

# Designing a Game-Inspired Learning Management System

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**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.

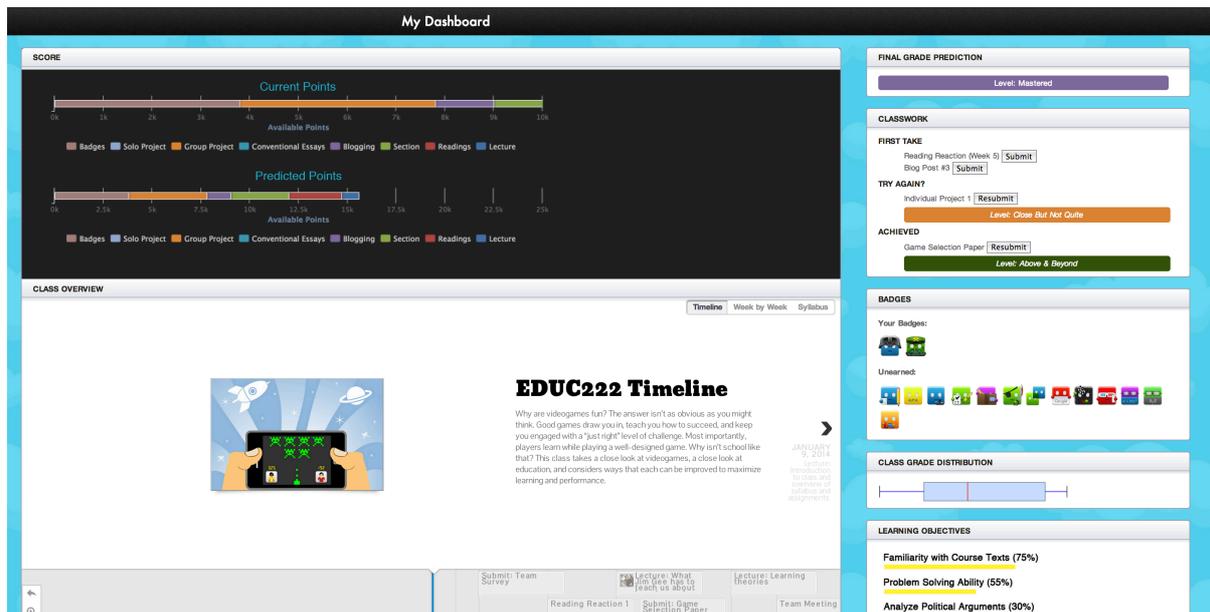


Figure 1: GradeCraft Student Dashboard

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.

