

# Teaching Technology Integration to K-12 Educators: A ‘Gamified’ Approach

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**Abstract** The purpose of this paper is to present the course design and evaluative data associated with the learning experiences of practicing teachers engaged in a gamified approach to a graduate level course on technology integration. Twenty-two teachers across three offerings of the course completed a survey examining their experience with the gamified course and course elements. Survey mean scores were positive overall. Participants reported they were motivated by the gaming principles incorporated into the course, including the use of badges and awards and the opportunity to tailor course experience to their own interests. Participant responses to open-ended items similarly revealed that recognition and autonomy were important aspects of their learning experience. Implications for the theory and design of a gamified course within teacher education are discussed.

**Keywords** Course design · Gamification · Gaming · Teacher preparation · Technology integration

## Introduction

Games can be powerful tools in teaching and learning. Several researchers have suggested that incorporating off-the-shelf video games can improve student learning and motivation (Dickey 2006; Malone 1981; Rieber 1996), and there is some evidence supporting those claims (Ke 2008). However, off-the-shelf video games often create challenges that inhibit their use for

learning, including high development costs and a lack of compatibility with learning objectives (Rice 2007). Instead of using full-fledged video games, researchers have proposed *gamification* - that is, the incorporation of game principles into learning environments (e.g., Kapp 2012; Muntean 2011). The general idea is that incorporating the positive elements of full-fledged video games into an existing learning environment capitalizes on the potential to improve learning and motivation with fewer challenges and constraints than off-the-shelf games.

Several studies provide evidence of the effectiveness of gamification approaches in education. For example, Domínguez et al. (2013) implemented a gamification system into an undergraduate level online technology introduction course. The results suggested that the gamification approach had a positive influence on students’ academic achievement, emotions, and social interactions. De-Marcos et al. (2014) compared 371 first year undergraduate students majoring in business enrolled in three versions of the same course - one that was gamified, one that was supported by social networking, and one that used the existing approach to instruction. Students in the gamified and social networking approaches performed better on class projects, whereas students in the traditional approach performed better on a test of knowledge. Furthermore, using the gamification approach in an online mathematics assignment platform was reported as having a positive influence on students’ cognitive engagement (Goehle 2013).

With this in mind, the Learning, Design, and Technology program at The University of Georgia redesigned a core course in our Master’s degree program around several principles of gaming. The course, called, *Introduction to Computer-Based Education*, is taught entirely online and introduces K-12 teachers and school library media specialists to a variety of learning technologies. The course was redesigned in 2012 to update the content of the course while gamifying key learning activities. Our goal in gamifying the course was to make it

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more appealing to teachers within our program as well as to teachers across our College of Education.

The purpose of this paper is to describe the design of our gamified approach to teaching technology integration to K-12 teachers and provide evaluative data reporting participant experiences within the gamified course. The study addresses several gaps in the existing literature. Although current studies on gamified learning are promising, they mainly focus on undergraduate level courses. Few have investigated the gamification approach beyond undergraduate level. Furthermore, researchers have noted the need for studies that explicate the underlying design principles associated with gamified learning environments (Dicheva et al. 2015). The design and evaluation results offer researchers and teacher educators insight into the application of and outcomes associated with the integration of game theory in graduate-level coursework.

### Gaming Principles to Guide the Course Redesign

Video games share various principles that provide players positive play experiences and, in turn, support players' participation. A considerable number of principles for video game design have been noted in the literature (e.g., Dickey 2005; Garris et al. 2002; Gee 2007; Kapp 2012; Malone and Lepper 1987). Bonk and Dennen (2005) drew upon the work of Gee and summarized 10 principles of massive multiplayer online gaming as a guide for the development of training and education. For our course redesign, we adopted six of those principles: achievement, interaction, multiple routes, practice, probing, and challenge. The remaining four principles were not included in our redesign because they either were not desired as part of our redesign (e.g., creating a virtual identity or avatar) or were more strongly related to game-based learning rather than gamified environments (e.g., learning by playing a game; taking risks in artificial environments). The six principles guiding our course redesign are described below.

