Leveling-Up: Evolving Game-Inspired University Course Design

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Abstract: The authors examine two iterations of a high-enrollment university political science course designed around motivational constructs found in video games. The idea of "leveling-up" is used as a driving metaphor to showcase the fact that both the course and the research design are an iterative process driven by improving and understanding student outcomes. Both the courses and the research design employed to understand them have evolved over two academic years. We demonstrate that positive effects on students' motivation to engage with coursework (and sense of control) remain robust across both iterations. We also employ social network analysis to understand how student networks form around how students learned to make sense of the grading system from each other.

Introduction

There has been a flurry of recent innovation driven by the desire to re-contextualize and operationalize various constructs inherent in (good) video game design to improve educational outcomes (e.g., Sheldon, 2012). Indeed, many of the features of well-designed video games that Gee has outlined—identity play and the formation of affinity groups, exploration in and of semiotic domains, support for risk-taking, amplification of input, support for practice and ongoing learning, on-demand and just-in-time information, multiple routes towards success (Gee, 2003)—are also features of well-designed learning environments. "Gamification," or game-inspired design, seeks to more directly leverage the mechanisms that make video games so motivating.

As education researchers and interventionists we are invested in this design process and are curious about whether or not game-inspired assessment systems change students' relationship to the class and promote a state of flow (Csikszentmihalyi, 2008). We wonder if game-inspired grading systems lead students to work harder and/or feel in more control over their grades. We also wonder if all students work harder, or just certain types of students (e.g., students such as those who tend to learn for learning's sake regardless of context).

To begin to answer these questions we examine a political science course taught at the University of Michigan. The professor of this course has experimented with implementing gameful elements to his course over the years, and has consequently modified his course over time. As researchers we have been involved in two iterations—or "levels"—of his course, and our research design has "leveled-up" as well. This paper outlines the development of this course as well as the research agenda deployed to understand it.

Specifically, we ask the following research questions:

(1) What is the relationship between students' motivation profiles and whether or not the grading system *encourages them to work harder*?

(2) What is the relationship between students' motivation profiles and whether or not they feel *more in control of their grades*?

(3) What is the relationship between students' motivation profiles and whether or not they *complete more assignments*?

(4) What is the relationship between students' motivation profiles and their perceived difficulty of *earning the grade they want*?

(5) What is the relationship between students' attitudes and engagement with the grading system and the rate at which they self-report selecting novel assignment types?

Questions one through four are addressed in both iterations of the course and will serve to show that results are replicable. Question five explores academic risk taking: an affordance of game-inspired course design and a desired outcome of university level courses in general. We also employ social-network analysis approaches to explore a sixth question:How do students make sense of a complex game-inspired grading system within and across their social networks?By employing social network analytic techniques, we give the "game" of the course a visual structure by identifying how players form informal knowledge partnerships, which allowed us to see how

the game played out.

Gaming Political Science

The professor of the political science course under examination wished to design a course that gave his students more autonomy over the ways they approached course content. To accomplish this, he presented students with four options (i.e., “pathways”) that could be tailored to their own individual preferences. While both iterations of the course operate similarly, we describe each version to highlight differences and ground further discussion.

Fall 2011: Expanding Student Choice to Increase Motivation (Level-1)

The grading system of the political science course gives students control over their final grade in two distinct ways. First, students must choose the *types* of assignments that make up 60% of their final grade. In so doing they complete two out of three types of assignments offered throughout the term: traditional essays, an open-ended group project, and posting and responding on the class blog. Second, students are given the freedom to determine how each of the individual assignments is *weighted* for the final course grade calculation. In order to “unlock” their ability to choose and weight their coursework, however, students are required to complete a quiz that assesses their understanding of the course’s grading system. Once this has occurred students can choose the path they will follow to complete the course. The remaining 40% of a student’s grade is traditional in that it consists of a core set of requirements: attendance (5%), “keeping up with the reading” (15%, assessed via quizzes and/or blogs), and “section,” which consists of attending discussion sections (20%). Figure 1 is an example of the grading system in action; Student “A” chose to give three of the four assignment types equal weight, while Student “B” chose to weigh the first essay more heavily (presumably because he perceives himself to be a good writer).

