Analysis of Gamification in Education

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ABSTRACT / INTRODUCTION

Gamification refers to the application of game dynamics, mechanics, and frameworks into non-game settings. Many educators have attempted, with varying degrees of success, to effectively utilize game dynamics to increase student motivation and achievement in the classroom. In an effort to better understand how gamification can effectively be utilized to this end, presented here is a review of existing literature on the subject as well as a case study on three different applications of gamification in the post-secondary setting. This analysis reveals that the underlying dynamics that make games engaging are largely already recognized and utilized in modern pedagogical practices, although under different designations. This provides some legitimacy to a practice that is sometimes dismissed as superficial, and also provides a way of formulating useful guidelines for those wishing to utilize the power of games to motivate student achievement.

RELATED WORK

The first step of this study was to review literature related to the use of gamification in education. This was undertaken in order to inform the subsequent case studies. Several works were reviewed with the intention of finding specific game dynamics that were met with a certain degree of success across a number of circumstances.

To begin, Jill Laster [10] provides a brief summary of the early findings of Lee Sheldon, an assistant professor at Indiana University at Bloomington and the author of *The Multiplayer Classroom: Designing Coursework as a Game* [16]. Here, Sheldon reports that the gamification of his class on multiplayer game design at Indiana University at Bloomington in 2010 was a success, with the average grade jumping a full letter grade from the previous year [10]. Sheldon gamified his class by renaming the performance of presentations as 'completing quests', taking tests as 'fighting monsters', writing papers as 'crafting', and receiving letter grades as 'gaining experience points'. In particular, he notes that changing the language around grades celebrates getting things right rather than punishing getting things wrong [10]. Although this is plausible, this example is included here first because it points to the common conception of what gamifying a classroom means: implementing game components by simply trading out the parlance of pedagogy for that of gaming culture.

Although its intentions are good, it is this reduction of game design to its surface characteristics that Elizabeth Lawley warns is detrimental to the successful gamification of a classroom [5]. Lawley, a professor of interactive games and media at the Rochester Institute of Technology (RIT), notes that when implemented properly, "gamification can help enrich educational experiences in a way that students will recognize and respond to" [5]. However, she warns that reducing the complexity of well designed games to their surface elements (i.e. badges and experience points) falls short of engaging students. She continues further, suggesting that beyond failing to engage, limiting the implementation of game dynamics to just the surface characteristics can actually damage existing interest and engagement [5]. Lawley is not suggesting that game elements should be avoided, but rather she is stressing the importance of allowing them to surface as part of a deeper implementation that includes the underlying foundations of good game design.

Upon reviewing the available literature, certain underlying dynamics and concepts found in game design are shown to be more consistently successful than others when applied to learning environments, these are:

- o   Freedom to Fail
- o   Rapid Feedback
- o   Progression
- o   Storytelling

Freedom to Fail

Game design often encourages players to experiment without fear of causing irreversible damage by giving them multiple lives, or allowing them to start again at the most recent 'checkpoint'. Incorporating this 'freedom to fail' into classroom design is noted to be an effective dynamic in increasing student engagement [7,9,11,15].

If students are encouraged to take risks and experiment, the focus is taken away from final results and re-centered on the process of learning instead. The effectiveness of this change in focus is recognized in modern pedagogy as shown in the increased use of formative assessment. Like the game dynamic of having the 'freedom to fail', formative assessment focuses on the process of learning rather than the end result by using assessment to inform subsequent lessons and separating assessment from grades whenever possible [17]. This can mean that the student is using ongoing self assessment, or that the teacher is using

ongoing assessment to inform their teaching or illustrate a point; all while eschewing concrete grades much of the time.

As Kapp notes, this doesn't mean letting students have four chances at a multiple choice question with four possible answers. What it means is "encouraging learners to explore content, take chances with their decision making, and be exposed to realistic consequences for making a wrong or poor decision" [9]. In line with the formative assessment model, this means incorporating student assessment that highlights useful lessons taught through the experience while subduing indelible marks or grades. Joey Lee and Jessica Hammer of Columbia University encourage teachers to "maintain this positive relationship with failure by making feedback cycles rapid and keeping the stakes low" [11]. This points to the next game dynamic of rapid feedback.

