Gamification in Education: A Literature Review

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Abstract

This paper seeks to explain the growing phenomena of integrating gamification into education through a literature review of relevant work and to provide educators insight into how to integrate gamification principles into existing curriculum. Section 2, Gamification 101, provides a more detailed survey of many of the characteristics and concepts associated with gamification. Section 3, Effectiveness of Gamification, presents a survey of existing research into the actual effectiveness of gamification – vice the perceived benefit of replicating the addictive behavior demonstrated by the person intent on clearing level 9 of Candy Crush. Section 4, Examples of Gamification in Education, introduces case studies from existing research that explore existing programs integrating gamification principles into education. Section 5, Approaches for integrating Gamification into education, provides a survey of best practices presented in existing literature for integrating the concepts of gamification effectively into existing curriculum. This paper finds that gamification can be integrated effectively into education to motivate students and enhance learning. However, effectively integrating gamification into education demands a thoughtful analysis of the students involved, the course material and learning objectives, the holistic structure of the learning experience, then consideration of what specific elements and mechanisms will most effectively guide the student through a meaningful learning experience.
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1. Introduction

The power of even the simplest games should be both awe inspiring and infuriating to most teachers. They are awe inspiring because games like Angry Birds, Candy Crush, and countless others can captivate people of all ages to play for hours and hours for apparently no reason other than reaching the next level or achieving some arbitrary rank or status that has no real value to the player or society. They are infuriating because many teachers spend similar hours and hours trying to find way to motivate their students to spend even a fraction of that time studying subjects that do matter. The problem is that standard lessons are considered boring and ineffective by some students and while many teachers seek innovative ways to motivate their students, they find it difficult to connect in a meaningful way.1

One approach many teachers are now pursuing is known as gamification. In fact, gamification has recently been used in multiple applications from promoting learning to employee performance, customer engagement, and even crowdsourcing initiatives.2 In education, gamification refers to using elements common in games in education. There are some obvious overlap between games and the classroom that makes gamification of curriculum a logical approach: in games players work to achieve specific goals and win, in the classroom students work to achieve specific learning objectives and do well academically; in games players progress from level to level based on performance, in the classroom students must pass prerequisite courses and show some level of understanding before progressing academically.3

Gamification is becoming more prevalent in education because of its perceived ability to motivate students and thus enhance the learning process.4 However, this is really not a new concept, as Dicheva, et al, discuss in their article “Gamification in Education: A Systematic Mapping Study” (2015), “badges and ranks have been long used in the military, in the early Soviet era, game elements were used by the Soviet Union leaders as a substitute for monetary incentives for performing at work, etc.”5 Huang and Soman (2013) assert that the trend is increasing for two significant reasons: it resonates more directly with today’s “digital generation” and “[i]n real life, individuals do not feel that they are as good as they are in games. When confronted with obstacles, people may feel depressed, overwhelmed, frustrated or cynical; feelings that are not present in the gaming environment. They also prefer instant gratification to keep themselves engaged and motivated.”6 In their own literature review of gamification in education, Caponetto, et al., confirmed the increasing interest in gamification in education by using Google Scholar

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4 Caponetto, et al., 50.
5 Dicheva, et al., 75.
to relevant identify scientific documents. Their findings, in Figure 1, showed a continual increase from 2011 to 2013 with incomplete data for 2014.

![Number of scientific works published annually](image)

**Figure 1**: Annual distribution of papers mentioning gamification and education

This paper seeks to explain this growing phenomena through a literature review of relevant work and potentially provide educators insight into how to integrate gamification principles into existing curriculum. Section 2, Gamification 101, provides a more detailed survey of many of the characteristics and concepts associated with gamification. Section 3, Effectiveness of Gamification, presents a survey of existing research into the actual effectiveness of gamification – vice the perceived benefit of replicating the addictive behavior demonstrated by the person intent on clearing level 9 of Candy Crush. Section 4, Examples of Gamification in Education, introduces case studies from existing research that explore existing programs integrating gamification principles into education. Section 5, Approaches for integrating Gamification into education, provides a survey of best practices presented in existing literature for integrating the concepts of gamification effectively into existing curriculum.