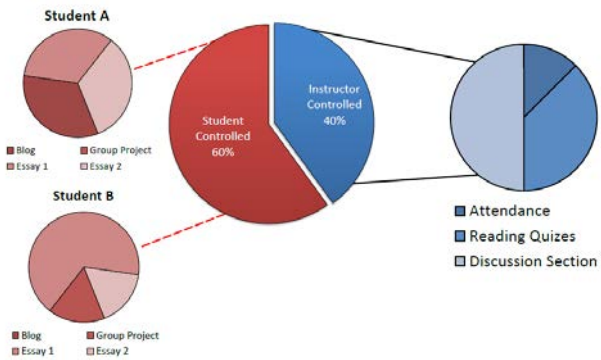

Figure 1: Fall 2011 possible course assignment configurations.

Fall 2012: Operationalizing Student Choices via Badges and LMS (Level-2)

In order to facilitate the added complexity, the professor of the political science course, in partnership with the authors, implemented *GradeCraft—a* Learning Management System (LMS) used to keep track of the various moving parts of the grading system. GradeCraft consisted of a grade book as well as features that allowed students to track and predict their desired grade. It also allowed for the inclusion of badges that were awarded to students for various accomplishments. (GradeCraft follows gameful design principles, but is not described in this paper for reasons of space.)

As with level-1, the level-2 version of the political science course assigned forty percent of students’ grade in the traditional manner. Students were again able to choose what types of assignments would make up the remaining sixty percent of their grade. The four assignment types, however, were slightly modified consisted of traditional essays, an open-ended group project, a “new media” individual project, and contributing to the class blog. Students were encouraged to work on two of the four assignment types, but are allowed to select any number. Students were again given the freedom to determine how each of the four assignment types was weighted. This decision was operationalized by giving students six points (called “Kapital”) to “spend” on any assignment type they wished. They spent their points through the LMS, and these points determined the weight of each assignment. A student could have, for example, assigned all six points to academic essays (Student “A” in Figure 2). Doing so would make essays six times as important as before. Any assignment type without at least one Kapital point lost half its value when calculating final course grades.

In order to recognize and/or incentivize certain behaviors, students were awarded badges. Cumulatively, these badges were valued at up to twenty-five percent of the total points possible, and thus served as de facto extra credit. Figure 2 shows two students with different "game plans" for succeeding in the course, and Table 1 summarizes key differences between the two iterations of the course:

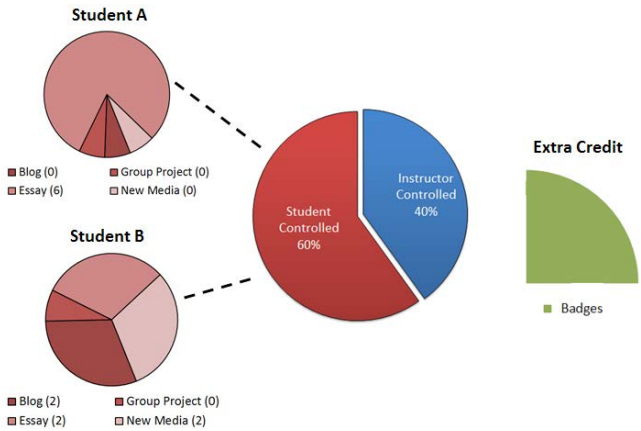

Figure 2: Badges serving as an additional gameful layer.

Level	Term Taught	Grading System Platform	Game-inspired Elements
1	Fall 2011	None (students manage themselves)	Assignment Choice, Assignment Weighting
2	Fall 2012	*LMS Supported*	Assignment Choice, Assignment Weighting, *Badges, Grade Predictor*

Table 1: Comparing levels 1 and 2.

Methodology

Data from both courses was gathered using online surveys administered in the final weeks of the term. The survey contained motivation and attitude items measured on a 5-point Likert scale. Academic Novelty and social network questions were only present in the Fall 2012 version of the survey. The entire survey took about 15 minutes to complete in each year.

Sample

For the Fall 2011 term there were 292 students enrolled, and 176 completed the survey, for a response rate of 60%; for the Fall 2012 term there were 299 students enrolled, and 232 completed the survey, for a response rate of 78%.

