## **Designing a Game-Inspired Learning Management System**

Caitlin Holman, Stephen Aguilar, Barry Fishman, University of Michigan cholma@umich.edu, aguilars@umich.edu, fishman@umich.edu

**Abstract:** Through the experience of implementing game-inspired grading systems in undergraduate courses at a large university, we found ourselves pushing the boundaries of what was functionally possible in current Learning Management Systems. Simultaneously, students reported difficulty understanding the core requirements of the course 'game', recognizing the various pathways available for them to succeed, and assessing their course performance. In response to these articulated needs (and using the classic videogame user dashboard as inspiration) we developed a custom learning management system to better support game-inspired courses and foreground the affordances of gameful course design.

## Supporting Gameful Grading Systems

Numerous educators are experimenting with implementing game-inspired course designs in traditional education settings (Sheldon, 2012; Fishman & Aguilar, 2012). These courses often feature curriculum and assessment designs that are difficult to support in the standard Learning Management System (LMS). The administrative tasks involved in managing this style of course—particularly the various types of material submitted on irregular schedules and the importance of swift response to student action—also differ significantly from those of traditional courses, and thus present a technical challenge to instructors using non-optimized software. In our case, the design of GradeCraft was in part a response to complaints from students who were unsure of their progress in the course, and who struggled to decide what they should work on to achieve their desired outcome/grade. Over the process of deploying this system, and at the request of teachers using the software, we have increasingly built features designed specifically to support the instructional challenge of providing rapid feedback for students in a variety of forms (text, badges, learning objectives progress, etc.). Our system is a platform for experimenting and optimizing our course designs.

### **Our Design Process**

We began the design process by taking an inventory of techniques currently used in gameful courses. This produced a list that included such techniques as: using points and incremental levels instead of grades; awarding badges to recognize achievements and skill-acquisition; allowing students to redo assignments as many times as necessary to succeed; giving students the ability to decide the types of assignments they would attempt; allowing students to determine how much assignments would count towards their final grade; having students work together in both self-selected and pre-arranged groups on larger, sometimes competitive, challenges; sharing earned skills amongst students; requiring the completion of specific assignments and tasks in order to 'unlock' other challenges; and displaying generalized information regarding classmates' performance.

While these represent relatively simple game mechanics (and each is being actively researched as to its specific pedagogical value and motivational impact in the classroom), we hoped building an interface that included these tools would solve the initial comprehension and logistical issues students were experiencing, and would establish a solid foundation from which to build more nuanced gameful functionality in the future. We have deployed the interface in four classes so far, making iterative changes after each round in response to user testing, student survey feedback, and instructor requests. We are also employing a design-based research approach, with the intention of producing a usable tool that is rooted in theory (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003).

## The Student Dashboard

From the student perspective, our system functions as a single-page dashboard displaying their comprehensive course progress. The top portion of the display includes a visual chart of the points they have earned (broken down by color to reflect the type of assignment), a list of the badges they have earned paired with the badges still available to work on, and a graph of their progress towards achieving the course learning objectives. It also displays a To Do list that highlights upcoming assignments, assignments that could be redone to show improved content or skill mastery, and, if possible, feedback on a recent successful assignment. We use a box and whisker plot to chart the distributed grades earned across the entire class. Beneath this is a display of the semester plan that students can manipulate, selecting between a calendar view, a list view, a timeline, and a tech-tree

display of the semester dates and assignments. These displays also operate as the portal through which students submit their work, identify self-selected groups, record participation, predict their scores, and receive feedback.

My Dashboard		
SCORE		FINAL GRADE PREDICTION
Current Points		Level: Mastered
0k 1k 2k 3k 4k 5k 6k 7k 8k	9k 10k	CLASSWORK
Available Points  Available Points  Available Points  Conventional Essays III Biogging III Section III Readings III Lecture		FIRST TAKE
Predicted Points		Reading Reaction (Week 5) Submit Biog Post #3 Submit
		TRY AGAIN? Individual Project 1 Resubmit
Available Points	_22.5k _ 25k	Level: Close But Not Quite ACHIEVED
🗰 Badges 🗰 Solo Project 💭 Group Project 💭 Conventional Essays 💭 Blogging 🥥 Section 💭 Readings 🔛 Lecture		Game Selection Paper Resubmit Level: Above & Beyond
CLASS OVERVIEW		
	Timeline Week by Week Syllabus	BADGES
<image/> Image: Section of the section of t		Your Badges:
		Unearned:
		CLASS GRADE DISTRIBUTION
		LEARNING OBJECTIVES
		Familiarity with Course Texts (75%)
6	Submit: Team Proceed Control C	Problem Solving Ability (55%)
Q.	Reading Reaction 1 Submit: Game Team Meeting	Analyze Political Arguments (30%)