2. Gamification 101

2.1. Categories of Gaming

When discussing the use of games or gaming concepts in education, at least four categories emerge in the literature.

- Gamification: As the focus of this literature review, gamification involves the use of game-game design elements and mechanisms into non-game context. Generally, this
includes elements such as “rewards, leader boards, badges, levels, trophies, among others.” 7

- Game-based learning: The use of actual games in the classroom to reinforce course concepts and enhance the learning and teaching experience. 8

- Serious games: “Serious games are games designed for a specific purpose related to training, not just for fun. They possess all game elements, they look like games, but their objective is to achieve something that is predetermined.” 9

- Simulations: “Simulations are similar to serious games, but they simulate real-world things and their purpose is user training in an environment resembling real life.” 10

2.2. Characteristics of Gamification

Gamification, as with the other categories defined above, seek to increase the student’s motivation and thus level of commitment to learning the material by employing concepts already familiar to most consumers. 11

In a report by Kai Erenli of the University of Applied Sciences in Vienna, Austria entitled “The Impact of Gamification: Recommending Education Scenarios,” Erenli offers a commonly held list of characteristics every game shares:

- fun: the activity is chosen for its light-hearted character
- separate: it is circumscribed in time and place
- uncertain: the outcome of the activity is unforeseeable
- non-productive: participation does not accomplish anything useful
- governed by rules: the activity has rules that are different from everyday life
- fictitious: it is accompanied by the awareness of a different reality 12

While Erenli devotes some time to applying each of these characteristics to developing gamification scenarios for education, he explicitly rejects the notion that games in the context of education should be or are “non-productive.” 13

8 Ibid.
9 Kiryakova, 2.2.
10 Ibid.
11 Ibid., 3.
13 Ibid., 16.
In their research at the Simon Fraser University in Canada, Andrew Stott and Carman Neustaedter also discuss two characteristic of gamification they call the freedom to fail concept and storytelling that are directly related to the application of gamification to education. The freedom to fail concept involves providing rapid and ongoing feedback that does not directly affect the students’ final grades, but encourages incremental or scaffolded learning. Similarly, storytelling in education increases engagement and progression through content.14

2.3. Potential Impact of Gamification

Erenli also provides some insight into the potential utility of gamification by presenting some interesting facts with reference to open market soft-ware based games. The bullets below are taken directly from his report:

- Not only "youngsters" play games
  - Average age of gamers: 37 years (they also have been playing for an average of 12 years).
  - Average age of most frequent game purchasers: 41 years.
  - Percentage of youth playing computer & video games: 97%.
  - Percentage of gamers older than fifty (2011): 29% (a significant increase from 9% in 1999); this figure is certain to rise in coming years with nursing homes and senior centers across the USA now incorporating video games into their activities.

- Games have already "invaded" people’s homes
  - 77% of American households own videogames.
  - 68% of parents believe that playing games provides mental stimulation or education, 57% believe games encourage their family to spend time together, and 54% believe that playing games helps their children connect with their friends.
  - Percentage of female gamers: 42%. In fact, women over the age of 18 represent a significantly greater portion of the game-playing population (37%) than boys age 17 or younger (13%).
  - Percentage of gamers who play games with other gamers in person: 65%.

- Gadgets have undergone a process of "smartization"
  - 55% of gamers play games on their phones or mobile devices.
  - 2,600,000 games are downloaded each year in Germany.

Revenues of mobile games have increased by 40% in 2012.

Games are addictive

- Gamers have collectively spent 5.93 million years playing World of Warcraft.
- Time spent gaming per day in the US: 215,000,000 hours.\(^{15}\)

In addition, Pim van de Pavoordt’s research indicates that children who grew up as digital natives immersed in the internet are more likely to engage in online games than with other students or teachers in a traditional classroom environment. They propose three potential reasons for modern day students’ desire for e-learning options: “First of all they want to be connected to one another, secondly they want to be entertained through games, movies and music, and finally they want to present themselves and their work.”\(^{16}\)

3. Effectiveness of Gamification

While the facts stated above indicate the potential impact of gamification, there have also been a number of studies to determine empirically and conceptual if gamification is actually effective in education.

