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Gamification as Design Thinking

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Gamification, which introduces game mechanics into a non-game setting, has been considered a potential way to improve student learning, motivation, and engagement. Empirical studies of gamification often focus on students' outcomes and/or their perceptions of the gamified system while giving less attention to the rationale behind the conceptualization and design process itself. This article uses gamification as a lens through which to re-imagine a learning environment, drawing on design thinking methods of problem solving. Design thinking is an approach to addressing "wicked problems" that do not have simple, right answers. By using gamification as a form of design thinking, this article explores ways that gamification can help instructors take apart and re-configure courses that are challenging to design, using a graduate-level online philosophy course as a worked example. Readers are provided the rationale behind the iterative prototypes and the culminating reflection of the process. The article concludes by arguing that gamification's contribution is not limited to student outcomes and that it can be also be used as an innovative approach to course design.

Game-based learning, gamification, and other game-inspired approaches to education bring together two strands of research that have made important contributions to learning and instruction in recent years: play and design. Neither of these are new areas of study, but the success of digital games has re-invigorated interest among educational researchers to find ways that play and/or design can be integrated meaningfully into learning environments. Of all the approaches to games and learning, gamification may be considered the most controversial (Deterding, Dixon, Khaled, & Nacke, 2011). While it has found success in the business, apps, fitness, entertainment, and digital gaming (Burke, 2014; Kapp, 2012; McGonigal, 2011; Zichermann & Cunningham, 2011), some have criticized this success as exploitation (Bogost, 2011; 2015) and an over-simplified approach to games and design (Robertson, 2010).

Gamification does not seem to have translated its success as a marketing tool to formal learning contexts, despite the fact that traditional classrooms already resemble gamified environments in many ways (de Byl, 2013). In higher education, gamification seems to have most measurable impact on student participation/attendance (Barata, Gama, Jorge, & Goncalves, 2013; Caton & Greenhill, 2014; O'Donovan, Gain, & Marais, 2013; Wiggins, 2016) and performance (Fanfarelli & McDaniel, 2017; Landers & Landers, 2014), but students' perceptions of gamification are mixed (Berkling & Thomas, 2013; Haaranen, Ihantola, Hakulinen, & Korhonen, 2014). It makes sense for empirical studies on gamification to focus on student gains. However, gamification might serve another, and arguably more useful, purpose. To the extent that a gamified class is carefully designed, the design itself is an object of interest, as it exposes the values, intentions and biases of the designer. The process of gamifying a class, in particular the decisions that go into what behaviors get rewarded or penalized, how the gamified system is presented, and how users are expected to interact, can be a useful feedback system for the designer/instructor and the students (Hung, 2017; Hung et al., 2017; Nicholson, 2015).

This article presents how design thinking and gamification were used to improve upon a difficult graduate level philosophy course. Design thinking is described as a way to approach ill-structured (Simon, 1973) or wicked problems (Buchanan, 1992; Rittel & Webber, 1973). Like gamification, it has been used in a variety of contexts, including architecture and urban planning (Rowe, 1987), business (Brown, R. L., 2009; Brown, T., 2009), social issues (Manzini, 2015), and education (Bereiter & Scardamalia, 2006; Carroll et al., 2010; Collins, Joseph, & Bielaczyc, 2004; Leinonen & Durall-Gazulla, 2014; Scardamalia & Bereiter, 2014). First, I provide an overview of design thinking and the steps involved in applying it to a class of problems known as ill-structured or wicked problems. Then I describe the particular problem I faced and how design thinking and gamification were applied to address the problem. Finally I discuss the results I gathered from the design process itself, what it revealed about my instructional practice as it was implemented and why I believe gamification, when combined with design thinking, can be a productive way of improving upon a course.

Literature Review

Design Thinking

Design thinking emerged in the 1960s and 1970s as a way of addressing problems brought on by an increasingly complex and technological society (Dorst, 2006; Stewart, 2011). Herbert Simon defined "ill-structured problems" (Simon, 1973; 1996) as problems that have incomplete information, unclear goals and boundaries, and tendencies to evolve over the course of problem-solving (Voss, 1988). For Simon (1996), design is part of any profession that involves "changing existing situations into preferred ones" (p. 111) and not

limited to the design material artifacts, but intellectual activity as well, such as the creation of a new policy or plan of action. Coming from a policy perspective, Rittel and Webber (1973) refer to "wicked problems" as indeterminate problems that have no clear formulations and that have no right or wrong solutions, only better or worse ones. However, they differ from Simon in that they see all wicked problems as unique and that there can be no truly scientific approach since there is no science of the particular (Buchanan, 1992).