Rapid Feedback
As Kapp notes, "feedback is a critical element in learning. The more frequent and targeted the feedback, the more effective the learning" [9]. Frequent targeted feedback is highly prevalent in game design. James Gee notes that, "level design ensures players get lots of practice applying what they have learned [...] feedback is given moment by moment, and often summarily at the end of a level or in boss battles, which require players to integrate many of the separate skills they have picked up in prior battles with lesser enemies" [7].

Of course feedback is already a key element in education even without any attempts to integrate game design, but Kapp notes that educators can increase feedback mechanisms by harnessing elements of game design through "continual feedback to learners in the form of self-paced exercises, visual cues, frequent question-and-answer activities, a progress bar, or carefully placed comments by non-player characters [9]. The mention of a progress bar provides a good segue to the next game dynamic: progression.

Progression
Progression is seen throughout game design in the form of levels or missions. It is recognized in modern pedagogy as scaffolded instruction [8]. Beth Kemp Benson describes scaffolded learning as framing, guiding, and supporting students by organizing information into categories in order to focus attention. She notes that "this can eliminate or reduce the I-don't-know-how-to-get-started problem and allow the student to restart if he or she gets stopped or stumped" [2]. This speaks to 'the freedom to fail' dynamic mentioned previously, and mirrors the effectiveness of 'levels' in game design.

Progression can also be linked to the game dynamics of 'the interest curve' [9] and 'just in time teaching' [7,16]. The idea of the interest curve is that by purposefully sequencing events in a particular order, engagement is increased. For instance, when seeking to engage an audience, such as in public speaking or film, it is important to begin with a highly interesting element so as to grab the audience's attention. Further, it is important to grab attention at certain points so as not to lose their attention. These high and low points create a sequence known as an interest curve. Just in time teaching refers to the process of gathering assessment immediately prior to a lesson, so as to tailor the lesson to the specific needs of the students at that particular time. By consistently touching on points that are most relevant to the audience at the time of the lesson, not only is engagement increased, but students are better equipped with the tools to succeed. Kapp notes that these dynamics are effective because they "purposefully sequence events within the flow of the entire game to continually grab and hold the player's attention" [9].

Connie Hackathorn and Max Lieberman, two graduate students at The University of Arizona, found progression to be useful in their gamification of Prof. Wayne Brent's University of Arizona course *Teaching With Technology* [16]. Hackathorn and Lieberman used Bloom's taxonomy [3] as a guide in designing the course. Bloom's Taxonomy is a well established classification model of the different learning objectives that educators set for students. There are many objectives, ranging from remembering facts to analyzing and applying concepts and making connections between concepts.

Hackathorn and Lieberman used Bloom's Taxonomy as a guide in designing the progression of the course which required students to complete a level or assignment satisfactorily before being able to progress to the next. They did this by incorporating lower order thinking skills into the first stages (identifying, remembering, understanding), progressing to higher order thinking skills in subsequent levels (analyzing, evaluating, critiquing, summarizing) and finally arriving at the highest order thinking skills in the final levels (composing, creating, designing, planning, inventing) [16]. This is an intelligent design because the students will need the knowledge they gained in earlier stages to successfully complete the higher levels. As noted by Gee previously, this a key element in games that requires "players to integrate many of the separate skills they have picked up in prior battles with lesser enemies" [7] and apply them to 'boss battles'.

Storytelling
Another aspect of game design that can positively impact learning in the classroom is the use of storytelling and narrative. As Kapp notes, most games employ some type of story. SimCity tells the story of building a city from the ground up, Monopoly tells the story of becoming rich through property ownership at the risk of losing it all [9]. He also notes that "people learn facts better when the facts are embedded in a story rather than in a bulleted list" [9], and provides a good example of how even a simple integration of storytelling can be utilized to good effect.

His example begins with a class that unfolds in a typical matter, with the introduction of terminology followed by an explanation of concepts, a description of a model and case study, and finally a quiz. He then offers an example of how the use of storytelling might change how the class unfolds:

> As soon as Mary walks into the classroom, she is given a role and told, "An employee sends you an email saying he suspects a co-worker has embezzled $10,000. What is the first thing you need to do?" As Mary describes her actions to the instructor, the instructor provides feedback, corrects misconceptions, uses appropriate terminology, and then gives Mary and her classmates the next part of the story..."   [9]

Providing a unifying story throughout a curriculum can put the learning elements into a realistic context in which actions and tasks can be practiced, something that is considered extremely effective in increasing student engagement and motivation [6,9,15].