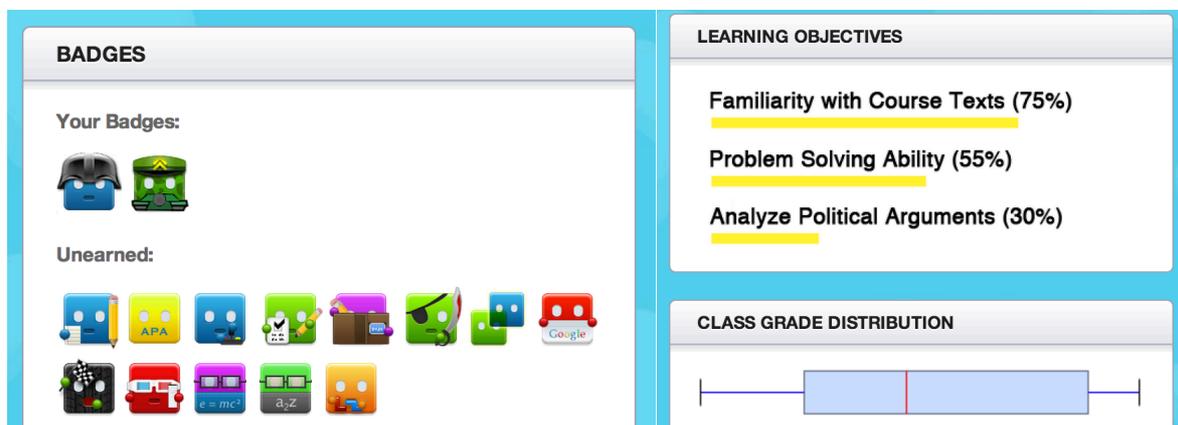
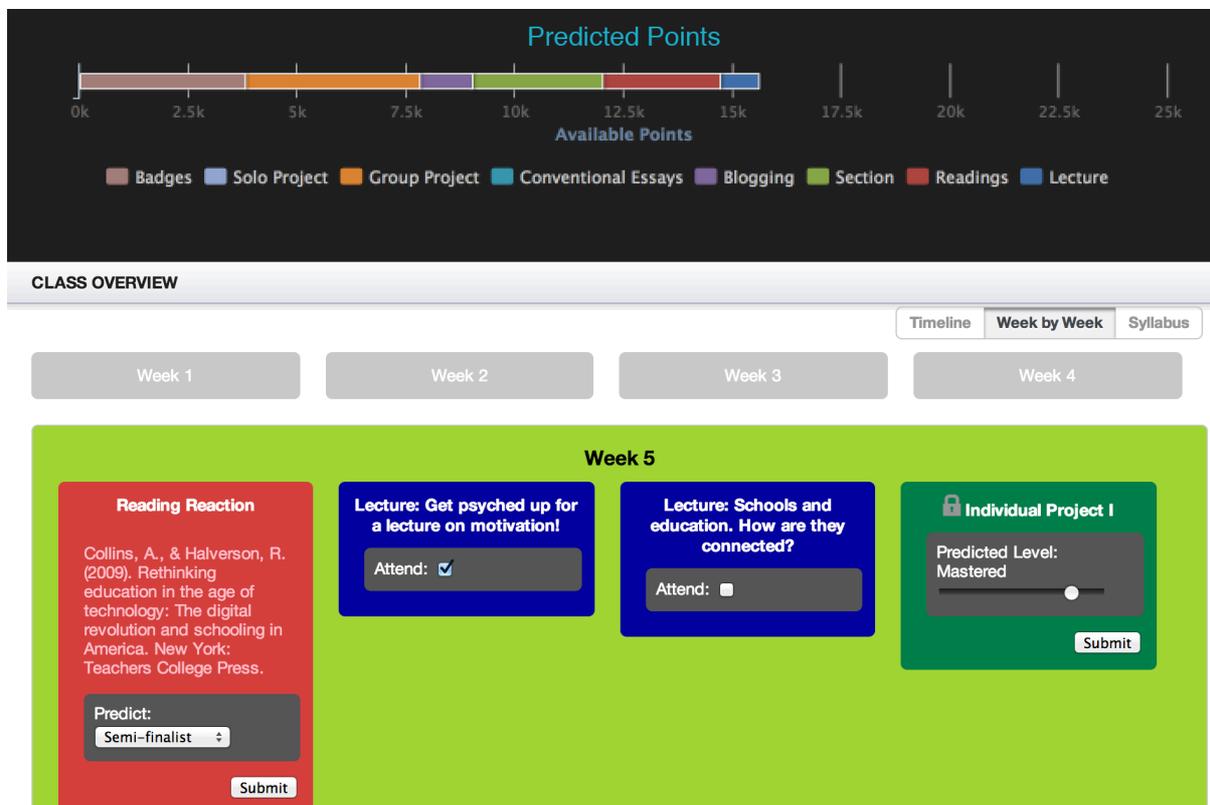


Figure 2: Panels showing student badges, learning objectives, and course grades

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 success—all 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, <http://timeline.verite.co/>) 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.

➔  
JANUARY 9,  
2014  
Lecture:  
Introduction to  
class and overview  
of syllabus and  
assignments.