Design thinking is seen as the best approach to address ill-structured or wicked problems. Although there are variations, most forms of design thinking include empathy, abductive reasoning, framing, and progressive refinement. Empathy is central to design thinking. Solutions are designed specifically to improve the lives of the humans involved in some way (Leinonen & Durall-Gazulla, 2014). Consequently, a starting point to design thinking is to observe, engage and involve those who are connected to and affected by the problem.

Deductive and inductive reasoning are suited for problems that have clear, identifiable parameters and/or for problems that have solutions with relatively predictable outcomes. In contrast, abductive reasoning is used when there is incomplete information (Burdick & Willis, 2011; Cross, 2006; Dorst, 2011; Louridas, 1999) and when the *only* known component is a desired outcome. In order to begin the actual work of designing, the designer has to first frame the problem, which is to articulate the perspective from which the designer would tackle the problem. In other words, "IF we look at the problem situation from this viewpoint, and adopt the working principle associated with that position, THEN we will create the value we are striving for" (Dorst, 2011, p. 525, emphasis in text). Framing is also an important part of "problem setting." Schön (1984) writes:

> When we set the problem, we select what we will treat as 'things' of the situation, we set boundaries of our attention to it, and we impose upon it a coherence which allows us to say what is wrong and in what directions the situations need to be changed. Problem setting is a process in which, interactively, we *name* the things to which we will attend and *frame* the context in which we will attend to them (p. 40, emphasis in text).

Once the problem has a frame, the designer can start prototyping and testing solutions through a process of progressive refinement, which involves continuing improvement on designs to be tested in the real world (Collins et al., 2004).

Design thinking entered education and educational research both as a research methodology (Barab & Squire, 2004; Brown, A. L., 1992; The Design-Based Research Collective, 2003; Collins et al., 2004) and a pedagogical approach. Design thinking complements constructivist approaches to learning, where learning is also seen as unpredictable and altered by new insights (Sheer, Noweski, & Meinel, 2012). Schön (1992) refers to teaching and learning as a "design transaction," during which the student and teacher should learn from one another through reciprocal reflection by understanding how things are interpreted from one another's perspectives. He even cites games as an example of how players take on different perspectives by understanding the rationale behind the moves of other players (Schön, 1992). His emphasis on the importance of reflective practice (1984, 1987) has also been influential in education. By reflecting-in-action, the practitioner is able to gain metacognitive awareness and perceive his/her intuitions and biases, test hypotheses, and take on new perspectives. The approach of having students learn by designing their own games combines design thinking and game-based learning (Kafai, 1995, 2006; Li, Lemieuz, Vandermeiden, & Nathoo, 2013). Design thinking also supports new forms of literacies brought on by new media technologies as well as game-based learning. Burdick and Willis (2011) cite the Quest to Learn School as an example of design thinking and digital literacies coming together to support learning and abductive problem solving in students. Similarly, Carroll et al. (2010) bring design thinking to middle schools to help teachers and students develop design thinking mindsets and skills such as human-centeredness, empathy, metacognitive awareness, prototyping, and collaboration. Finally, curricula planning are examples of wicked problems (Rittel & Webber, 1973). Each class is unique, not only in terms of content, but also the specific students in them. Teaching and educational innovations are usually not evaluated in terms of right and wrong, but better or worse solutions to particular problems.

Having given an overview of design thinking and its contributions to education and games, I now describe the wicked problem I faced and the way I applied design thinking, through gamification, to improve upon the class. The focus on the design process is informed by Schön's (1984, 1987) description of reflection as a process of revealing doubt and designing solutions to address them.

The Wicked Problem

"Philosophy of Technology" was a graduate level course in our program in educational technology and had been a difficult course for students in terms of connection. The readings were dense, and the topics were typically abstract. Our students came from a variety of backgrounds. Many of them were preparing to be, or already were, working as K-12 teachers.

Others were instructional designers in institutions of higher education. They were competent students who did well and enjoyed the challenge posed by other courses in the program. However, the philosophy course was designed to ensure that students also develop skills in reading challenging texts and discussing complex and controversial topics. Students also had to produce formal, academic writing that draws on various philosophical perspectives to make reasoned arguments, comparisons, and syntheses. The challenging readings, topics, and formal writing assignments were not activities I wanted to lose, dilute, or trivialize through gamification.