These game dynamics of the Freedom to Fail, Rapid Feedback, Progression, and Storytelling are elements that an educator interested in harnessing the effectiveness of games would be smart to focus on as they are shown to be grounded in proven pedagogical practices. Therefore, they are brought forward here as a way of performing the following case studies.

CASE STUDIES

These case studies evaluate the effectiveness of gamification in three instances of gamified educational endeavors in order to identify key aspects and provide some guidelines for best practice. This was done by reviewing course web pages, journal submissions, video interviews, online articles, and student work. For Case Study 3, discussions with the course instructor, as well as a review of previous iterations of the course, were undertaken as well.

This study was done through the lens of the literature review; the four dynamics and concepts mentioned previously (Freedom to Fail, Rapid Feedback, Progression, Storytelling) were used as a framework for evaluating these three cases. In some instances these concepts are recognized verbatim, in other cases where a similar concept is discussed under a different guise, the parallel concept will be noted in parentheses. During this study, other gaming dynamics and concepts were uncovered and are included here as well.

CASE 1: INTRO TO INFORMATION STUDIES

Professor Clifford Lampe is an Assistant Professor at the School of Information at the University of Michigan. Lampe utilizes gamification principles in his 200-student lecture class titled UMSI 110 - Introduction to Information Studies. Lampe identifies four elements of gaming in particular as being effective in his classes: Choice (Freedom to Fail), Rapid Feedback, Collaborative Processes, and Competition [14].

Evidence of Choice (Freedom to Fail)

Lampe notes that one of the most effective attributes for engagement in video games is that users get to choose their path through the game. He integrates this feature into his class by allowing students options for how to play out their assignments. At the beginning of the semester, students create a 'quest log' which requires them to select which of the possible future quests they will be more likely to participate in. Students are able to drop quests that they are not interested in. Further, Lampe also integrates the 'leveling' of assignments, where a higher level assignment is not available to the student until it has been 'unlocked' by completing a lower level assignment [14].

Evidence of Rapid Feedback

Lampe states that he has mechanisms built in to the class that give students rapid feedback, however it is unclear what these are. He does note that providing rapid feedback and having such a wide variety of assignments causes a large increase in work load for both himself and the teaching assistants. To combat this, he has one TA dedicated to making sure that the students have their assignments and know what quests they are participating in, and that feedback is given in a timely fashion. This TA is called the "grades master", and their role as full time feedback assistant is integral to having feedback mechanisms working efficiently enough to reflect gaming feedback sufficiently [14]. This is problematic for typical teaching situations where such a resource is not available.

Lampe also notes that feedback from students, particularly course feedback, is increased as a result of the playful atmosphere that gamifying a classroom causes. It seems students are less timid to be a part of the improvement process because the course is transparently experimental [14].

Evidence of Collaborative Processes

Collaboration is heavily embedded in the course. Lampe's students participate in guilds and guild quests, which encourages peer collaboration. Based on limited information, it is difficult to decipher whether or not this is simply a renaming of group work. What is clear is that the guild is the same group throughout the semester, they participate in all discussions together, and they produce a team assignment once in the semester [14].

Evidence of Competition

Lampe integrates Live Action Role Play (LARP) into the curriculum. He goes so far as to have students dress up as a character of their choice and 'battle' in class against one another, showcasing their knowledge of different concepts covered in the course (*Fig. 1*).
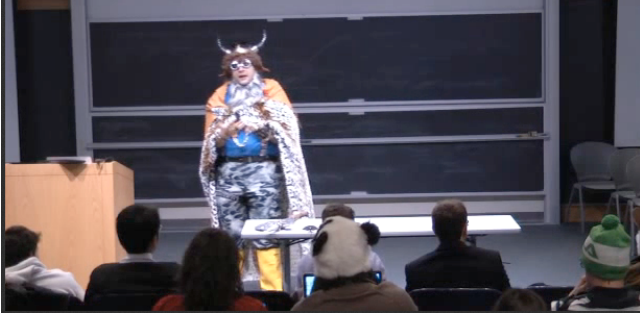
Fig. 1

The 'head-to-head' nature of this role play element relies on competition as a key motivator. It also provides students with a valuable alternative way to showcase their comprehension [14]. Lampe notes that the students react in different ways to this element of the course. There are those who feel that it is cheesy at best, and at its worst condescending. However, Lampe notes that the vast majority of students are happy to have anything implemented that cuts down on the 3 hours of 'being talked at' that they are accustomed to. This speaks to the importance of differentiated instruction. Especially in a class of this size, it is impossible to please every student with every lesson all of the time. However, by utilizing a variety of techniques, not relying too heavily on any one style, and being flexible enough to tweak things when necessary, experimental techniques can be implemented with less risk and more investment from students.

