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Designing Digital Badges to Improve Learning in Virtual Worlds

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Abstract

Digital badges are digital indicators of achievement that are issued in response to user action within a virtual environment. While badges have been successful in multiple domains, they do not always achieve their purpose. Past research indicates that this is likely a function of specific badging design and how well the badging system integrates with the system's needs and goals. The present article examines how careful badge design can be used to facilitate pedagogy and learning in virtual worlds. It integrates educational and psychological theory to discuss several key uses and best practices of designing digital badges for virtual worlds, including assessing peer skill in multiuser worlds, fostering curiosity to drive exploration of the world, setting appropriate goals to structure learning about the world, and teaching users about the world through feedback. Both entertainment and educational applications are discussed alongside examples to better communicate how to integrate badges in virtual worlds.

1. Introduction

Digital badges are digital indicators of achievement and are most closely related to badges that may be obtained in scouting organizations, or the ribbons and medals that have long been standard in many militaristic organizations. Badges are composed of three primary components (Hamari & Eranti, 2011): (1) *signifier* – the visual or observable badge (i.e., badge's name, description, and image); (2) *completion logic* – the actions that must be completed in order to earn the badge (i.e., what must the learner achieve in order to receive the badge) (3) *reward* – the earner's reward once the badge has been earned (e.g., currency, points, the badge itself). Each component can be designed in specific ways that can affect the way the user and badge interact. For example, the specific goals set by a badge's completion logic and described by its signifier can affect the user's understanding of the task at hand and motivation and ability to complete that task (Wegge & Haslam, 2003). Motivation is also likely to be impacted by the badge's reward; is it considered valuable to the learner? Badges are more effective at motivating learning when they are valued by their earning community (Hickey, Willis, & Quick, 2015). Thus, each portion of a badge requires careful design in order to achieve effectiveness.

Digital badges are not a cure-all; simply put, sometimes they achieve their intended goal (e.g., Denny, McDonald, Empson, Kelly & Petersen, 2018) and sometimes they do not (e.g., Biles, Plass, & Homer, 2015). This is likely a function of specific badging design and how well the badging system integrates with the system's needs and goals. The present article examines how careful badge design can be used to facilitate pedagogy and learning in virtual worlds meant for entertainment and education. It leverages badging research and education and psychological theory to identify how badges can be designed to positively influence learners.

2. Badging Uses in Virtual Worlds

Badges can be used from a variety of purposes, such as providing feedback, professional credentialing, helping users set appropriately difficult goals, fostering curiosity, and conveying social status (Antin & Churchill, 2011; Fanfarelli 2018; Fanfarelli & McDaniel, 2015). These purposes carry into virtual worlds, but with specific considerations relevant to their implementation. While a thorough examination of all uses is beyond the scope of a single article, this article examines several badging purposes and considers how designers can apply them to badging in virtual worlds:

1. Assessing peer skill (O'Brien, Oliver, & Connors, 2013) in multiuser worlds,
2. Fostering curiosity to drive exploration (Fanfarelli, 2018)of the world
3. Setting appropriate goals to structure learning (Rughinis, 2013) about the virtual world
4. Teaching users through feedback (Devedzic & Jovanovic, 2015) to help them learn about the virtual world.

For each purpose, examples are used to demonstrate how the recommendations might be implemented in different contexts. Varied examples are chosen to demonstrate how these principles relate to a selected variety of domains and applications using virtual worlds, but not to suggest that they are only limited to the specific presented applications.

2.1. Assessing Peer Skill in Worlds with Many Users

In general, virtual worlds are multiuser environments, which may range from a few to thousands of users. When the number of users is small, instructors, players, and other interested actors may easily identify and track the skill of other users, much like knowing the skill of teammates on a real-world sports team. However, when that number becomes unwieldy, assessing

and tracking skill, ability, or experience can become quite difficult (Billington, 1997). In World of Warcraft, players may need to assess other players' capabilities in order to decide if they would be worthy allies in difficult challenges, such as raids – challenges that 10-25 players attempt to complete over the course of several hours (Flueggen, Doyle, & Veith, 2018). If these players are too weak, the group will be unable to succeed, resulting in nothing gained and time wasted. For example, raid success is partially determined by the raid leader's ability to learn the intricacies of the raid battles and help other members understand the specific situation being faced (Williams, Kirschner, & Suhaimi-Broder, 2014). Although some players will know the skills of others because they are friends or part of the same guild, most players will often have to team up with players they do not know, and will need to assess if these players are fit to be their companions in the challenge that is to come.