Figure 1: GradeCraft Student Dashboard

The top progress bar serves an informational purpose, but may also have a motivational effect, as preliminary research indicates that this type of display boosts user motivation to complete tasks (Kohler, Niebuhr, & Hassenzahl, 2007). The inclusion of learning objectives, whose progress is tied to achievement within various components of the course, is intended to help students direct their attention to the broader course goals – items that may get overlooked without persistent reminders and representations of student advancement.

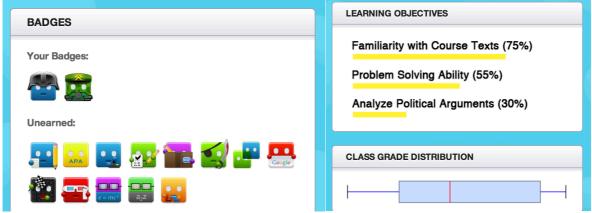


Figure 2: Panels showing student badges, learning objectives, and course grades

Badges are currently being investigated as both a motivational tool and an alternate credential system (Joseph & Global Kids, Inc., 2012). GradeCraft provides tools that allow instructors to create badges, define the criteria necessary for earning those badges, award badges both manually and automatically (when attached to achieving certain levels in assignments), and display back to students the badges they have earned. As we are beginning to study the social impact of badging in the classroom, students are now able to share their earned badges with their classmates. By implementing the Mozilla Open Badges Displayer code (in addition to the Issuer code that allows our students to share their badges beyond this environment) we are also able to allow students to display badges they have earned in outside spaces, highlighting their skills for their classmates and instructors. We anticipate that this new information about their classmates' achievements may have a motivating effect, in addition to establishing an explicit understanding of the distributed skillsets in the classroom, potentially laying the groundwork for more effective group work to be completed.

The Grade Predictor tool allows students to explore "what if?" questions; as they look forward to the semester assignments they can decide exactly which tasks they will work on, and predict how successful they will be in each. Their progress is displayed as a bar that fills in with each additional achievement and is broken down by assignment type to allow the student to visualize the impact of each type of work. Students can strategize effort and achievement, avoid tasks they dislike, maximize work they know they can succeed in, and knowingly take 'safe' risks completing work they are less familiar with. We have observed some students plan to complete many assignments at an "acceptable" level of work, while others decide to do a few valuable assignments at a truly "above and beyond" level. The Grade Predictor display reflects a student's current achievements, and the interface has proven crucial to guiding conversations between the instruction team and students trying to figure out how to recover from a specific mistake, or simply improve their overall course standing. We consider the Grade Predictor to be a key feature within our LMS that builds student autonomy within the course, and provides students with the information to take control over their own successall within an interface designed to scaffold the creation of achievable individual goals. In the initial implementation of the tool, the Grade Predictor tool was a completely separate interface in the LMS; in response to user testing it has been relocated to the Student Dashboard in order to more seamlessly highlight the tool's functionality for students.



Figure 3: Grade Predictor Tool

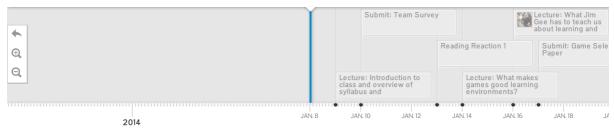
In response to student and instructor feedback on our most recent implementation, we have now added an interactive timeline (based on the Timeline.JS work, <u>http://timeline.verite.co/</u>) and will be increasingly allowing students to personalize their dashboards, including dragging and dropping sections of page, minimizing the display of badges and assignments students do not intend to work on, and configuring the presentation of which progress metrics are persistently displayed.



# EDUC222 Timeline

Why are videogames fun? The answer isn't as obvious as you might think. Good games draw you in, teach you how to succeed, and keep you engaged with a "just right" level of challenge. Most importantly, players learn while playing a well-designed game. Why isn't school like that? This class takes a close look at videogames, a close look at education, and considers ways that each can be improved to maximize learning and performance.