Taking chances is what learning is all about, and if the implementation of these techniques is being driven by the desire to make a better learning environment, students will pick up on that and student investment will increase. With this in mind, it is important then to see and convey that the course design is an iterative process, something that relies heavily on the ability to collect and implement feedback from students.

Other Findings

Lampe also notes that students appear to retain information better over the long term when it is associated with 'shock value'. Because students remember the experience, they remember much of the information associated with it [14].

CASE 2: JUST PRESS PLAY

Just Press Play (JPP) is a real world game developed at the Rochester Institute of Technology (RIT). It is not a specific class, rather a 'gaming layer' that students engage with in and around their academic classes. It is offered to the more than 400 students in the School of Interactive Games and Media at RIT. Rather than focusing specifically on academic achievement, the game instead encourages the positive social behaviours that lead to academic success. These include making personal connections with faculty and with students in other years, proposing ideas for course design, attending workshops, and many more. The guiding aim of the game is to increase student engagement in University life for the sake of academic and social success [13].

JPP also aims to help students recognize and be recognized for their own personal achievements, be it social or academic, which can in-turn provide them with real world benefit as it allows them to show evidence of their learning, skills, and achievements to interested parties, such as potential employers [13].

Fig. 2

Achievement cards (*Fig. 2*) are physical cards, similar in size to trading cards, and are embedded with radio-frequency identification (RFID) and secret codes, which allow students and/or faculty to record achievements. These achievements are then uploaded to the online component of the game (*Fig. 3*) students can track their progress and compare their success to the community of players.

Fig. 3

Evidence of the 'Freedom to Fail'
The game has nothing to do with grades, and can be played by students over their entire career at the University and even after graduation. By separating the achievements from grades, students are free to engage with the game aspects of their choosing, without fear of reprimand. This encourages exploration and risk taking, two elements that effectively utilize this key dynamic in game design [13].

Evidence of Rapid Feedback
By utilizing RFID and codes, feedback is instant in the case of unlocking achievements. Another example of instant feedback can be seen in the achievements that require visiting a professor at their office or going to a conference (*Fig. 4*). In these cases the student instantly gains the benefit of beginning a relationship with their professors and network which decreases anxiety in approaching them for subsequent needs.
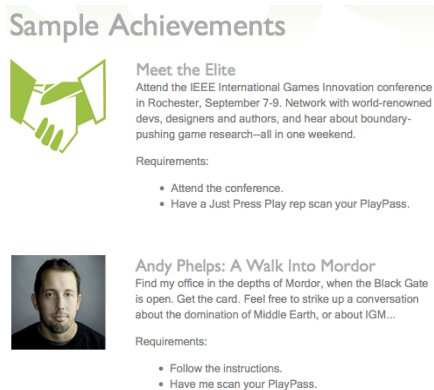

Fig. 4

The case of increased workload often associated with increased demand for rapid feedback is largely avoided because the work has been done in advance through the development of the system. It should be noted however, that faculty time is taken up by being available to scan codes and assist players.

Evidence of Storytelling
JPP includes good use of storytelling. When certain achievements are unlocked, students gain access to more parts of a fictional 'alternate history of RIT' that describes a battle fought between two rival factions. These rivals are based on the split between the real world faculties of Art and Engineering. The story represents the need to embrace aspects of both sides in order to achieve mastery.

Evidence of Progression
JPP has strong evidence of the use of progression. Players involved in JPP 'level up' to unlock new achievements that were not previously available. Further, progress is visually represented, through the online platform, in real time. On the online platform, students can also compare their progress over time and to other players in the game.

CASE 3: SPECULATIVE DESIGN
Dr. Carman Neustaedter is an Assistant Professor at the School of Interactive Arts & Technology at Simon Fraser University. He utilizes gamification principles in his course of approximately 70 students titled IAT 431 - Speculative Design. An examination of this class shows evidence of Freedom to Fail, Rapid Feedback, Progression, and Storytelling to varying degrees.