When digital badges are viewable to all users in a particular learning environment, they can be used to quickly communicate a learner's skills or abilities (Hickey, Willis, & Quick, 2015). World of Warcraft is used as an example because it does this quite adeptly through their badges, which they refer to as "achievements," a common synonym for digital badges in video games (Fanfarelli & McDaniel, In Press). Before allowing a new player to join their group, many users will first examine that player's achievements to see their previous accomplishments. For example, a player looking to try the heroic (i.e., harder) mode of the Azjol-Nerub dungeon might choose to see if prospective group members have first unlocked the achievement for defeating the strongest monster in the normal mode of the dungeon. Players who have achieved this feat are ready to progress to the harder challenge and are more likely to be successful in learning the unique quirks of the monster's more difficult variation.

While World of Warcraft has a badging system that aids skill assessment, many games do not. For example, Pokémon GO is an augmented reality game that generates a virtual world using real-world map data on mobile devices. Players catch and train monsters called Pokémon, and may choose to use them to fight exceptionally powerful versions of the Pokémon (i.e., raid battles, not to be confused with the raids in World of Warcraft). Many of these Pokémon cannot be defeated without the aid of multiple powerful allies. Each Pokémon has particular elemental strengths and weaknesses, and thus certain species of Pokémon will be stronger against certain others (e.g., fire types are strong against grass types). Thus, the strength of an ally is relative to the specific Pokémon being faced and includes a number of factors. More powerful allies will have:

- The species of Pokémon that is a strong counter to the Pokémon being faced.
- Higher combat power for those Pokémon.
- The best abilities for those Pokémon.
- Skill in predicting the enemy's most powerful moves, so that they can dodge them and survive longer.

Other factors exist, but these accurately describe the main concerns. While Pokémon GO currently has a badging system called "medals," these badges have two major flaws. First, the badges are not visible to other users, and thus cannot be used for peer skill assessment. Second, even if these badges were visible to peers, none of the badges provide insight into the factors that are characteristic of a skilled raid battler. With some exceptions that also do not concern raid battling skill, they are primarily focused on the game's collection mechanics (e.g., number of Pokémon caught).

However, this system is ripe for expansion to better aid peer skill assessment. Pokémon raids are organized into tiers (Juselius, 2017), where Tier 1 (T1) contains the easiest bosses, which can easily be defeated by one player, and T5 contains the most difficult bosses, which cannot be defeated

alone, except under very specific and rare circumstances that do not characterize normal gameplay (e.g., glitches and exploits). In the middle of the tier system, T3 raids are typically the highest tier of raid that can be defeated by a solo player, but only by more powerful raid battlers as the player must have strong counter species, with the correct moves, and of high combat power in order to succeed. Thus, a useful sequence of badges might target skill in T3 raids:

- Tier 3 Contender – You have defeated a Tier 3 raid boss without help from any allies.
- Tier 3 Battler – You have defeated 5 unique Tier 3 raid bosses without help from any allies.
- Tier 3 Champion – You have defeated 10 unique Tier 3 raid bosses without help from any allies.

A user who is able to defeat 10 unique T3 raid bosses is likely to possess powerful Pokémon of a range of different elemental types, with the best abilities. Thus, seeing the Tier 3 Champion badge would help a player understand that person's strength as a potential ally for fighting T5 raid bosses. Likewise, a player that has none of these badges is probably a lower-skilled player, and may not be sufficient for defeating more powerful raid bosses.

2.2. Fostering Curiosity to Drive Exploration

Virtual worlds are digital spaces that afford user exploration. Whether in small confined worlds, or large expansive continents, exploring the environment will help users to learn about their virtual surroundings. This may be important for creating fun in video games, teaching a Soldier about a hostile foreign environment in military simulations, or familiarizing a doctor with a field hospital after a natural disaster. While these environments may hold great learning value, they will not be able to transfer that value if the learner is not inspired to explore that world.