The course was a blended course that alternated weekly between face-to-face and online meetings. Our institution used Moodle as its learning management system (LMS), which supported the use of badges. However, in earlier attempts to use it, I had found Moodle's implementation of badges to be onerous and not a viable solution to this particular problem. This turned out to be a positive development because it forced me to turn to other solutions. Ideally, the solution would also work within Moodle. Since I already share a Google Sheet with each student, on which students can see their grades and rubrics associated with the assignments (see Hung, 2017), I did not want to add yet another site by using a third-party application or readily gamified platform. At the same time, I did not want the technical constraints and infrastructure to over-determine the basis of the solution.

Method

Different design studies present the procedures for design thinking in different ways, but they generally build on the fundamentals—empathy, abductive reasoning, framing, and progressive refinement—described above. I use the methods suggested by Stanford University's Institute of Design (n.d.) here for their straightforwardness. Their framework involves:

- Empathize: Focus on human-centered approach to design by observing, engaging, and understanding those who will be impacted
- Define: Frame the problem based on the observations collected and develop a point of view from which to approach the problem
- Ideate: Develop the design plan by "going wide" and using techniques such as mind-mapping, sketching and other methods of brainstorming
- Prototype: Start with a rough plan, storyboard, or sketch and start building
- Test: Test the design in the real world, and refine it over time

These steps are intended as guidelines, and not a strictly prescribed process.

Empathize and Define

In my case, the need to empathize with students was precisely the problem that needed to be resolved, so it makes sense to see them as the same step in the process. Since the class only had seven students, it provided an opportunity to start small and come up with solutions that can be sustainable and scalable to larger classes. I started first by talking to, and consulting with, instructors who have taught similar courses, including looking at how they structured their courses. I also accounted for the feedback that former and current students gave me from formal course evaluations and informal exchanges. Students were given a way to send me anonymous feedback while a course is in progress through polls and questionnaires distributed throughout the semester. Collectively, this was used as the basis for understanding students' needs and expectations and the starting point of where to start bridging their needs with the academic requirements and desired outcomes for the course.

Ideate

The next step was to brainstorm how the course should be improved. This involved generating a long list of desired outcomes. The process I used was to simply type down as fast as I could the ideas as came to me, without stopping until I was out of ideas. After the list was complete, I looked for patterns that emerged and color-coded them accordingly, noting points of overlap. Figure 1 shows the outcome of the process. What became clear was that the two areas that are the most common targets for gamification – showing up on time (attendance) and posting things on time – were no longer a high priority.

My teaching strategies already contain varying degrees of gamification. These include giving students choice in their assignment (when possible), giving them freedom to fail by letting them re-submit assignments an indefinite number of times until the end of the semester, and using a progress bar to display their growth over time (Hung, 2017; Dicheva, Dichev, Agre, & Angelova, 2015; Sheldon, 2011). The design I wanted to create was in addition to these strategies. Consequently, I also wanted to avoid over-complicating the course by adding too many layers to it. In my experience, students tend to spend less time on the LMS than I expect, so gamification works best if it is simple to figure out. This called for a visual solution. While I liked the visual appeal of the progress bar and the competitive element of a leaderboard, I wanted to avoid students feeling that their performances and failures were on public display. While public displays of competition may appeal to some students, others find it less motivational (Domínguez et al., 2013). The solution was to give all students a pseudonym that only

Figure 1
Desires outcomes for Philosophy of Technology

they and I would know. They were free to share it with one another if they wanted, but the publicity was not to be imposed upon them.

Prototype

The list generated from the brainstorming (Figure 1) served as the blueprint for the gamification design. The next step was to translate this into a set of variables that could be represented visually as a progress bar and/or leaderboard in some form. Google Sheets was the platform used to design the underlying mechanics, collect the data using Google Forms, and display the leaderboard as a live chart.

The prototyping proved to be the most difficult step because it involved transforming a series of qualitative criteria into a coherent system that could be quantified and measured. Like all wicked problems, the prototypes changed as I experimented with different features of Google Sheets. In total, the prototype went through eight iterations before finally arriving at a version that could be used for the course.

Table 1 summarizes the major developments in the iterations. The design itself is not original. The gamified system is made up of a set of categories and sub-categories that represent different student achievements, actions, and observations.