Evidence of the 'Freedom to Fail'
Evidence of the 'freedom to fail' dynamic is found through the emphasis of user feedback and student reflection in the final project. By incorporating feedback collection and reflection into the final project design, it is implied that the design process is an ongoing cycle, and that errors are useful (so long as they are reflected upon and utilized for further iterations). Language such as 'prototype' and 'low-fidelity' further strengthen this message.

Further evidence of the freedom to fail is given in the first week 'riddle question' which is transparently separate from grading. In the description of the task, it is stated that the first week submission is not graded, but feedback is given so that expectations are clear for subsequent submissions. This appears to be a good balance, as any drop in student motivation to complete the task is offset by the benefit of knowing the marking style of the professor.

Neustaedter is considering changing the sequence of assignments in future semesters in order to incorporate more of the freedom to fail dynamic. Rather than have the curriculum work towards a final project, the project would be pushed to the beginning of the course (and the grade weighting lessened) in an attempt to provide students with a frame of reference for subsequent activities. Subsequent activities would incorporate reflection and reiteration. In this case, the emphasis would be on learning from one's mistakes, therefore incorporating more of the 'freedom to fail' dynamic.

Evidence of Rapid Feedback
Evidence of rapid feedback in Neustaedter's course is most apparent in the use of a course score board (*Fig. 5*), which is available to the students through the course website.

The scoreboard shows a ranked-order list with the student's rank highlighted in orange. This scoreboard effectively shows the students how they are doing overall. Further, it shows how individual assignments have affected their overall score, because they are able to recognize any change in their rank both visually and numerically as a result of their latest submission. This ability to see changes visually as a result of their work provides an important cause and effect cue that can lead to increased ownership and sense of responsibility.

Fig. 5

Also, the use of graded rank titles, such as 'artistic intern' or 'grand master speculative designer', ties the course's content to its broader industry and career connections; something that can also lead to increased motivation.

It is important to note that the effectiveness of this scoreboard is not solely a result of the use of points. Had Neustaedter opted to use the traditional grading mechanisms of letter grades or percentages, the effect in this area would likely have been the same. As noted by Lawley earlier, it is the *underlying* dynamics of games that are effective, not the surface elements. This scoreboard does a good job of increasing motivation because achievement is tied to future opportunity as much as past results. Where a 'B' student might be satisfied with their current mark and leave it at that, a student that is a mere 50 XP from the student in front of them might be more motivated to put in the extra effort on the next assignment.

Letter grades seem to imply a certain finality, but the use of points in combination with a feedback mechanism such as a scoreboard imply that making it further up towards the top of the board is often still a possibility. This implied message is given here through the use of a dynamic scoreboard, not the use of points in and of themselves.

Another important feature is that it also shows their status in comparison to the other members of the class, sparking healthy competition which can lead to increased motivation.

Further evidence of rapid feedback is found in that selected answers from the weekly 'riddle' questions are showcased in class. This is an efficient method of providing feedback and

has the further benefit of allowing for the 'just in time teaching' concept discussed earlier. The teacher is able to modify the day's lesson based on the responses from the riddle questions. If the submissions show significant misunderstanding on a particular concept, the teacher can choose to change the focus of the next lesson in order to address the issue.

Evidence of Progression
Evidence of progression is most evident in the online course website. Here students are given visual clues as to where they are currently situated in the course curriculum (*Fig. 6*).

Fig. 6

There is also use of progression evident in the online submission of weekly 'riddle questions' which students gain access to as the weeks progress. These are discussed in more detail in the next section 'Evidence of Storytelling'.

Evidence of Storytelling
Evidence of storytelling is apparent in this course in several ways. One is in the form of the student as protagonist, working their way from 'Usability Intern' through 18 other designations before reaching the top designation of 'Grand Master Speculative Designer'. This provides students with a sense that the skills and concepts learned during this course have practical use in their future endeavors in the field.

