives

GradeCraft helps to encourage students to be less concerned with grades and more focused on mastering skills by completing assignments and earning badges. To this end, we have chosen not to display course grades on their dashboard by default. However, we recognize that we are working within a dominant educational paradigm where grades information is highly sought after, so students can click the "Check My Final Grade" button in order to see how their current score would translate into a final course grade. This information is recorded, and provides valuable embedded feedback to instructors regarding which students continue to be overly focused on grades. Such information can, in theory, inform future course design or pedagogical strategies.

Figure 4: Checking Their Grade

Students can also check how their current score compares to the class average by clicking "How Am I Doing?" This helps them gauge their performance in the class, without being as potentially demotivating a reference as a leaderboard.
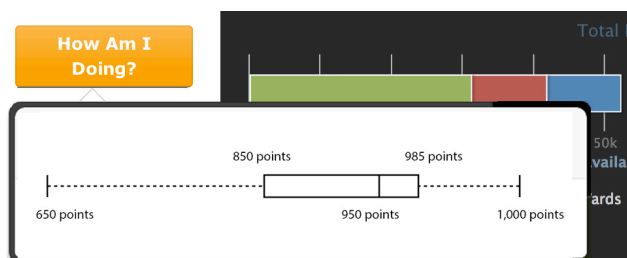

Figure 5: Checking Class Standing

We believe giving students meaningful choices (ones that have an impact on how they will "play the game") is crucial to designing a good game [3][5]. Students in the political science course mentioned above are able to select which assignments they will do, how much of their grade those assignments will be worth. But how do they make these complex calculations? We built a grade prediction tool to help them in this process. When the predictor is first loaded, the bar chart fills with any points they've already earned, broken down by assignment type.
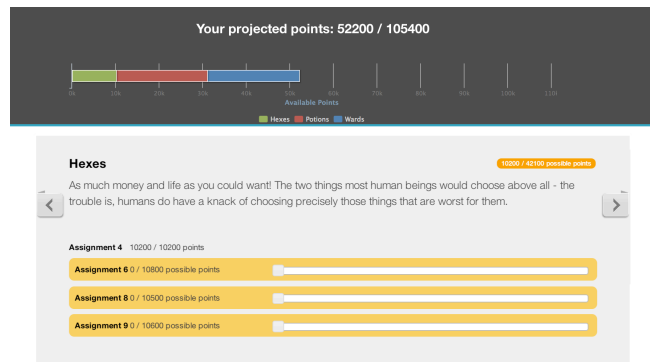

Figure 6: The Grade Predictor

The student can slide through each assignment type, selecting how many assignments they plan to do, how well they believe they will score on them, and if applicable, how significantly they would like to weight that assignment type. Students are thus able to model their performance. GradeCraft captures these modeling instances, allowing instructors and researchers to begin to understand the process behind how students make course engagement decisions.

The predictor stays in sync with the student throughout the semester, showing them their current score at any given moment, and allowing them to assess what work must be done to earn a particular grade. The predictor also acts as a resource, displaying links to materials and tools recommended by the instructor to help students complete the assignment.

2.2 The Instructor Perspective

When initially setting up a course in GradeCraft, instructors can declare the overarching learning objectives. As they create assignment types and badges, each one can be tagged with the relevant learning objectives.

Instructors can then visualize exactly how their objectives are distributed across the entire course per activity, and in relation to the grading scheme. This helps instructors to see if their learning objectives are fully represented in the course structure or if there are elements that need clearer application.
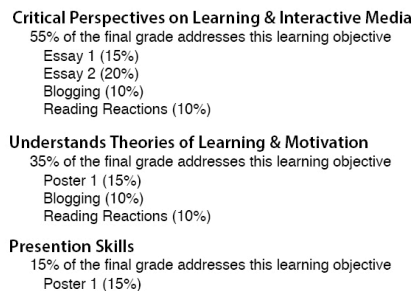

Figure 7: Learning Objectives Assignment Breakdown

Instructors create badges to foster the development of particular attributes, skills, or actions that they feel are important for their students to have or do. Each badge has a set of criteria that must be accomplished in order for a student to earn it. Instructors can easily view which badges have been earned, how often, and when. They can also see which badges students are working on, which

criteria have been marked complete, and which are proving more difficult for students to achieve. Comparing this data to the learning objectives that the badges reflect will help instructors gauge how successfully students are learning the intended course material.