The main categories and sub-categories were described to the students, but the weights (Table 2) and how they were calculated were not. This was to avoid attempts to "game the system" by focusing only on what had the largest effect. This approach to gamification is more cumbersome and less exact than using countable, discrete elements. However, it had an unplanned, but desirable, outcome: it made me more aware of my classroom as a learning environment. Because I was more consciously monitoring for these achievements, I became more self-aware as an instructor as a result.

Results

The iterations described in Table 1 were tested with hypothetical students because the course had not yet started. By the time it began, the prototype was in a workable and reasonably sustainable condition. The students were introduced to the gamification and were told they were allowed to ignore it if gamification was not their preferred way of learning. A chart that was able to refresh data live was embedded into a website and linked as an external website from Moodle. It would have been better if the chart could be embedded directly into Moodle, but I had trouble getting the chart to update the data live at the time. Also 0n the external website was the list and description of the main categories and sub-categories.

Table 2
Weights of Main Categories and Sub-categories of Achievements

Main Categories		Sub-categories	
Self-guided Learning	25%	Looking up words/concepts	25%
		Taking risks in interpretation	25%
		Expressing uncertainty or ignorance	25%
		Going to additional sources	25%
		Total	100%
Connecting Ideas	20%	Connecting with technology	20%
		Connecting with self	20%
		Connecting with society	20%
		Connecting with texts	20%
		Connecting with history	20%
		Total	100%
Community Building	20%	Sharing ideas	20%
		Asking questions	20%
		Supporting classmates	20%
		Attendance and punctuality	20%
		Total	100%
Historical Thinking	15%	Understanding history of technologies	10%
		Understanding evolution of ideas	20%
		Understanding historical context	35%
		Connecting with history	35%
		Total	100%
Philosophical Thinking	20%	Understanding key ideas	15%
		Understanding perspectives	35%
		Connecting with texts	25%
		Identifying fallacies	15%
		Making meaningful critiques	10%
		Total	100%
Total	100%		

Table 1
Iterative Step in Design Thinking

Iteration	Major Developments	Notes
1	Played with major categories and sub-categories of achievements	Major categories and sub-categories draw on the major patterns that emerged from the brainstorming. I started with: *Rhetoric*, *Technology Pathway*, *Community*, *Class Participation*, and *Moodle Participation* as the main categories, each of which contained sub-categories. These will continue to be adjusted throughout the iterations. Note the initial emphasis on conventional targets for gamification such as participation.
2	Added "Dashboard" to centralize control and improve usability	The Dashboard is the main spreadsheet where I can test the balance and inter-relationships between the categories and sub-categories.
3	Played with "quests" as a concept	Quests were considered as a possible way to frame the leaderboard and what the students could compete for.
	Added adjusted averages as a mechanic	The adjusted average was added so that all the categories can be presented as a percentage instead of a raw number. This was done to improve how the categories could be compared and visualized.
4	Abandoned quest concept	The "quest" concept did not lead anywhere.
5	Revised categories	The major categories and sub-categories were revised again. Prior to this revision, some of the categories were still over-reliant on conventional, academic categories and did not draw enough on brainstormed themes. The revised categories were: *Self-guided Learning*, *Connecting Ideas*, *Community Building*, *Historical Thinking* and *Becoming a Philosopher*.
6	Started testing how data will be collected with Google Form and parsed in the spreadsheet	Testing began on the best way to collect information through Google Form and how that data would be analyzed on the spreadsheet. The plan was to create a form that I would use each time a student did something that I valued and wanted to acknowledge.
	Added additional competitive mechanic	An additional, competitive mechanic was added to change the way the scoring worked. Their scores were now calculated in relation to one another.
7-8	Improved ease of use	The form, spreadsheet, categories and visualization were finalized.
	Finalized categories	
	Cleaned up interface	

After the end of the first class, the students were emailed their pseudonyms. The students were told that the leaderboard would not be a direct reflection of their grades. Their academic writing, made up of three short papers and one extended paper, contributed to the largest portion of their final grades. While these papers also contributed to their leaderboard scores, most of the scores came from discussions in class and on Moodle, as well as more informal conversations held on a class-specific Slack channel, an instant messaging tool that allows for file-sharing and other application integrations. Each time I registered an instance of an achievement, for example, when I noticed a student taking risks or admitting having difficulties interpreting a reading, I used a Google Form to update the spreadsheet and leaderboard.

Figure 2 shows what the leaderboard looked like at the end of the semester. This was the student's view, which only displayed the main categories. Regardless of whether the leaderboard had any effect on the students, it became a useful diagnostic tool for myself to know my

own class, my students and the learning environment better. While it was somewhat cumbersome, it was not disruptively so, especially when compared to prior attempts at using badges on Moodle.