Fostering curiosity is one way to motivate users to explore and learn (Kidd & Hayden, 2015; Ryan, 1982). Curiosity, in the realm of learning, is a state of mind that involves a strong desire to acquire information or experiences (Lowenstein, 1994). Not only does curiosity's presence motivate learning, it has been shown to improve memory through activation of the brain's reward centers (Gruber, Gelman, & Raganath, 2014; Kang, Hsu, Krajbich, Loewenstein, McClure, & Wang, 2009; Von Stumm, Hell, & Chamorro-Premuzic, 2011). For these reasons, curiosity is an interesting mechanism for motivating users in educational contexts.

Curiosity is derived from an ideal-sized gap between current and desired understanding or knowledge (Lowenstein, 1994). If the gap is too large, the learner will be uninterested or frustrated. If the gap is too small, the learner will achieve their goal with ease and feel boredom. Digital badges can manipulate this gap (Fanfarelli, 2018) in order to inspire curiosity for the virtual world and encourage exploration.

Consider a user in an expansive virtual world, as one might find within a Massively Multiplayer Online Role-Playing Game (MMORPG). Designers may masterfully craft such a world to motivate players to explore by promising unique and aesthetically pleasing environments, interesting creatures, and NPCs with tales to tell and quests to give. However, exploration lies upon a continuum of varying granularity. While a jungle biome full of lush flowers and colorful dragonfly-like creatures may draw a player's attention, at what point does she feel as though she has seen everything? After noting there are really only five flower variants, and that the bugs do not seem to drop any interesting loot, the player may move forward to the next area. Certainly, designers, modelers, and animators could include even more variety to inspire deeper exploration, but asset creation is costly, and they will reach a limit where return on investment is no longer sufficient to justify further asset development.

As the player begins to feel that she has nothing more to learn or earn from the biome, she begins to experience a closing of that gap that inspires curiosity. She perceives that her present understanding matches her desired understanding, and her efforts will no longer be fruitful. Curiosity has waned and it is time to move on to the next thing. This scenario is ripe for a badging intervention. While asset development is costly, badge development is relatively inexpensive. Badge design requires little effort in comparison to designing a new 3D model, and one badge's design can be used over and over again, with little modification beyond new text. Perhaps after the player completes the final primary quest in the jungle, she is notified that a new badge is available:

- A Closer Look – Not all that glitters is gold, but a sparkle beneath the water should be treasured. What secrets lie beneath the jungle's shallows?

With this "A Closer Look" badge, the player is given a riddle that teaches her about a missed secret in the biome she thought she had finished exploring. This badge widens the gap between current and desired knowledge, and curiosity emerges, motivating the player to explore deeper. Perhaps she begins searching through the water and notices some glittering objects, which she begins to collect. Eventually, these combine to form a valuable item or interesting boss battle to reward the player, teaching her that solving future badging riddles are likely worth her time.

2.3. Setting Goals of Appropriate Difficulty

While badging can help players set useful goals that allow them to find more usefulness in an environment, designing effective badges necessitates an understanding of which goals are actually useful. Expected Badges, or badges that explain their completion logic (i.e., earning requirements) to users before they are earned (Blair, 2011), are inherently goal-setting aids (Fanfarelli & McDaniel, 2015); they define a task that should be completed, and offer a reward for its completion. Further, badging completion logic is structured similarly to goals in a learning environment. When designers create badging completion logics that integrate learning goals, badges can motivate students to guide learner effort toward meaningful learning tasks, or otherwise structure the learning within a virtual world. This is important because learners, especially novices, learn more when learning is structured (Kirschner, Sweller, & Clark, 2006).

Large expansive virtual worlds can be overwhelming and may incite confusion or indecision in a user without guidance or structure. With so many possibilities, the learner is tasked with identifying the *right* path – not attempting to achieve goals that are far beyond their abilities or wasting effort on those that are too simple and do not lead to growth. In order to inspire the most learning without overwhelming the learner, goals should be of moderate difficulty (Locke & Latham, 2002). However, moderate difficulty looks different for each learner. After all, each learner has their own prior experiences, knowledge, and qualifications that may make them more or less advanced when they attempt to complete tasks within a virtual world. In this instance, it is useful to have a system that can suit each learner.