**Achievement** *Learners are continuously rewarded for skill mastery and advancing knowledge.* Good video games provide players with achievements through many different mediums. For example, online role-playing games offer reward systems such as earning currency, as well as discovering, collecting, and/or constructing objects (Holt and Kleiber 2009). Rewarding learners with achievements allows them to experience a sense of competence (Ryan and Deci 2000) and the feeling of appreciation for their participation (Muntean 2011).

**Interactions** *Learners grow through interactions with others, including technology.* Human beings are highly social. Video games provide multiple ways for players to interact with other players or the game environment itself (Hsu and Lu 2007; Malone 1981). By collaborating with peers, learners can learn from each other and extend their knowledge span (Bedwell

et al. 2012). With technology, learners gain access to experiences that they can learn from in the present and draw upon in the future (Rosario and Widmeyer 2009).

**Multiple Routes** *Learners have more than one way to progress and learn.* Many video games allow players to choose from multiple paths as they achieve the goals of the game (Dickey 2005, 2006). The principle of multiple routes has the potential to improve learning by increasing learner autonomy. Choices support autonomy, which plays an essential role in promoting student motivation and engagement (Deci and Ryan 2000). Highly engaged students are more likely to perform better than the less engaged students (Carini et al. 2006).

**Practice** *Learners spend time practicing in an interesting context.* Video game players master a necessary skill (e.g., solve puzzles; beat the “Monsters”) by constantly practicing that skill in new ways and without the threat of a harsh loss (Bedwell et al. 2012; Rosario and Widmeyer 2009). A gamified learning environment should therefore provide interesting topics, activities, and contexts. This can challenge and encourage learners to actively and repeatedly practice new concepts and skills within a safe context for learning.

**Probing** *Learners engage in cycles of inquiring, hypothesis building, and “doing.”* Good video games encourage players to build, test, and explore their own hypotheses in order to find the solutions for a variety of tasks. When a player is unsuccessful at attempting to negotiate a new level or area within a game, it can confirm that his/her initial hypothesis was wrong and suggest that a new or modified hypothesis is needed (Rosario and Widmeyer 2009). Therefore, a gamified learning environment should allow learners to frequently test their hypothesis, learn from the results, and build new hypothesis to test later.

**Challenge** *The game should push learners outside of their current comfort zone in an attainable manner.* Rather than diminishing players' interest in playing games, pleasant frustration increases players' engagement in games (McGonigal 2011; Wilson et al. 2008). Good video games adjust challenges to make players feel that game is challenging but doable. Tasks that are too easy or too difficult will lead to boredom or frustration (Csikszentmihalyi 1990; Malone and Lepper 1987; Sweetser and Wyeth 2005). Gamified learning environments should therefore seek to provide learners with this type of “pleasantly frustrating” tasks (Gee 2004). The ideal challenge should match learners' abilities to accomplish the tasks while providing motivational tension (Driskell and Dwyer 1984).

### Course Design

The major objective of the gamified course was for learners to apply a variety of technology integration concepts within a

learning environment. Course content focused on the use of current technologies to develop learning activities that meet one or more of the four C's of 21st century learning (i.e., creativity, critical thinking, communication, and collaboration) (National Education Association 2011). The technologies of the course spanned three current trends in computer-based education: mobile learning, Internet technologies (e.g., Web 2.0), and educational gaming (Johnson et al. 2014). This content was covered in the context of five course elements that incorporate the aforementioned principles of gamification. Table 1 displays the elements of the course and their alignment with the six gaming principles; those elements are described next.

**Levelling Up** Students negotiated their own learning path through four major projects and gradually achieved mastery within one of the three trends of computer-based education. After completing each project, students 'levelled up', earning a new status in the course for each level. With each new level, students faced challenges that became increasingly more difficult and developed deeper expertise within a specific trend. As shown in Fig. 1, students began in Level I with a broad introduction to each of the three trends. In Level II, they explored and critiqued specific tools in two of the three trends then developed a learning activity in Level III for one of the three areas. As students progressed to higher levels, they repeatedly practiced previously acquired skills in new and novel situations. Consistent with the idea of levelling up, students gained experience points for successfully completing a task rather than earn a grade. *Gaming Principles: Achievement, Multiple Routes, and Practice.*