In “Does Gamification Work? – A Literature Review of Empirical Studies on Gamification” Juho Hamari, Jonna Koivisto, and Harri Sarsa take a structured approach to determining the effectiveness of gamification by considering:

1. what motivational affordances the reviewed studies have implemented as dependent variables,
2. what psychological outcomes have been measured as possibly both independent and dependent variables,
3. what behavioral outcomes have been measured as dependent variables.\(^{17}\)

Their research shows that a majority of the current studies on the effectiveness of gamification do indicate that gamification in education produces positive effects and benefits. However, they also found that most of even the quantitative papers they reviewed were descriptive in nature and focused on the learners expressed response to the implementation of gamification and not demonstrated change in performance.\(^{18}\)

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\(^{15}\) Erenli, 16.


\(^{18}\) Ibid., 3028.
In a similar study presented at the International Forum of Educational Technology and Society in 2005, a group of researchers went further to quantify the effectiveness of both gamification broadly and individual gaming mechanisms in education. The group included Darina Dicheva, Christo Dichev, Gennady Agre, and Galia Angelova. The figure below shows the distribution of results from the case studies they analyzed grouped into these categories: positive, positive first impression but not properly evaluated, mixed or suggestive, negative, and not evaluated yet or results not accessible.\(^{19}\)

![Figure 2: Work distribution by reported results\(^{20}\)](image)

As the figure above indicates, the majority of the papers they reviewed report positive results from introducing gamification to education. Specifically, they found:

- significantly higher engagement of students in forums, projects, and other learning activities;
- increased attendance, participation, and material downloads;
- positive effect on the quantity of students’ contributions/answers without a corresponding reduction in their quality;
- increased percentage of passing students and participation in voluntary activities and challenging assignments;
- minimizing the gap between the lowest and the top graders.\(^{21}\)

Dicheva, et al., also quantified how widely used gaming mechanisms based on the number of papers reporting their use and summarized the findings from papers discussing each mechanism. As

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\(^{19}\) Dicheva, et al., 82.

\(^{20}\) Ibid.

\(^{21}\) Ibid., 83.
indicated in the figure below, their research indicates the most common gaming mechanisms in education are badges, leaderboards, and points.\textsuperscript{22}

![Figure 3: Work distribution by game mechanisms\textsuperscript{23}]

Qualitatively, some of their findings include:

- Regarding the use of badges, in some of the case studies their assignment does not affect student grading, but is aimed at triggering competitive motivation.

- Badges are given for different achievements, for example, for challenge achievements and participation achievements, for learning, time management, and carefulness, for contributing to threads and reading/voting on content, or for performance and fun.

- As to levels, (Kapp, 2012b), for example, considers three types of levels: game levels, playing levels, and player levels. Goehle (2013) recommends choosing levels so that initially levels are earned quickly but become increasingly difficult to obtain later on.

- Examples for using virtual (in-game) currency include spending it on puzzle hints, assignment extensions, quiz do-overs (allowing the buyer another three chances at a quiz), or getting help on certain homework problems, extending a due date with no penalty, using a larger index card for notes on a test.\textsuperscript{24}

In a paper on visualization and gamification of “e-Learning,” Marie Olsson argues that some of the variance in the effectiveness of gaming mechanisms depends on the learner’s intrinsic motivation to learn. She posits that extrinsic motivators like badges are useful if they lead a student to more intrinsically motivated learning activities. In contrast, if a student is already intrinsically motivated to learn, the same

\textsuperscript{22} Ibid., 80.
\textsuperscript{23} Dicheva, et al., 80.
\textsuperscript{24} Ibid.
extrinsic motivators can have the opposite effect and undermine the original intrinsic motivation leading to less desirable learning outcomes.\textsuperscript{25}

Craig Miller of Normandale Community College introduces another interesting way to think about the effectiveness of gamification in education – the physiological benefits. He discusses scientific research findings that “the increased release of the chemicals norepinephrine, epinephrine, and dopamine in the brain that not only bring on ‘good feelings’ make us more receptive to learning.” \textsuperscript{26} Further, neuroscientists have demonstrated that to learn the brain must create neural connections and that the brain does not distinguish between actual or simulated events when creating those neural connections.\textsuperscript{27} This reinforces Stott and Neustaedter’s finding that “one common thread found throughout successful game dynamics is that they all work to increase a feeling of agency and ownership in the user.”\textsuperscript{28}