#### **Figure 4: Interactive Semester Timeline**

#### The Instructor Dashboard

While gameful assessment systems are potentially motivating for learners, they are also a formidable task for instructors to execute successfully. Part of the difficulty is related to the change in pedagogical approach; new or different pedagogies require new practices by teachers who are used to organizing instruction and assessment in a particular way. Pedagogies that present more choice to learners and result in a broader variety of representations of learning are more difficult to manage than "traditional" didactic pedagogies (e.g., Crawford, 2000). On the instructor side, GradeCraft makes it easier for teachers to manage the gameful structure of the class itself. This includes providing tools to monitor the progress of individual students and groups of students, to organize and support both collaborative and competitive work, and to provide feedback on assignments that are linked to different kinds of recognition for student work in the form of badges and marked progress towards achieving learning objectives.

The instructor dashboard is designed to help teachers know how their class is performing in a single view. The ten lowest and highest performing students' grades are each visualized with stacked bar charts, each color segment reflecting achievements within an assignment type (e.g., Attendance, Reading Reactions, Blogging, etc.). Instructors can rapidly see what types of work is being done by each student, and isolate which students may be in need of more support. One instructor has reported that this visualization is now at the core of his meetings with his teaching team, as they go through the students occupying these tiers one-by-one to understand how they are progressing through the course. A box and whisker plot is used to capture the overall class performance, displaying the range of achievement as well as situating how the majority of students are doing.

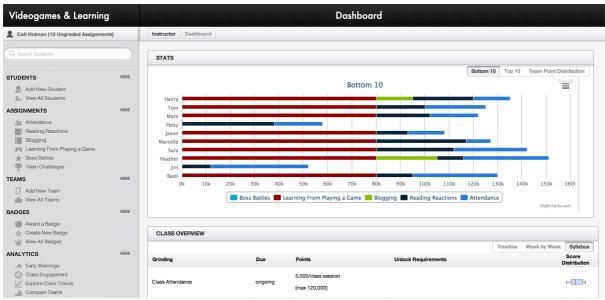


Figure 5: Instructor Dashboard

Grading can be a challenge in any course, but especially so in gameful frameworks given the personalized nature of the assignments themselves, the varied due dates, the likelihood (and active encouragement) of resubmission, and the variety of feedback required, including grades, text feedback, badges, and progress on learning objectives. Asking instructors to independently assess these items, and subsequently mark them in three different parts of the GradeCraft interface, resulted in instructor confusion and frustration. Ultimately the badging system in three different courses was abandoned as a result. We must expect that completing the 'necessary' grading for a course will take precedent over the 'optional' assessment of items like badges. This means that in order to create a successful course that implements badges in a useful manner, we must include the marking of student progress on all items in a single unified grading form. To achieve this we have constructed a rubric grading tool that allows instructors to define the grading scheme for any assignment, and connect it to specific learning objectives and badges. Instructors can share specific rubrics with the students to better guide their work. After the grading process has been completed, instructors can visualize the overall class performance on each metric in the rubric. We hope that this display will help teachers to better discover skills and content areas where groups of students need more specific instruction to improve their performance.

At the beginning of the semester, when told I would get to play a video game for homework, I was thrilled. Really, a video game? And I get to choose II? I expected that I would use this homework to procreastinate other homework, but didn't really expect to "get" anything out of my game play. I had pretty low expectations as far as what I would learn; I hrew the game had a touching story of friendship, but I didn't expect to learn about friendship, or Disney characters, which the game features, or pretty much anything else. As excited as I was to play a game for class, I never thought I would think critically about a game that uses the words "keyblade", "heartless", "twilight town", and "Mickey Mouse". I am happy to say that I was wong.

#### Why This Game?

The game I focused on this semester is Kingdom Hearts: 358/2 Days (pronounced "three fifty-eight over two days). I was somewhait familiar with the original Kingdom Hearts for the PlayStation2 after watching my sister play it when I was younger, but because I was familiar with the game and because I don't own a PS2, I elected to play the fifth game in the Kingdom Hearts series.