**Badges and Awards** Rather than taking a punitive approach to grading (e.g., reducing points for each error), students in the course could achieve awards for their skill mastery or advancement of knowledge. At the conclusion of each level, projects that both met and exceeded the requirements were eligible for awards for excellence. Badges were awarded when students contributed positively to the course outside of the required activities. Through the use of badges and awards, students were pushed outside of their comfort zones in order to attain new skills or

knowledge without the threat of grade loss for failure. *Gaming Principles: Achievement and Challenge.*

**Mastery-Focused** Students in the course were allowed to resubmit work if instructor feedback indicated that they failed to meet the requirements of the tasks associated with each level. This placed the focus of the course on achievement and challenge - experience was only earned if and when a project met the specified requirements, but students could resubmit until they earned or reached their own desired level of experience. This mirrors the option to replay levels within a video game until the level is mastered. *Gaming Principles: Probing and Challenge.*

**Quests** During synchronous class meetings, learners regularly worked in small groups to share recent technology discoveries and applications in various contexts. They then practiced applying their new knowledge by brainstorming a learning activity around their group discussion. These quests occurred during each synchronous class meeting, providing students with an opportunity to engage in repeated cycles of forming a hypothesis about a new technology, presenting it to others, and revising it based on feedback. *Gaming Principles: Interactions and Practice.*

**A Boss Level** Games typically have a final challenge that requires students to use their recently acquired skills to defeat some sort of boss, often as a team that combines a variety of unique skills. In this course, students were challenged to engage in an instructional design project in which they develop, implement, and evaluate (i.e., field test) a learning activity in their area of mastery (see Fig. 1). Students designed content in a context appropriate for their professional goals and tested it with members of the target audience. Teamwork was strongly encouraged but not required. *Gaming Principles: Practice and Probing.*

## Student Experiences in the Gamified Course

Participants included a convenience sample of 22 graduate students (16 female, 6 male). These were drawn from a larger pool

**Table 1** Five course elements by principle of gaming\*

	A	I	MR	Prac	Prob	C
<i>Leveling Up.</i> Four levels that gradually increase in difficulty.	X		X	X		
<i>Badges and Awards.</i> Badges distributed for contributions; awards distributed for excellence.	X					X
<i>Mastery-focused.</i> Experience is earned only when project meets stated requirements; resubmissions are allowed.					X	X
<i>Quests.</i> Sharing recent technologies and their uses for learning.		X		X		
<i>Boss Level.</i> Challenge to develop, implement, and evaluate a learning activity.				X	X	

\* A achievement, I interaction, MR multiple routes, Prac practice, Prob probing, C challenge

**Fig. 1** Course levels (I - IV) and description of level activities for the gamified course

	4 C's (in class)	Gaming	Web 2.0	Mobile
I	Read / Watch assigned videos about the 4C's  Share Quest - share your understanding	Read / Watch assigned resources Find 3 more resources Summarize / Reflect  Complete activities for all three trends (Gaming, Web 2.0, and Mobile)		
II	Contribution of new resources (TED video, Blogs, etc.) to shared document  Idea Quest - share instructional technology ideas with others	Explore 5-6 tools/resources across two areas Summarize and critique tools explored  Complete activities for two of the three trends		
III	Continued discussion  Application through topic-focused activities	Demonstration a learning activity for one tool/resources Use scholarly literature to support the potential of your activity Create an online presentation for others to view  Complete activities for one topic		
IV	Technology Integration Project "Boss" Level			
	a. Idea and group forming: Ideas posed and discussed on discussion boards; ideas selected by 'natural selection'. Can choose to go deeper with others in your topic, or learn to integrate your topic with other topics to meet specific goals.  Presentation: Storyboards (PPT summary of TIP -Problem, Solution with Technology including Theoretical Justification, Strategy, Plan, Results, Lessons Learned).			
	b. Design, Develop, and Field-Test your learning activity.			
	c. Report out. Complete a 12-slide PPT as indicated. Goal: Concise, clear, compressed idea. Within 12 slides. Post as resource to other people.			
	d. Create online tutorial/presentation for your TIP; post online. Go back and watch 3 other tutorials. Leave constructive feedback and/or rate. Debrief during last class.			

of 50 students, indicating that just over half (56 %) of the solicited participants chose not to complete the survey. Eighteen of the participants were practicing teachers or school library media specialists in a K-12 setting; the remainder were educators in the field of higher education with K-12 experience ( $n=2$ ) or trainers in the private sector ( $n=2$ ). The average number of years of experience in their field was 9.18. The study was approved by our university's Institutional Review Board.