	Dream Interpreter	Inner Eye	Marauders Map	Lumos	Rune Reader	Tea Leaf Guru
Wizard						
Ron Weasley			50% complete!			✔
Fred Weasley	20% complete!					✔
Harry Potter			✔	✔		
Hermione Granger	90% complete!	✔	✔	✔	✔	✔

Figure 8: Badge Analytics

Standard access data—login count, page views, resources accessed—provide the basic framework within which instructors can first begin to investigate student engagement. Instructors can view an interactive table displaying individual student statistics, or select to see class or section graphs for each value. While this data is possible to collect in all learning management systems, displaying these metrics for instructors' use has not been done to our knowledge. Making this data plainly available to instructors allows them to have a richer understanding of how their students are choosing to engage—or disengage, as the case may be—with their course. With this information instructors can intervene as necessary to improve student outcomes.

Name	House	Score	Badges Earned	Log ins	Page Views	Predictor Views	Last Self-Predicted Grade	Current Final Grade
Hermione Granger	Slytherin	52200	18	21	38	21	A+++	A
Blaise Zabini	Ravenclaw	50070	12	10	15	3	A	A
Hannah Abbott	Gryffindor	45870	8	10	18	4	A	B
Seamus Finnigan	Gryffindor	44919	7	14	21	5	B+	B
Pansy Parkinson	Ravenclaw	43860	7	12	16	4	A-	B
Harry Potter	Hufflepuff	42880	15	9	14	3	B+	B

Figure 9: Student Activity

When approaching the mid-point of the semester, a professor viewing the engagement charts could, for example, sort students by their attendance record, and schedule conversations with students who have missed a high percentage of classes. Alternatively, an instructor might notice that a student who had been performing well in the course suddenly stopped attending and has not been turning in assignments. This acts as an early warning system, suggesting to the instructor that something has changed and that they should contact the student while it is still relatively easy for the student to recover from the situation.

Students need feedback regarding their class performance, and guidance as to what else they *should* be doing. GradeCraft gives students direct access to analytics that can help answer these questions, but also provides instructors with further material to support conversations with students regarding what additional work they can do in the course. Instructors can see each student's dashboard view, visualize how well they have completed the comprehensive learning objectives, and check where the student has ranked in completing each assignment.

In discussing with students what their specific path through the course is, instructors can use the predictor tool to keep track of exactly what choices a student has made, and make recommendations regarding what should be attempted next. GradeCraft logs what choices students make in the predictor, and what final grade these selections ultimately build to. Instructors can see students predicted final grade charted over time, and drill down to explore which specific assignments a student was considering doing, and how well they expected to do on any particular assignment.
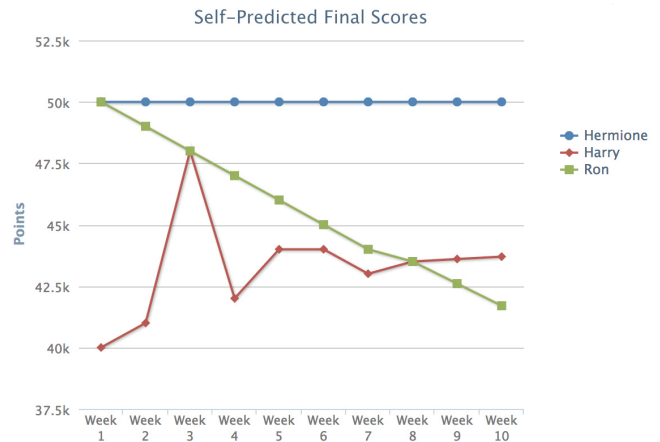

Figure 10: Self-Predicted Final Grades Over Time

If instructors know when students deviate negatively (through missing assignments, or lower than expected scores) from their original intentions on an assignment, we can predict earlier in the course timeline which students may be in need of support. This is an improvement on current early warning systems, which rely on comparing a student's behavior to previous classes or current classmates. The unit of analysis in GradeCraft is the course itself, rather than the academic histories students bring with them. These histories cannot fully capture the nuance of a student performing differently than they themselves had *intended*.