Measures

To measure student motivation we used the Patterns of Adaptive Learning Scales (PALS; Midgley et al., 2000). This instrument has been validated and used in multiple areas (Ames, 1992; Blumenfeld, 1992; Elliot & Harackiewicz, 1996), and produces scales that indicate a respondent's mastery goal orientation (MGO), performance-approach orientation (PA), performance-avoidance orientation (PV), and avoiding novelty (AN). An example item relating to MGO is: "One of my goals in this class is to learn as much as I can." An example item relating to PA is: "I want to do better than other students in my class." An example item relating to PV is: "It's very important that I don't look stupid in this class." An example item relating to AN is: "I prefer work as I have always done it, rather than trying something new." Each of the scales used in the survey was highly reliable (1).

Results

OLS regressions were used to test research questions one through five (Table 2). Results are promising and indicate that whether students "like" the grading system is positively related to whether they feel encouraged to work harder; their perceptions of their control over their final grade; whether students complete more assignments; and the ease with which students feel they can earn the grade they want. We note that these findings replicate observations from our previous work on this topic (Fishman & Aguilar, 2012).

	Fall 2011 (Level-1)			Fall 2012 (Level-2)		
	β	SE β	R^2	β	SE β	R^2
Encouragement of More Hard Work (2)			.591			.613
Intercept	.780	.344		1.10	.341	
Mastery Orientation	.182†	.093		.198**	.079	
Performance-Approach Orientation	.189	.132		.132	.093	
Performance-Avoid Orientation	-.091	.130		-.012	.092	
Interest in Class (3)	.101	.095		.054	.084	
"Liking" of Grading System (4)	.462***	.073		.494***	.054	
Control Over Final Grade (5)			.674			.668
Intercept	1.052	.324		1.749	.319	
Mastery Orientation	-.097	.087		-.014	.074	
Performance-Approach Orientation	.162	.124		-.122	.087	
Performance-Avoid Orientation	-.098	.122		.164*	.086	
Interest in Class[b]	.103	.090		-.054	.079	
"Liking" of Grading System[c]	.637***	.069		.637***	.050	
More Assignment Completion (6)			.495			.515
Intercept	.973	.385		.810	.379	
Mastery Orientation	.261***	.104		.129	.087	
Performance-Approach Orientation	.207	.147		.083	.103	
Performance-Avoid Orientation	-.052	.146		-.028	.102	
Interest in Class	.155	.107		.242**	.094	
"Liking" of Grading System	.276***	.082		.341***	.059	
Ease of Desired Grade Attainment (7)			.766			.547
Intercept	.763	.270		1.671		
Mastery Orientation	-.091	.072		-.023		
Performance-Approach Orientation	.174†	.103		-.056		
Performance-Avoid Orientation	-.056	.102		.085		
Interest in Class	.039	.075		-.090		
"Liking" of Grading System	.718***	.058		.561***		
Assignment Variation (8)						.546
Intercept				1.687	.383	
Mastery Orientation				-.020	.089	
Performance-Approach Orientation				-.052	.104	
Performance-Avoid Orientation				.083	.105	
Avoiding Novelty				-.001	.076	
Interest in Class				-.091	.094	
"Liking" of Grading System				.559***	.060	

*Note: *** = p< .001; **= p < .01; * = p <.05; †= p < .10*

Table 2: Replication across two iterations of the course.

We were also pleased to find preliminary support for the idea that if students like the grading system, that they will be more likely to try assignments that they may have otherwise avoided *regardless of incoming predisposition towards avoiding academic novelty*.

Grading System Help Network: Social Network Analysis

If the grading system, and whether or not students "like" it, is the mechanism that is at play with game-inspired courses, as our data suggests, then it is important to explore how information regarding the grading system is disseminated among students. To explore this question, we asked students to name other students they spoke with about the grading system, and using social network analysis tools (Csardi & Nepusz, 2006) created the representation shown in Figure 3.