**Data Collection and Analysis** Participants completed a researcher-generated questionnaire that examined their perceptions of their experience within the gamified course and the importance of specific course elements. The questionnaire focused on gathering information about the overall course experience as well as the specific features of the course that were most salient (Patten 2001). Overall course experience was assessed using four items that focused on participants' perceptions of their own learning and motivation both broadly and within specific principles (see Table 1). A sample item from the survey is, "My learning interests were met in the course." Participants rated their agreement with these items

on a five-point Likert scale that ranged from strongly disagree (1) to strongly agree (5). The survey also contained items measuring the importance of specific course features - in particular, the gamified course elements such as, "opportunity to select your own path to expertise," and, "badges and awards." Participants rated these items in terms of their perceived importance on a scale from least important (1) to most important (5). In order to extract more details of their experiences in the gamified course, three open-ended questions were included asking participants to briefly explain some of their ratings or describe their experience within the course.

The survey was administered electronically within 3 months of completing the course. The survey items were analyzed using descriptive statistics. Open-ended items were analyzed using thematic analysis. Rather than establishing inter-rater reliability in a statistical manner, the researchers engaged in consensus building. Consensus building helps improve the credibility and trustworthiness of the data in that multiple researchers come together to reach high levels of agreement about the nature of the themes and application of codes (Baxter & Jack 2008). Our consensus building process consisted of the researchers repeatedly examining qualitative data independently then meeting to identify and refine

the coding process. After an initial reading and open coding, the researchers met to share initial findings and identify the major themes that emerged. Each researcher then revisited the responses and identified participant responses that fell within each theme. The researchers met again to come to consensus about the responses identified within each theme and finalize the nature of each theme.

## Findings

Table 2 contains the mean scores for the survey items that assessed participant perceptions of their experience and the importance of gamified course elements. Overall mean ratings suggest that participants held positive perceptions about their experience within the gamified course. The highest-rated item ( $M=4.50$ ) was, “I found the gaming principles motivating,” and the lowest ( $M=3.73$ ) was, “I use the skills/concepts from the course in my teaching today.” These ratings fall closer to a rating of strongly agree (5) or agree (4). Participants also reported that the most important course elements were the mastery-based focus of the course ( $M=4.73$ ) and the opportunity to select one’s own path to expertise ( $M=4.68$ ). These fell closer to a rating of most important (5).

## Open-Ended Items

**Engagement** Overall, participants found the gaming elements engaging and fun. Several factors contributed to their engagement with the course, such as badges and awards, the ability to choose their own path, the course’s mastery-based nature, and a seemingly informal learning environment. Over half of those reporting engagement in open-ended responses ( $n=9$ )

**Table 2** Mean scores for learner perceptions of their course experience and the importance of gamified course elements

Item	M	SD
<i>Learning and Motivation<sup>a</sup></i>		
I found the gaming principles motivating.	4.50	0.91
The badges/awards were motivating.	4.41	0.91
I could tailor my experience to my own interests.	4.41	1.10
The gaming principles helped me learn.	4.18	1.01
I use the skills/concepts from the course in my teaching today.	3.73	1.12
<i>Importance of Course Elements<sup>b</sup></i>		
Mastery-based rather than punitive or punishing	4.73	0.46
Opportunity to select your own path to expertise	4.68	0.48
Badges and awards	4.14	0.83
Gained experience rather than earned grade	4.05	0.90
Working as a team on Boss Level	3.91	1.11

<sup>a</sup> 5 Strongly Agree, 1 Strongly Disagree || <sup>b</sup> 5 Most Important, 1 Least Important

described their experiences in the course as enjoyable (e.g., *I really enjoyed the class. No reservations, best online class I’ve had in almost 4 degrees worth of university time*).