GradeCraft allows instructors to visualize which assignment types students choose to complete, and how much weight they decide to give them. Mapping these choices back to students' final grades will help us investigate if students know their own skills and choose to weight them higher, or if students weight things so as to reduce the risk of working on assignment types they are less familiar with. Given that one of the long-term goals of game-inspired grading systems is to encourage students to explore new types of activities and broaden their skill sets, tracking this relationship will be key to understanding if the frame change is successful in achieving this goal. We need to understand how

students perceive risk-taking in relation to assignment type selection, and how to incentivize this behavior to achieve the best learning outcomes.

Clearly built rubrics have the advantage of helping students understand what is explicitly expected of them and how they should direct their efforts, provide a more concrete avenue for instructor feedback, and reduce bias in grading [1]. In order to support these goals, we designed an interactive grading rubric, allowing instructors to set categories, enter criteria and scoring guidelines, and then select how students had fared on each criterion. These assessments build to a final score on the assignment.

From these selections instructors can then explore how well students complete their work from the perspective of these criteria. An instructor might create the category of "Writing Skill" in a long-form essay rubric, with the criteria of "Spelling & Grammar," "Clarity of Thought," and "Supported by Research." When the grading has been completed, the instructor can then see how students individually, as a section, and as a class did on each criteria. Different levels of success would have implications for student, section, and class interventions, explanations, and greater understanding of what the class as a whole needs to be taught in order to succeed.
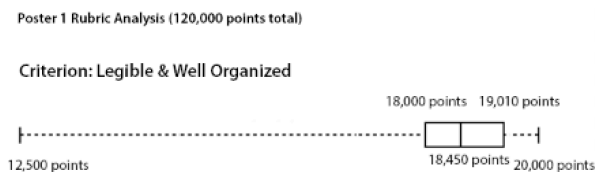

Figure 11: Class Criterion Score for Poster Assignment

3. CONCLUSIONS

GradeCraft gives educators access to new types of analytics because of the multiple points at which students interact with the system. Rather than simply "drilling down" into a letter grade and examining the parts that constitute it, GradeCraft collects data that speaks to process and decisions. It captures which assignments students choose to complete, how students weight those assignments, how students did in regards to completing specific assignment rubrics, and which badges were awarded throughout the course. Each of these decisions is captured, and it is our hope that the resulting data will yield valuable insights about student behavior within game-inspired courses. It is our hope that GradeCraft foregrounds the affordances of the game-inspired grading systems in such a way as to make complicated decisions clear, while also yielding data that speaks to student processes, as opposed to simply reporting student outcomes.

4. ACKNOWLEDGMENTS

5. REFERENCES

[1] Andrade, Heidi Goodrich. 2005. Teaching with Rubrics: The Good, the Bad, and the Ugly. College Teaching, Vol. 53, No. 1 (Winter, 2005), pp. 27-30. Taylor & Francis, Ltd.

[2] Gee, J. P. 2003. What videogames have to teach us about learning and literacy. New York: Palgrave Macmillan.

[3] Malone, T. W., & Lepper, M. R. 1987. Making learning fun: A taxonomy of intrinsic motivations for learning. In R. E. Snow & M. J. Farr (Eds.), *Aptitude, learning, and instruction: Cognitive and affective process analysis* (Vol. 3, pp. 223-253). Hillsdale, NJ: Erlbaum.

[4] Prensky, Mark. 2002. "The motivation of gameplay: The real twenty-first century learning revolution", *On the Horizon* (Vol. 10 Issue: 1, pp.5 – 11).

[5] Schell, J. 2008. The art of game design: a book of lenses. San Francisco, Calif.: Morgan Kaufmann.