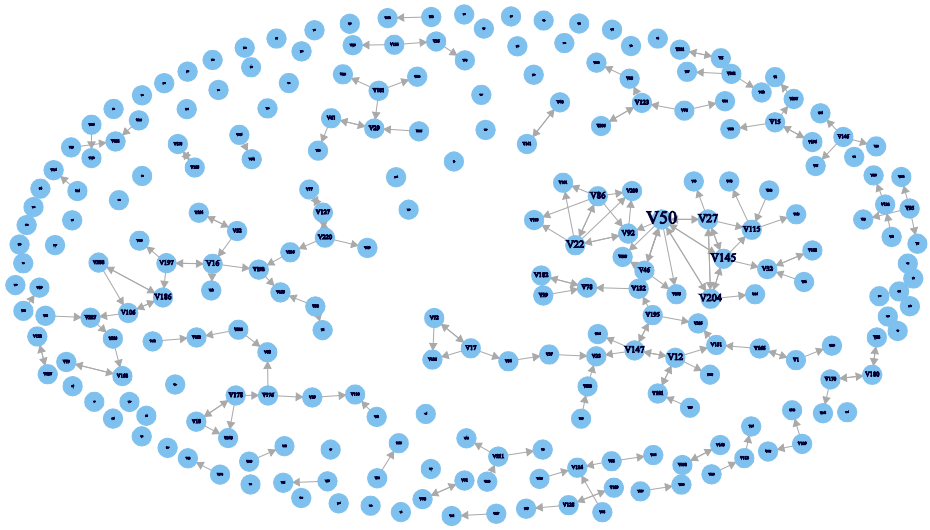

Figure 3: Fall 2012 Political Science grading system help network.

Initial social network analysis yielded a pattern of interaction that seemed dominated by solo students, and also contained a number of dyads and triads (Figure 3). One possibility for this pattern is that most of the students in the course were able to understand the grading system on their own, or were able to find one or two peers to help them make sense of it.

Upon closer inspection we also noticed evidence of two "sub-networks." Network A and Network B (Figure 4) are each characterized by different suggested behaviors across the actors of each network. Network A suggests a "daisy-chain" pattern of interaction that is not necessarily dominated by a central figure, but instead represents knowledge of the grading system moving from one person to one or two others, without establishing a hub of information. Network B, on the other hand suggests the opposite. Student V50 serves as a prominent node (due to being named multiple times compared to his or her peers) and is generally surrounded by other prominent nodes such as students V20, V145, and V27. Both sub-networks imply different ways that information about the grading system was disseminated.

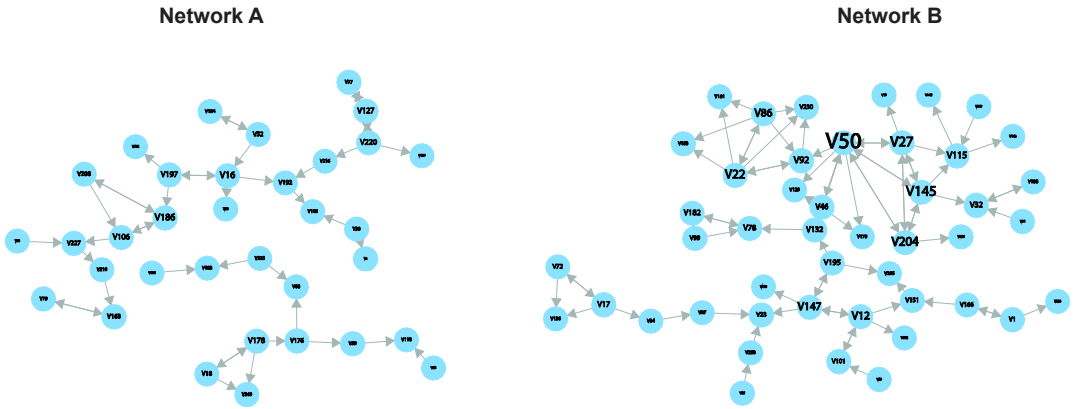

Figure 4: Fall 2012 grading system help sub-networks.

Which factors relate to how these sub-networks form? Logistic regression analysis suggests one possibility: Students were asked to identify the sources of information they used to make sense of the syllabus—which represented the only formal documentation of the grading system. Consequently, we infer that asking for help in understanding the syllabus serves as a reasonable proxy for asking for help with the grading system.