**Badges and Awards** Nearly half ( $n=11$ ) of the participants mentioned badges and awards to be a memorable component of the course, noting that they enjoyed the competition of receiving badges and awards and looked forward to them. Participants highlighted two specific aspects: recognition ( $n=8$ ) and motivation ( $n=4$ ). Those who indicated recognition enjoyed being acknowledged by their professor and classmates for their hard work and effort. Participant responses included, “I enjoyed the badges because I felt my hard work and participation were recognized, which doesn’t always happen in grad school courses,” and,

How often do you get a badge or award these days for trying hard? Never. You might get an A on a test or quiz, but it is not the same as being recognized for specific work or efforts you put into a project.

Several participants ( $n=4$ ) noted that they liked seeing others receive badges and awards, but did not find that course element motivating. One reason for this was because they, the participants, were not competitive ( $n=2$ ) and this lessened their own interest in receiving a badge or award. Another reason was because they did not personally receive a badge or award, which lessened their motivation because they felt they did deserve some sort of recognition.

**Autonomy** Autonomy was another effective outcome of the gamification approach. Autonomy occurs when an individual performs actions for his or her desire, or personal reasons, rather than being controlled by others (Ryan and Deci 2000). Ten (of 22) participants indicated that they experienced a sense of autonomy during the course. One reason for this was the ability to choose one’s own path throughout the semester. Participants ( $n=6$ ) noted that this provided them with a sense of control and ownership over the content of the course and their individual course project topics. Participant responses included, “It was most beneficial to select my own path to expertise because I had more ownership and input into my own learning,” and, “Being able to choose my own field to work in allowed me to tailor it to the grade I am teaching (Pre-k).”

Another reason was that the mastery-based nature of the course allowed students to engage in a safe learning environment, which gave them more motivation to explore and learn about topics of interest. One participant noted:

[The focus on mastery] to me is the single most important aspect of an authentically educational experience

(contrasted with training). In authentic education, a learner is intrinsically motivated to do the best work. In training, the learner is externally motivated to increase the score (note, that I distinguish the score from the actual performance).

## Discussion

Student perceptions of their course experience suggest that they held positive attitudes about their own learning and motivation after participating in the gamified course. Responses to the survey items indicated that students agreed or strongly agreed that the gaming principles helped them learn, motivated them, and allowed them to tailor the experience to their own needs. Responses also indicated that many of the students continued using the skills and concepts from the course in their own teaching several months after the conclusion of the course. These results are consistent with studies of undergraduate students that suggest that gamification can have a positive effect on academic achievement and engagement (see Domínguez et al. 2013; Goehle 2013).

Both the mastery-based nature of the course and ability to select one's own path were among the highest-rated items on the survey, and responses to the open-ended items were consistent with these ratings. In particular, students noted that they experienced a strong sense of autonomy as a result of these gamified elements in this study. This is not altogether surprising. Adult learners desire opportunities to tailor learning to their own interests, as well as focus on mastering a concept or skill that can be applied to their own professional context (Chan 2010; Knowles 1980). In our gamified environment, students engaged in regular cycles of selecting and learning about new technologies for the classroom. They then received regular and repeated feedback from both peers and experts through in-class quests as well as opportunities to resubmit their work if unsatisfied with their achievement. It is likely that these course elements helped meet the need for autonomy among adult learners and positively affected their learning experience. Others (Frick et al. 2009; Merrill 2002) have noted that learners benefit greatly from repeated opportunities to engage in authentic tasks while receiving coaching and feedback.

The results of the current study also offer insight into the use of badges and awards as part of a gamified learning experience. While the literature strongly suggests that these types of recognition can be motivating (e.g., Davidson 2011), our results suggest that this may not be true for all students. Open-ended responses revealed that some students found the element of badges and awards enjoyable but less motivating than their peers. It may be that badges and awards are more effective at augmenting other elements of a gamified course rather than supporting a gamified experience in and of themselves.