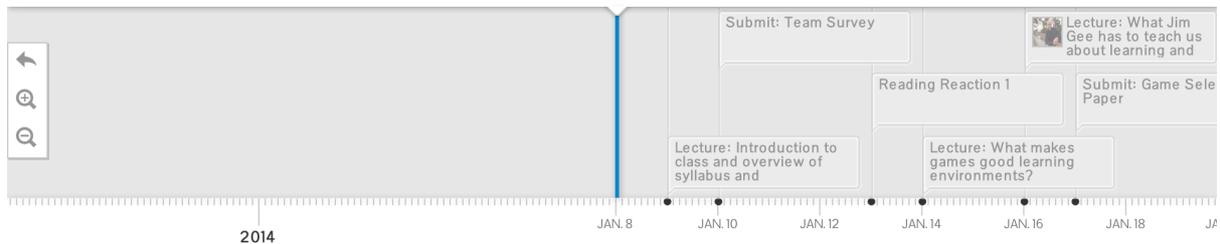


Figure 4: Interactive Semester Timeline

### 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.

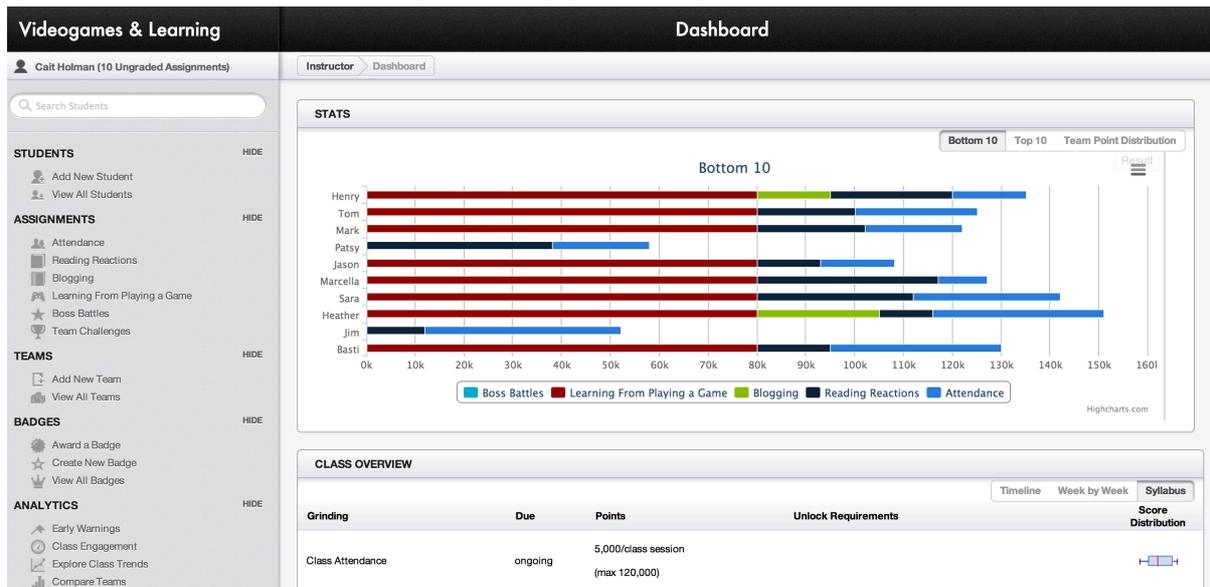


Figure 5: Instructor Dashboard

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.

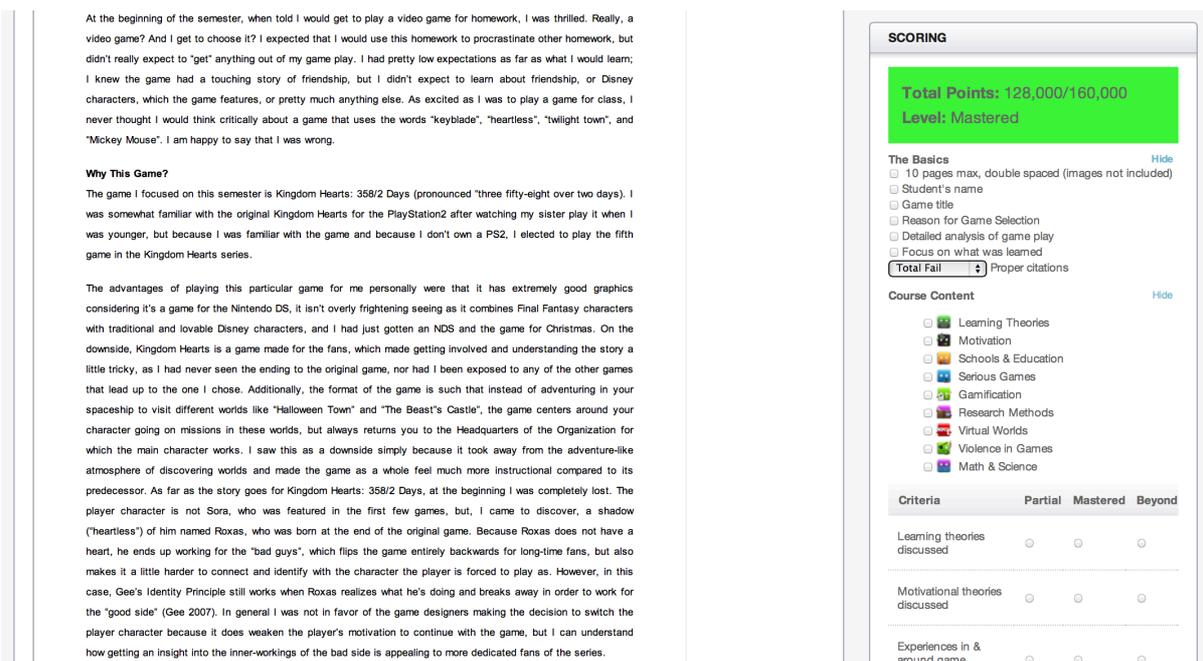


Figure 6: Rubric Grading Tool

## 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.

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