Results indicate that, after controlling for other possible sources of information (e.g., the syllabus itself or the professor), the Performance-Approach Orientation (PA) was the only factor that significantly predicted *students asking other students* for help with the grading system (Table 3). Since PA orientation revolves around public demonstration of competence this makes sense—asking for (and giving) help likely represents a desire to be publically competent when engaging with the grading system, which requires understanding it first. We reiterate, however, that these findings are preliminary and warrant further investigation.

	β	*SE β*	e^{β} *(odds ratio)*
Intercept	-.471	.347	.624
Controlling for other Sources of Information			
Syllabus	.144	.295	1.155
Professor	.018	.303	1.019
Graduate Student Instructor	.455	.356	1.576
Motivation Factors			
Mastery Orientation	.120	.149	1.127
Performance-Approach Orientation	.467*	.216	1.596
Performance-Avoid Orientation	-.349	.218	.705
Avoiding Novelty	-.088	.153	.915

*Note: **= p < .01; * = p <.05; †= p < .10*

Table 3: Students helping fellow students in understanding syllabus.

Implications

We are pleased that the second iteration of the political science grading system replicated results from the prior year (Fishman & Aguilar, 2012). This suggests that game-inspired grading system interventions can be robust over time. If true, then interventions such as this one can scale so that more students can feel a sense of control over their final course grade, as well as be motivated to work more and work *harder*. (For what's a good game if not one that makes you want to work hard to "beat it"?) Yet, games aren't simply about putting in time. They are also about having the freedom from failure to develop skills that might otherwise go underdeveloped. This is why we are happy to have collected evidence that suggests game-inspired grading systems support tolerance for academic novelty, regardless of the motivation profile a student enters the course with.

Further Study

Future research will ideally continue to add evidence to the notion that game-inspired grading systems are learning environments worth spreading because they encourage autonomy, lessen the risk of failure, and motivate students to work harder. Yet, we also recognize that these grading systems are just that, *systems* that unfold dynamically. In order to better understand them and what parts of them promote adaptive learning behavior we have taken an initial step towards exploring the underlying networks at play thanks to social network analysis techniques. While our data is preliminary, we hope make more sense of it over time. This is why we strive to push our methods as well as our design, so that our research may continue to level-up.

Endnotes

(1) Fall 2011 MGO α=.92, Fall 2012 MGO α=.87; Fall 2011 PA α=.88 Fall 2012 PA α=.89; Fall 2011 PV α=.80, Fall 2012 PV α=.81; Fall 2012 AN α=.73; Fall 2012 AN: α=.73.

(2) "The grading system encourages me to work harder than I would in a different kind of grading system"

(3) "I find this class interesting"

(4) "I like the grading system"

(5) “I have more control over my final course grade because of the grading system”

(6) “I do more assignments because of the grading system.”

(7) “I think it is much easier to earn the grade I want because of the grading system.”

(8) “The grading system encourages me to work on assignment types I would normally avoid.”

References

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*(3), 261-271.

Blumenfeld, P. (1992). Classroom learning and motivation: Clarifying and expanding goal theory. *Journal of Educational Psychology, 84*(3), 272-281.

Csikszentmihalyi, M. (2008). *Flow: The psychology of optimal experience* (P.S. Edition ed.). New York: Harper Perennial.

Csardi G, Nepusz T: The igraph software package for complex network research, InterJournal, Complex Systems 1695. 2006

Elliot, A. J., & Harackiewicz, J. M. (1996). Approach and avoidance achievement goals and intrinsic motivation: A mediational analysis. *Journal of Personality and Social Psychology, 70*(3), 461-475.

Fishman, B., & 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.

Gee, J. P. (2003). *What videogames have to teach us about learning and literacy*. New York: Palgrave Macmillan.

Midgley, C., Maehr, M. L., Hruda, L. Z., Anderman, E., Anderman, L., Freeman, K. E., . . . Urdan, T. (2000). Manual for the Patterns of Adaptive Learning Scales (PALS). Ann Arbor, MI: University of Michigan.

Sheldon, L. (2012). *The multiplayer classroom: Designing coursework as a game*. Boston, MA: Cengage Learning.

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