## Implications

The most immediate implication of this study is that gamified learning can be an effective tool for teaching technology integration in teacher education. Teachers who experienced our gamified course environment found it motivating and held the perception that several gamified course elements (i.e., mastery-based learning, multiple paths to expertise) contributed positively to their learning. Teacher educators should consider incorporating the elements associated with mastery-based learning and the freedom to select one's own path into the coursework of practicing teachers who are learning new technologies. Doing so is beneficial not only from a gamified learning perspective (see Gee 2007; Dickey 2005), but also may appeal more broadly to adult learners (Chan 2010). Others (Domínguez et al. 2013; Gibbons 2013) have reported positive outcomes associated with increased autonomy within a gamified learning environment.

At the same time, caution is warranted when using badges and awards as an element of a gamified course. In a course about technology integration, this might include recognizing students' hard work and effort to integrate technology in new and unique ways. The results of this study suggest that it is important for course designers to strike an appropriate balance when implementing this course element. Too much focus on badges and awards or too poor of a distribution of them among students may create the opposite of the intended effect - that is, they may become de-motivating for students who find them less important or fail to receive recognition when it is expected. When badges and awards are used, it may be important to associate them with a specific performance that is worthy of recognition. Other researchers have noted that badges and awards are more motivating when they recognize a learner's competence with a specific set of skills (Abramovich et al. 2013).

## Limitations

The biggest limitations associated with this study are the nature of the sample and the questionnaire. As an evaluation of our course redesign, the focus was on describing how gaming principles were enacted as specific course elements within a technology-focused Master's level course for K-12 professionals. The questionnaire in particular was developed for evaluative purposes to better understand the course experience in the *current* context. While we provide limited evaluative data that supports the efficacy of those elements in many ways, it would be difficult to generalize from a small sample of convenience to a larger population of teachers. In particular, additional modification and support may be needed to implement gamified course elements among preservice teachers. For example, it may be difficult for preservice

teachers to engage in cycles of inquiring and doing simply because they have less experience than inservice teachers or may lack access to a K-12 classroom in which to implement and explore new technologies. Teacher educators interested in gamifying courses should consider including experiences that expose preservice teachers to classroom challenges and support their learning in a way that is appropriate for their abilities and access. This might include using rich case studies to engage in considering strategies for integrating technology or providing opportunities to plan or teach with inservice teachers.

That being said, the study does address a noted gap in the current gamification literature; that is, it provides a highly detailed account of the design of a theory-driven gamified course and offers insight into participants’ experiences within that design. As such, teacher educators interested in developing similar course experiences can use this study to gain insight into the possibilities associated with designing, implementing, and offering gamified approaches to the teaching of technology integration among practicing teachers.

### Conclusion

Gamification is a relatively new approach to course design. While the idea has quickly gained popularity in the field, questions remain about how to gamify courses and whether gamified courses can positively affect students’ motivation and engagement as well as their learning. The current study suggests that a gamified approach to a graduate level course on technology integration can generate positive perceptions of learning and motivation in the context of teacher education. As Ertmer et al. (2012) noted, this is an important step towards motivating teachers to integrate technology into their classrooms in a way that promotes student learning. Future research should include rich case study accounts detailing teacher learning within a gamified course as well as examining and applying similar course elements with a larger sample of teachers. This would help establish the design principles associated with gamified learning in a practical sense while improving the generalizability of the results to help teacher educators determine if and how gamified approaches can improve teacher education.

### Appendix: Survey

Your current profession: \_\_\_\_\_

What semester did you take the course? \_\_\_\_\_

*The following questions relate to your experience in the course. Please select the number below that best represents yourself for each statement.*

Item Description	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	1	2	3	4	5
I found the gaming principles motivating.					
The badges/awards were motivating.					
I could tailor my experience to my own interests.					
The gaming principles helped me learn.					
I use the skills/concepts from the course in my teaching today.					
Item Description	Least Important	Somewhat Important	Important	Very Important	Most Important
	1	2	3	4	5
Mastery-based rather than punitive or punishing					
Opportunity to select your own path to expertise					
Badges and awards					
Gained experience rather than earned grade					
Working as a team on Boss Level					

#### Open-ended questions.

What was most memorable about the course for you?

Briefly explain some of your ratings

Anything else?

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