While the previous badge example about the glimmer in the water did not require any prior experience, except a basic foundation in reading and an understanding of where the water was located, some goals may only be achievable by more advanced learners. Consider a driving simulator used at a driving school, where the learner is a new driver placed into a virtual world that simulates the real world. A badge is available to her:

- A Shifty Situation – Drive a manual transmission car through the city course in heavy traffic while it is raining, without stalling or colliding.

A person driving a virtual or real car for the first time is unlikely to be able to succeed at this task. Simply getting a manual transmission (i.e., stick shift) car into first gear without stalling is likely to be a difficult task, never mind doing it again and again in stop and go traffic while dealing

with a wet road and worrying about lane changes. However, more advanced students who have either been at the school for a while, or have driven extensively with their parents at home, are more likely to be ready for this challenge. In a situation like this, a series of badges can be prepared to accommodate for the range in learner ability:

- A Shifty Situation I – Shift into first gear 10 times in a row, without stalling.
- A Shifty Situation II – Drive through the city course on any setting, without stalling.
- …
- A Shifty Situation V - Drive a manual transmission car through the city course in heavy traffic while it is raining, without stalling or colliding.

These incremental badges (Blair, 2011) represent a series of tasks at slightly increasing levels of difficulty and represent the badging correlate to scaffolding in traditional instruction. With this range of badges, even the most novice of learners will find tasks that provide moderate challenge for their present skill, with opportunity to slowly build upon that foundation until they reach mastery. On the other hand, stronger drivers can target the more advanced badges to find their moderate level of difficulty and learn most effectively.

However, the desire to create moderate difficulty poses a problem for advanced learners. If they must complete the first several badges in order to progress to the more advanced badges, they will be experiencing very little difficulty and may find themselves bored or simply wasting time by not growing from the goals they are completing. In many cases, learners will have some sort of instructor available to them. This instructor can assess the learner's base skills through an initial test, and manually issue the badges that are clearly beneath their capabilities, allowing them to immediately move to the harder challenges. When an instructor is not present, a similar test can be created within the game world, by asking the user to progress through a pretest scenario that evaluates subskills (e.g., shifting, maneuverability, prediction/reaction) and then assigns the proper badges or issues the earlier badges. This approach may be especially worthwhile if the simulation is likely to be used by a large number of users, and instructor costs can be saved on a large scale.

2.4. Teaching Users about the World through Feedback Badges

As learners attempt to complete their moderately difficult goals, or otherwise perform actions in the virtual world, it is important for them to understand when their actions are productive, beneficial, or otherwise positive. If learners know they are performing positive actions, they can continue along that path of success; if learners understand their shortcomings, they can consider ways to change course or improve (Nicol & Macfarlane-Dick, 2006). Feedback is the mechanism by which this occurs. Feedback is defined as information given to a learner to help them better understand their performance or comprehension (Hattie & Timperley, 2007) and is a key factor in the learning process (Black & William, 2009).

Consider a learning game where players are immersed in a virtual forest to learn about safe foraging for survivalists. In such a game, players might be required to search the area for plants, fungi, and other natural products that are either edible (e.g., mushrooms, birch bark) or useful for medicinal purposes (e.g., mint as an antiseptic). Players must first identify all of the things they believe are useful, and then put them to use for their specific purposes – designating which are edible, which are medicinal, and so on. Three pieces of information would be useful for this purpose: (1) did the player find all of the useful products? (2) Did the player choose a product that is not useful or is dangerous? (3) Did the player designate the right uses for each product?

In this instance, badges are not only useful for rewarding correct behavior and providing evidence of the learner's progress, but also for providing feedback to help the learner better

understand her performance (Fanfarelli & McDaniel, 2015). With this information, she can continue to perform positive actions in future trials, while adjusting to correct her negative actions. For example, perhaps the learner successfully identified some of the useful herbs, but not all of them:

- Herbalist in Training – You have successfully identified *two* useful herbs. There are still more around, can you find the rest? Perhaps you should check *by the water*.

As soon as the learner believes she has finished the task, she is met with the "Herbalist in Training" badge, providing immediate feedback that integrates acknowledgment of the learner's successes alongside the constructive criticism and helpful advice – all qualities which enhance learning via feedback (Nicol & MacFarlane-Dick, 2006). Note the italicized portions of the badge's description. Using if-then coding logic, this badge can be customized to the learner by detecting how many herbs have been identified, and where the remaining herbs reside. In this manner, the badge delivers personalized feedback and advice to help the player continue to succeed. Further, the badge can be upgraded with each additional success to continuously acknowledge the player's progress.