4. Examples of Gamification in Education

In their research, Stott and Neustaedter find that many of the underlying dynamics of gaming mechanics are already recognized and integrating into common pedagogical practices, even by instructors who may not be familiar with gamification. They see this as adding legitimacy to practices sometimes dismissed as superficial for those looking to motivate student achievement through the power of games.\textsuperscript{29} However, it would still be useful to know how prevalent gaming currently is in education and how instructors have integrated it into different academic disciplines at varying levels of education.

In a 2016 article in the International Journal of Game-Based Learning, Bradley Wiggins looked at how games and simulations were being used in the classroom at institutions of higher education. He focused specifically on communications programs, so it is difficult to draw broader conclusions on the use of games and simulations across all disciplines, but his findings still offer an interesting data point. Wiggins surveyed constructors (151 total) at all four-year and four two-year institutes of higher learning in Arkansas and got a response rate of 32\% (48 total responses). From those responses, he found that the instructors were nearly split on their understanding of the gamification concepts as they related to education. See figure below.\textsuperscript{30}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{gamification_data.png}
\caption{Gamification data}
\end{figure}

\textsuperscript{27} Ibid.
\textsuperscript{28} Stott and Neustaedter, 7.
\textsuperscript{29} Ibid., 1.
\textsuperscript{30} Wiggins, 22.
In a literature review by Ilaria Caponetto, Jeffrey Earp, and Michela Ott’s, the authors also looked at the use of gamification across the levels of formal education and in other training venues not strictly considered education, such as corporations providing in-service training on customer engagement. Interesting, almost half of the literature they found involved such “others” and a vast preponderance of the literature involving formal education discussed gamification at the university level (see figure below).\(^\text{32}\)

The Caponetto, et al., literature review also found that papers discussing gamification in education spanned a wide range of subjects including science, math, foreign languages, cultural heritage, health, computer science, software engineering, business, and logistics.\(^\text{34}\) While there review did not discuss specific applications within those fields in great detail, many others have researched examples of gamification in education across academic disciplines, levels of education, and in financial or healthcare education. The following sections summarize the findings from three such research projects.

\(^{31}\) Ibid., 25.
\(^{32}\) Caponetto, et al., 53.
\(^{33}\) Ibid., 54.
\(^{34}\) Ibid., 55.
4.1. Survey of Gamification in Education: Gaming Mechanisms

In “Gamification in Education and Libraries,” Kim presents four examples of gamification in education including one example from a high school and three examples from higher education. While Kim does not attempt to quantify the effectiveness of gaming mechanisms, it is still insightful to see what concepts instructors are using and how they are integrating them into their courses. Below are descriptions of each case.

Fantasy Geopolitics was developed as an auxiliary tool for ninth grade students taking social studies in 2009. Eric Nelson, a high school teacher at North Lakes Academy Charter School in Forest Lake, Minnesota, developed this lightweight game in order to encourage his students to care about geopolitics and see world news as something relevant to their lives. Fantasy Geopolitics starts with a draft session, during which students select a team of three countries (except the United States and China due to their domination of the news); then the players track stories about those countries in the news and get points for every mention of a country in a particular news source.

Cliff Lampe, a professor at the University of Michigan School of Informatics, gamified his undergraduate class. Lampe provided his students with the freedom to choose their options to accomplish the learning goals of the class, encouraged them to participate in “guilds,” and gave them rapid feedback on their performance via a monitoring system managed by his teaching assistants to further empower the students.

Dartmouth College and Webster University used gamification in order to make their student orientations more informative and interactive. They provided their new students at the orientation with SCVNGR, a location-based mobile gamification app with customizable treks and challenges, instead of a paper handout, so that each student could discover more about the school and the campus in the form of a scavenger hunt using a smartphone.