For me, the leaderboard communicated the strengths and weaknesses of each student more clearly. The discrepancies between the higher-ranked students (Cicero and Nietzsche) and the others can be explained by some of them being more active on Slack. All students in our program were asked to join Slack, and many already had accounts through their work. My class had its own channel as a third space for them to interact more informally and spontaneously. The channel became a vibrant place for conversation, such as when people shared links to news articles that related to topics from the class. Since the channel was open, other instructors and students were also able to join in the conversations. These conversations would not have been factored into their formal grades, but they could be acknowledged on the leaderboard. The students who had the lowest leaderboard scores were less active there.

Figure 3 shows an expanded view of the leaderboard that was not shared with the students. This was, in part, because it was a bit confusing and overwhelming to look at. Although I seldom looked at this myself, it did provide a way to take a deeper look at how the class was going, especially at the end of the course when I wanted to reflect on how the class went.

Discussion

The process of using design thinking with gamification provided me an opportunity to be a more reflective instructor during the design process, as well as during its implementation. It gave me insights into my own teaching, raising questions such as: Who was dominating the class? Who was I noticing more? Was I noticing or acknowledging one student too much or too little? In the remainder of this article, I argue that gamification and design thinking should be used together, and that gamification researchers can contribute to design research by making their gamification design process more explicit in order for all of us as a research community to learn.

Gamification and Design Thinking as Instructional Design

The main purpose of using gamification for this class was to improve on a class that many students have found challenging. Design thinking was used because it treats instructional design as a wicked problem (Buchanan, 2001; Rittel & Webber, 1973) with no right or wrong answers, only better or worse ones. A simple answer, such as making the readings and topics easier or lowering expectations would have been easier, but that would be to misidentify the problem. If learning by design is a good way to improve learning among students (Brown, A. L., 1992; Carroll et al., 2010; Kafai, 1995, 2006), then it should be a good way for us as instructors, instructional designers, and researchers to learn as well.

Figure 2
Student view of leaderboard

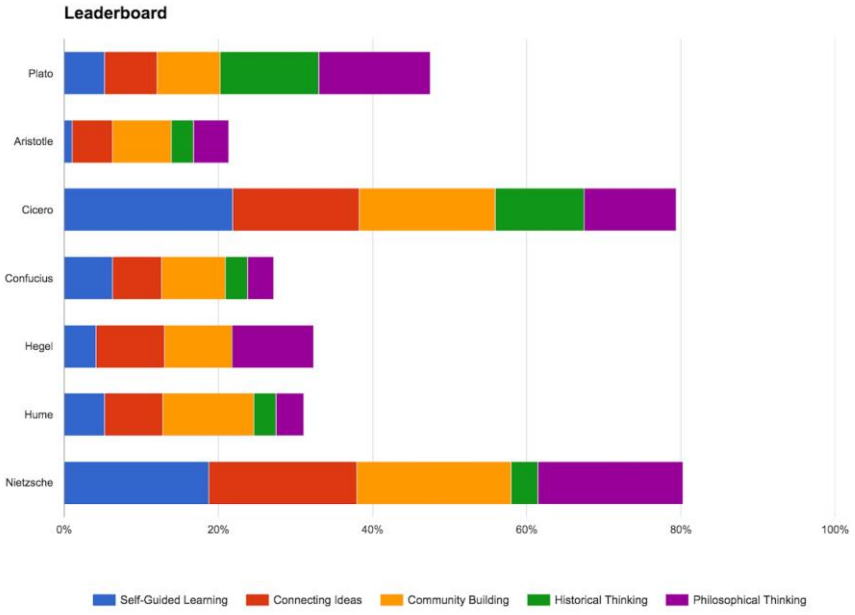
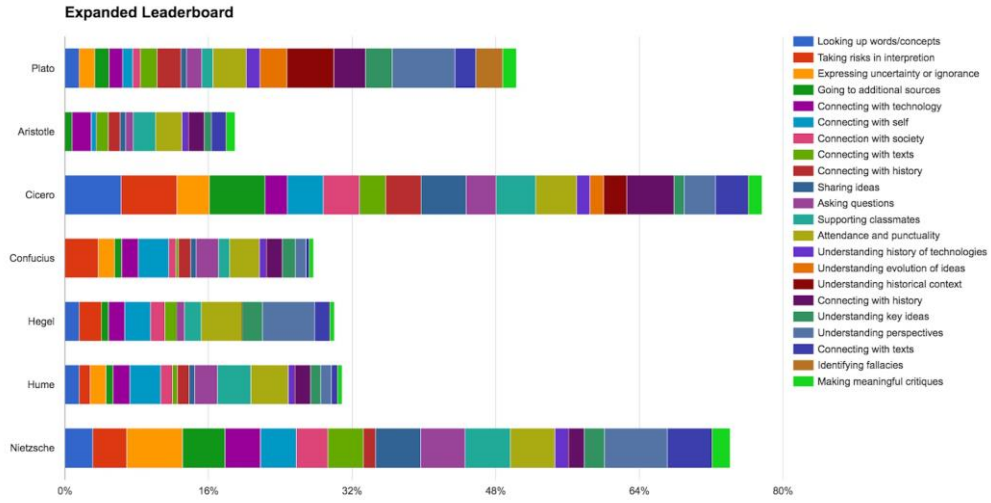