Another mark of effective feedback is its ability to build upon previous feedback (Kluger & DeNisi, 1996). When feedback builds upon previous feedback, it allows the learner to integrate the new with the old and gain a more holistic understanding of her successes and shortcomings. Multiple badges might be designed with this sort of feedback progression in mind:

- Herbalist in Training – You have successfully identified *[number]* useful herbs. There are still more around, can you find the rest? Perhaps you should check *[location]*.

Once the learner identifies all useful herbs, the "Herbalist in Training" badge can upgrade to the "Herbalist Gatherer" badge to credential her ability to identify useful herbs while also letting her know that she has finished the task successfully, and is ready to move onto the next task:

- Herbalist Gatherer – You have successfully located all useful herbs in the forest. Now, do you know the uses of each herb?
- The next badge takes the form of the original badge, but in relation to the use of each herb:
- Survivalist in Training – You have correctly named the uses for *[number]* of the herbs, but not all were correct. Consult the *water plants* section of your survival guide.

Again, the number of correct responses can be identified through if-then logic and used to personalize the badge. The second italicized part can be used to point the user toward the correct resource for learning about which herbs they misclassified, providing personalized and directed guidance for improvement. This badging system could be expanded to account for progressively more challenging levels, the presence and need to avoid toxic plants, more difficult challenges where herbs must be combined to form advanced survivalist remedies or cooking recipes, and so on. The important consideration is that these badges should be specific, personalized, and build upon each other with advice to help the learner better navigate their world and understand its contents.

3. Concerns Regarding Virtual World Badging: Unnecessary Badging

While there are many ways that badges can be designed to achieve their purposes, there are also some common pitfalls that should be avoided. The overjustification effect (Lepper, Greene, & Nisbett, 1973) is a phenomenon that occurs when a user is given an external justification to a task that she was already motivated to complete. When this occurs, the original intrinsic reason for completing the task may be undervalued by the individual and replaced with the new justification. In other words, badging an activity in which learners are already motivated to partake may cause learners to forget their original motivations (e.g., knowledge gain, entertainment) and may become enthralled in the badge hunting metagame. When badges are removed or not present in a subsequent

experience or portion of the same experience, the user may not revert to their original intrinsic interest in the experience, and may find herself lacking motivation to complete it.

In other words, badging, when used improperly, can actually lower motivation (Blair, 2011). When discussing exploration of virtual worlds earlier, this article discussed the original intrinsic motivations for exploring (i.e., joy of discovery of attractive and useful assets). Badges were only integrated at a point where the intrinsic motivation began to wane – not before, lest the overjustification effect becomes a problem. To that point, badges should never be implemented without purpose. While it is true that badge development is typically cheaper and faster than developing assets and intricate questlines, badge development still requires time and effort. As such, it is important that virtual world designers consider which gaps are most appropriate for badges to fill, and which could be better filled by pre-existing mechanisms.

4. Conclusion

This article has examined several pedagogical uses of virtual world badges for both education and entertainment. However, some limitations exist. First, while existing research was used to derive the recommendations made in this article, these recommendations are the result of the author's interpretation and consideration. Thus, future research must empirically test these recommendations before designers can implement them with full confidence. Meanwhile, this article provides them as preliminary guidelines for design, and a signpost for future empirical research. A second limitation resides in this article's sampling of badging uses. While this article examined several different uses of badging in virtual worlds, it is not exhaustive. Many other uses exist and require intense study. One of the more interesting potential uses of badges in virtual worlds pertains to more subjective interactions, and teaching players to be better in social situations. For example, how can designers use badges to curb offensive behavior, and to teach players to behave pro-socially (Ivory et al., 2017)? This, among other issues, will be important in progressing our understanding of digital badging design for virtual worlds. However, regardless of the particular purpose, badges must always be designed thoughtfully and integrated seamlessly with other aspects of a system's design. In this manner, badges can achieve their intended purpose, while avoiding the potential limitations associated with badging.

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