Purdue University developed its own digital badge platform called Passport. Passport enables instructors to design digital badges and issue them to students. Students can earn and display those digital badges in Passport to demonstrate their competencies and achievements and share them in social media such as LinkedIn and Facebook.35

4.2. Survey of Gamification in Education: The “Others”

Huang and Soman also conducted five case studies of efforts to integrate gamification into education. Unlike the case studies selected by Kim, Huang and Soman expanded their research to four cases studies outside of formal education. This is significant given the Caponetto findings that almost half of the papers document using gamification are in training situations outside of the traditional classroom, the “others.” Understanding how gamification can teach consumers the principles of value-based healthcare or teach the general population how to make more environmentally sustainable choices in their daily lives, provide valuable lessons. Below are descriptions of each case.

An interview with Ben Leong, Assistant Professor at the School of Computing, National University of Singapore (NUS) and studying his publications provided insights into his creation of a game-like course called JFDI Academy. Through the application of game mechanics to a traditional scheme-based introductory programming course, it induced consistent behavior from students and identified gaps in each student’s learning progress.36

Launched in February 2013, Healthcare University was created by Capital Blue-Cross with the objective of using gamification to teach consumers the basics of healthcare and how to make value-based healthcare decisions. Healthcare University aims to simplify the process and encourage these consumers to learn and take action. The education program is structured as: watch a video, take a quiz, and play a game.37

Thus, to drive stickiness to corporate training, Deloitte successfully applied one of the most common gamification mechanics – points and badges – to its digital executive training program, Deloitte Leadership Academy (DLA). Deloitte’s objective was to encourage corporate training among executives and increase their engagement – both a general instructional goal and a behavioral goal.38

Targeted at children in the 6+ age group, PlayMoolah is presented on an online platform, and allows them to play the game via any internet access. As younger students lose focus easily, the pain points in teaching them financial literacy is that they have to find it interesting. Also, it had to be easy to navigate through the program, so that they could teach themselves, while parents monitored and guided their progress.39

Recyclebank was launched in 2004 to tackle just these issues. In addition to increasing recycling rates, the company also aims to empower people online and offline, to make smarter transportation choices, adopt a greener lifestyle, and minimize the use of energy and water. With a flexible learning program structure, Recyclebank encourages new visitors to try out the rewards program by navigating through three pledges to collect points.40

4.3. Survey of Gamification in Education: Effectiveness

Finally, Stott and Neustaedter evaluated three case studies and attempted to both document the gaming mechanisms involved and quantify the effectiveness of each mechanism. Below are descriptions of each case.

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

36 Huang and Soman, 16.
37 Ibid., 18.
38 Ibid., 19.
39 Ibid., 21.
40 Ibid., 23.
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.41

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 behaviors that lead to academic success.42

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.43

5. Approaches for integrating Gamification into the Classroom

Two useful studies that look in depth at how to integrate gamification into the classroom are “A Practitioner’s Guide to Gamification of Education” by Wendy Huang and Dilip Soman, and “Gamification in Education” by Gabriela Kiryakova, Nadezhda Angelova, and Lina Yordanova. While they use slightly different language, each lay out a very similar step by step process instructors can follow to build gamification into their curriculum.

For both, the first step in the process is a careful analysis of the students. Kiryakova, et al., refer to this step as “Determination of learners’ characteristics” and stress that teachers must consider how their students learn before they can consider what new tools or techniques would be suitable to introduce to the course. Further, teachers should consider what additional skills are necessary with the additional of gamification and ensure they maintain the correct difficulty level to keep students motivated. 44 Huang and Soman refer to this first step as “Understanding the Target Audience and the Context.” 45

The second step for both studies is “Definition of Learning Objectives” or “Defining Learning Objectives.” 47 For this step, Kiryakova, et al., argue “[t]he purpose of education is to achieve the learning objectives, because otherwise all activities (including gamification activities) will seem pointless.” 48

41 Stott and Neustaedter, 3.
42 Stott and Neustaedter, 4.
43 Ibid., 5.
44 Kiryakova, 4.
45 Huang and Soman, 7.
46 Kiryakova, 4.
47 Huang and Soman, 9.
48 Kiryakova, 4.
Further, Huang and Soman offers a useful topology of objectives including: General Instructional Goals, Specific Learning Goals, and Behavioral Goals.