ntages of playing this particular game for me personally were that it has extremely good grap considering it's a game for the Nintendo DS, it isn't overly frightening seeing as it combines Final Fantasy characters with traditional and lovable Disney characters, and I had just gotten an NDS and the game for Christmas. On the downside, Kingdom Hearts is a game made for the fans, which made getting involved and understanding the story a little tricky, as I had never seen the ending to the original game, nor had I been exposed to any of the other games that lead up to the one I chose. Additionally, the format of the game is such that instead of adventuring in your spaceship to visit different worlds like "Halloween Town" and "The Beast"s Castle", the game centers around your character going on missions in these worlds, but always returns you to the Headquarters of the Organization fo which the main character works. I saw this as a downside simply because it took away from the adventure-like atmosphere of discovering worlds and made the game as a whole feel much more instructional compared to its predecessor. As far as the story goes for Kingdom Hearts: 358/2 Days, at the beginning I was completely lost. The player character is not Sora, who was featured in the first few games, but, I came to discover, a shadow ("heartless") of him named Roxas, who was born at the end of the original game. Because Roxas does not have a heart, he ends up working for the "bad guys", which flips the game entirely backwards for long-time fans, but also makes it a little harder to connect and identify with the character the player is forced to play as. However, case, Gee's Identity Principle still works when Roxas realizes what he's doing and breaks away in order to work for the "good side" (Gee 2007). In general I was not in favor of the game designers making the decision to switch the player character because it does weaken the player's motivation to continue with the game, but I can understand how getting an insight into the inner-workings of the bad side is appealing to more dedicated fans of the series.

SCORING Total Points: 128,000/160,000 Level: Mastered 
 The Basics
 Hide

 10 pages max, double spaced (images not included)
 Student's name

 Game title
 Game title

 Reason for Game Selection
 Detailed analysis of game play

 Decision what was learned
 Econs on what was learned
 on what was learned
Proper citations Total Fail Course Content 🗆 🔛 Learning Theories Motivation Schools & Education Serious Games Gamification Research Methods 🛛 \overline{= Virtual Worlds Violence in Games 🛛 🔛 Math & Science Criteria Partial Mastered Beyond Learning theories 0 Motivational theories Experiences in & around game

Figure 6: Rubric Grading Tool

## **Future Directions**

Currently we are working on the development of a more-robust data analytics engine that can draw from multiple data sources, including students' current performance in the course, student behavior within the GradeCraft interface, and academic history and planning information from our university records. We will construct data displays based on this data-analytics engine that are both student-facing and instructor-facing. We are particularly focused on helping instructors recognize which students may need more support, and informing students about what behaviors high-achieving students use to succeed.

GradeCraft has thus far operated as a standalone solution, but we have heard repeated requests from instructors that integrating the application with other established solutions would drastically improve their students' experience and their workflow as teachers. We are currently in the process of implementing LTI integration in order to make this possible, and are crafting it so that GradeCraft can be both a plugin to another LMS, or the core LMS that can host other LTI tools.

## References

- Cobb, P., Confrey, J., diSessa, A., Lehrer, R., & Schauble, L. (2003). Design Experiments in Educational Research. *Educational Researcher*, *32*(1), 9–13. doi:10.2307/3699928
- Crawford, B. A. (2000). Embracing the essence of inquiry: New roles for science teachers. *Journal of Research in Science Teaching*, 37(9), 916–937. doi:10.1002/1098-2736(200011)37:9<916::AID-TEA4>3.0.CO;2-2
- Fishman, B. J., & Aguilar, S. (2012). Gaming the Class: Using a Game-based Grading System to Get Students to Work Harder... and Like It. In C. Martin, A. Ochsner, & K. Squire (Eds.), Proc. GLS 8.0 (pp. 111–118). Pittsburgh, PA: ETC Press.
- Joseph, B., & Global Kids, Inc. (2012, June 25). Six Ways to Look at Badging Systems Designed for Learning | Online Leadership Program. Retrieved from
- http://www.olpglobalkids.org/content/six-ways-look-badging-systems-designed-learning
- Kohler, K., Niebuhr, S., & Hassenzahl, M. (2007). Stay on the ball! an interaction pattern approach to the engineering of motivation. In Proceedings of the 11th IFIP TC 13 International Conference on Human-computer Interaction (p. Pages 519–522). Presented at the INTERACT'07, Springer-Verlag Berlin, Heidelberg.
- Sheldon, L. (2012). The multiplayer classroom: Designing coursework as a game. Boston, MA: Cengage Learning.

## Acknowledgments

Thank you to Mika LaVaque-Manty, Chris Quintana, Stephanie Teasley, Steve Lonn, and the USE lab for their support and guidance in this project.