Although it has been removed from the course in recent semesters, Neustaedter had previously incorporated storytelling in the course through a kidnapping mystery. This was done using a progression where students were given a new clue each time they reached a new XP level. The clue was a keyword that could be entered online to reveal a photograph (*Fig. 7*).
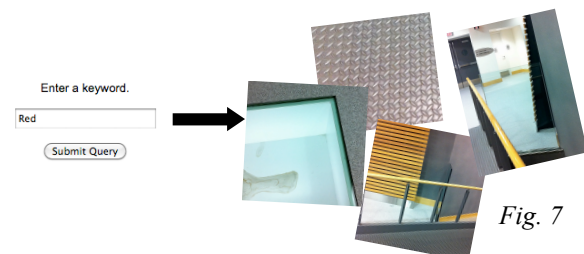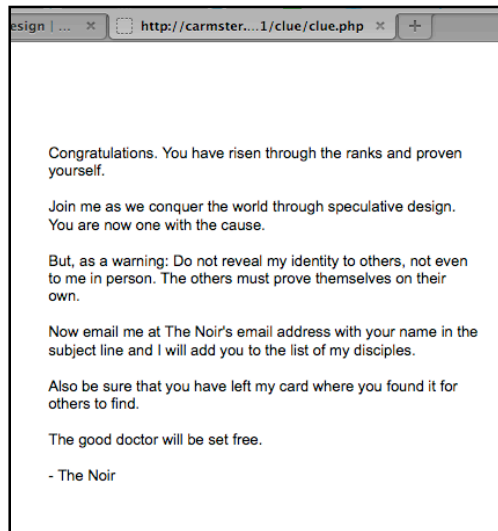

Fig. 7

These photographic clues eventually pointed to a specific location on campus where a business card was hidden that had the final keyword. When this final keyword was inputted into the online form, the identity of the kidnapper would be revealed (*Fig. 8*).

Fig. 8

Neustaedter notes that he removed this element from the course as he suspected that it came across as 'cheesy'. If students found this element to be cheesy, it was likely because the reward of finding the mystery kidnapper was not attached to any real benefit like actual underlying grades or the unearthing of useful knowledge. The XP points were, in the end, attached to real world grades. This lack of student engagement was also likely because this mystery was too far removed from course content. This points to the important consideration of context when implementing game dynamics in an educational setting, which is discussed in the conclusion that follows.

Further use of storytelling is evident in that IAT 431 requires students to perform a 'real world' implementation of their final project by having them perform a deployment of their project in a field scenario, much like a professional speculative designer would. This incorporation of a scenario-based activity provides a powerful bridge between classroom theory and real world application.

CONCLUSION
These three case studies are useful in seeing how theoretical 'best practices' in the gamification of education are extremely context sensitive. There is no once-size-fits all model for the successful gamification of a classroom. As noted by Andrew Phelps, Professor and Founding Director of the School of Interactive Games and Media at RIT, "the tricky part, and the part that is ultimately at the core of the experience, is identifying intrinsic rewards relative to the culture of the local community that one is seeking to engage, and building game-like interactions on top of those. [4].

An educator interested in harnessing the dynamics that underlie games would be well served by a focus on the game dynamics mentioned above (Freedom to Fail, Rapid Feedback, Progression, Storytelling) as they are seen to prove successful to some degree throughout the literature. However, the choice of which to employ and which to eschew can only be made by those within this context. As was seen in the case studies, methods that may work well in one context are not guaranteed to work well in another.

However, one common thread found throughout successful game dynamics is that they all work to increase a feeling of agency and ownership in the user. As Gee notes, "in a video game, players make things happen; they don't just consume what the [game designer] has placed before them [...] their choices matter" [6]. What also becomes evident is that the underlying dynamics that make games engaging are also recognized in modern pedagogy, although under different labels.

The freedom to fail concept in games has direct links to the concept of formative assessment in pedagogy; both incorporate ongoing assessment and feedback that is separated from permanent marks or grades. Rapid feedback in games has direct links to formative assessment in the same way. The concept of acutely designed progression in games has direct links to the concept of scaffolded learning in pedagogy; both structure learning in carefully planned increments in order to increase engagement and subdue feelings of helplessness and disorientation. Storytelling, although more prevalent in gaming culture, is also recognized as a powerful tool in the classroom.

What this leads to is the notion that a good teacher already utilizes the power of game dynamics, whether they know it or not. This isn't to say that gamification is a moot point, on the contrary it shows that its use can be a powerful tool in guiding the process of teaching to good effect. By utilizing gamification carefully, teachers can direct their classroom environment towards success in raising both engagement and achievement. As with any pedagogical framework, an educator must be careful to consider the context in which they are teaching: who their students are, and what the shared goals of the class are. When these are considered, and the educator gives themselves the freedom to fail, gamification of the classroom can lead to increased student engagement and success. At the very least all involved can learn from the process, and isn't that what education is all about?

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