The third step for each is similar and is focused on the thinking through the content and structure of the educational experience. , Kiryakova, et al., call this step “Creation of educational content and activities for gamification.” Their study focuses on developing the activities that allow students to achieve the stated learning objectives. They introduce four characteristics that activities should have to ensure they are interactive and engaging:

- Multiple performances – the learning activities need to be designed so that students can repeat them in case of an unsuccessful attempt. It is very important to create conditions and opportunities to achieve the ultimate goal. As a result of repetitions students will improve their skills.
- Feasibility – the learning activities should be achievable. They have to be tailored and adapted to students’ potential and skill levels.
- Increasing difficulty level – each subsequent task is expected to be more complex, requiring more efforts from students and corresponding to their newly acquired knowledge and skills.
- Multiple paths – in order to develop diverse skills in learners, they need to be able to reach the objectives by various paths. This allows students to build their own strategies, which is one of the key characteristics of the active learning.

Similarly, Huang and Soman call their third step, “Structuring the Experience.” For Huang and Soman, the key to structuring the experience is to identify the right stages and milestones to sequence the knowledge effectively and quantify what students need to know to move forward. Breaking the material down into a series of smaller manageable goals and rewarding students for their success is key for student motivation and learning.

Although Huang and Samon include intermediate step of “Identifying Resources,” the final step for each study is applying gamification elements and mechanisms. Both studies emphasize the importance of both individual achievement and the social element of the activity. Huang and Soman use the terms self-elements and social-elements to distinguish between mechanisms that motivate students to “focus on competing with themselves and recognizing self-achievement” and those that create competition or cooperation; mechanisms that “put the students in a community with other students, and their progress

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49 Ibid.
50 Kiryakova, 4.
51 Huang and Soman, 9.
52 Ibid., 9-10.
53 Ibid., 11.
54 Kiryakova, 4.
55 Huang and Soman, 13.
and achievements are made public.”

Huang and Soman’s topology of self-elements and social elements.

<table>
<thead>
<tr>
<th>Self-Elements (Complete Stage)</th>
<th>Social Elements (Push Stage)</th>
</tr>
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<tbody>
<tr>
<td>Points</td>
<td>Leaderboards</td>
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<tr>
<td>Levels</td>
<td>Virtual Goods</td>
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<tr>
<td>Trophies/Badges</td>
<td>Interactive Cooperation</td>
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<td>Time Restrictions</td>
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<tr>
<td>Aesthetics</td>
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Figure 6: Examples of Game Mechanics (Self-Elements vs. Social Elements)

6. Conclusion

After reviewing a body of relevant literature, this paper finds that gamification can be integrated effectively into education to motivate students and enhance learning. Armed with the knowledge highlighted in the literature review, teachers should feel empowered to start integrating gamification elements and mechanisms into their curriculum. However, as Section 5 of this paper demonstrates, that is not as easy as just creating a leader board in the classroom. Effectively integrating gamification into education demands a thoughtful analysis of the students involved, the course material and learning objectives, the holistic structure of the learning experience, then consideration of what specific elements and mechanisms will most effectively guide the student through a meaningful learning experience.

These findings have special significance for West Point as many departments are working to integrate technology into the classroom and the curriculum. The Department of Military Instruction and Department of History, for example, have built some very interesting tablet-based applications with Rowan Technology. These applications use hundreds of animated campaign and battle maps embedded with audio and video vignettes and interactive timelines to depict troop formations, tactics, and movements to help cadets better understand military history and current doctrine. There is also an encouraging entrepreneurial spirit amongst individual instructors who are experimenting with a multitude of free iPad applications that allow for real time voting in classrooms as a form of test-taking, virtual collaboration, and much more. Many of these digital and technological innovations touch on parts of what make gamification a powerful approach; however, none embrace it completely. While gamification may not be a silver bullet solution to enhancing learning in every discipline at West Point, its demonstrated potential certainly makes it worth considering.

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56 Ibid., 13.
57 Huang and Soman, 14.