Figure 3
Expanded leaderboard view



It is likely that the effects of gamification cannot easily be measured satisfactorily through surveys of motivation, engagement, attendance, or grades because there are too many variables that could affect how students respond. Critics of gamification argue that it over-simplifies complex problems (Bogost, 2015; Robertson, 2010). However, both gamification and design thinking are approaches to problem-solving. With design thinking, gamification may be used in more meaningful ways because design thinking offers a different lens through which to conceptualize the problem.

Based on my reflections, as well as student assessments, the philosophy course went well, and the feedback was positive. (As a course that used to be the most dreaded course of the program, I considered this a move in the right direction!) The students enjoyed interacting with one another, and their strong "Community Building" leaderboard scores reflect that. However, I do not believe gamification alone improved the class; it was gamification and design thinking together. Since design thinking insists on the designer start with empathy, gamification was designed around the students and not around Moodle or a third-party application. This is not to suggest that technological concerns are not important, but it is to argue that technology should not be the starting point of the design. Learning, motivation, and engagement are about humans, not technologies.

Gamification may or may not have improved my students' experience directly. However, the design process did help me re-conceptualize the course and focus on different details. Design thinking also made what was abstract temporarily concrete. The patterns that emerged from the brainstorming (Figure 1) became the key categories and sub-categories for the achievements through the iterations (Table 1), which further solidified into numerical values (Table 2). Those values may seem arbitrary, but all game mechanics are arbitrary to some extent. They only lose their arbitrariness after the prototype has a chance to go through more tests and re-designs. Being able to visualize the students in their leaderboards also likely benefited me more than the students because it made me more conscious of the learning environment and the interactions within it. It made it easier to visualize what was or was not going well, and for whom. This not only helped me be more reflective, but it also provided the foundation for the next prototype.

Designing in the Open

This particular gamification design is clearly not going to work for much larger classes, and it was not intended to be a universal prototype. It was designed for this particular class in mind. As a community of researchers, we can learn more from one another if we made our design process more transparent, either through design thinking or through any other method that shows how the gamified curriculum came to be the way it is. Some questions that those interested in using gamification in education need to address are:

- What was the problem the design was trying to solve?
- Why did you choose to use a particular mechanic or set of mechanics?
- How did the design evolve?

- What was the rationale behind assigning those particular values to those particular mechanics?
- When and why did you change your mind?
- What does your design tell you about your teaching style?
- Where does the input for the gamified system come from and how accurately does it reflect what you are trying to capture in your design?

Designing in the open is uncomfortable because it exposes the entire system to scrutiny and criticism. However, I would argue it is more akin to the open source movement, except what is shared is not software code, but rather the design thinking process. While the finished product is interesting to talk about, the process that went into its design is arguably more important. This is almost never a focus in gamification research.

Conclusion

This article describes how design thinking and gamification were used to address the wicked problem of re-designing a graduate course in philosophy and technology. The goal is not to advocate for a specific approach to gamification, or even gamification in general. Instead, it is to show the rationale and procedures taken to arrive at the particular design. I argued that design thinking and its focus on empathy is a good way to improve gamification because it puts the users at the center, not the technology, LMS or game mechanic. I encourage gamification designers to share their design processes more openly in order for all of us to learn and understand their design decisions. Finally, I suggest that, while gamification may not impact students directly, it can help instructors improve their instructional design, especially if used with design thinking, and this, in turn, will be a benefit to the students.

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