Chapter 14
Toward a Comprehensive Theoretical Framework for Designing Digital Badges

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Abstract Digital badges, as emerging trend in education technology, present a new means of assessment in the form of granular microcredentials. The problem facing educators is that distributed learning across various domains and contexts is not captured or structured effectively. This chapter will attempt develop a framework for designing digital badge systems to help address this issue. The authors first present a range of related theories that could support the design of digital badges, including enabling learning autonomy and personalization from the self-regulated learning perspective, goal setting, and pertinent motivating factors found in digital games. The culmination of these theories is then presented as a comprehensive framework which, in turn, could possibly lay the foundation for the design and implementation of digital badge systems.

Keywords Digital badges • Theoretical framework • Self-regulated learning • Goal setting • Reward systems • Video games

1 Introduction

A major problem facing educators in distributed learning is that assessment across various domains and contexts is not captured or structured effectively. Digital badges, as emerging trend in the field, present a new type of assessment in the form of granular microcredentials with the potential to address this problem (Gamrat, Zimmerman, Dudek, & Peck, 2014). Digital badges offer flexibility to learning and assessment that would be difficult to achieve through traditional modes of assessment. They function as a statement of achievement similar to a certificate or degree but are often much more granular in their representations of accomplishment (Gamrat et al., 2014). One advantage of using digital badges is that they can represent varying degrees of mastery and specialization within a learning program

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(Abramovich, Schunn, & Higashi, 2013). Utilizing educational badges in learning programs may also change a participant's achievement goals, as well as his/her values and expectations for success (Gamrat et al., 2014). Additionally, by allowing participants to choose their learning path, and clearly defining the conditions for success, designers provide a learning environment that is more likely to lead to motivate and engage learners (Dickey, 2005).

Despite the increasing popularity of digital badges, the field is still in need of a theoretical basis that is drawn from well-established learning and design theories. There is also a needed rationale for incorporating this tool into instructional design. The chapter aims to offer a comprehensive framework by reviewing related theories and research findings, which, in turn, could possibly lay the foundation for the design and implementation of digital badges.

2 Survey of Contributing Theories

This section will briefly review the pillared theories that could contribute to the theoretical framework; including self-regulated learning and related elements, and theories related to the motivational design of gaming. Applicable elements from relatively foundational theories, such as adult learning theories (i.e., andragogy), Cognitivism, general motivation theories, and behavioral theories are discussed in the actual model due to their similarity with the major contributing theories. These theories will be discussed in their relevance to digital badges and culminate in our theoretical framework.

2.1 Self-Regulated Learning

Self-regulated learners are active participants in learning who employ metacognitive, motivational, and behavioral self-management strategies to achieve their goals (Zimmerman & Martinez-Pons, 1990; Zimmerman & Pons, 1986). Self-regulated learning is a strong predictor of success across disciplines, academic groups, and contexts. It is further enhanced through the creation of attainable goals and subgoals in tandem with structured feedback from those goal systems (Bergamin, Werlen, Siegenthaler, & Ziska, 2012). For these reasons, self-regulated learning theory is important in understanding how to encourage student learning autonomy and ensuring academic success. In a curriculum with digital badges, learners often personalize their learning and demonstrate ownership and responsibility over the learning process. They also require a lesser degree of imposed structure. In response, the availability of digital badges is likely to help self-regulation because the inclusion of digital badges recognizes learners' desire for control and autonomy and largely supports personalization of learning goals. When a learner is working toward earning digital badges in any learning environment, he or she is very likely required to

regulate his or her own learning to some degree. Therefore, perspectives from self-regulated learning will certainly help shed light on the design of digital badges and digital badge systems.

2.2 Self-Efficacy

Goal-setting behaviors largely depend on the learner's awareness of their own knowledge and skills; known as self-efficacy. Simply described, self-efficacy is regarded as a learner's perceptions of the effectiveness of their skills and abilities in a given situation (Bandura & Schunk, 1981). Self-efficacy helps learners understand what they are capable of and informs them of what they are able to achieve by measuring their performance against a standard (Bandura & Cervone, 1983; Bandura & Schunk, 1981). The importance of self-efficacy in self-regulated learning is linked to students' understanding of their current knowledge or abilities and the level of effort they need to produce to achieve success (Cheung, 2004). Students are also more likely to enact self-regulation if they understand what they are capable of in a given context and are motivated to perform. In this regard, digital badges and well-designed digital badge systems might serve to promote learners' self-efficacy by providing a standard against to judge their current skills and abilities, and providing a motivational construct to promote continued success.

2.3 Game Motivation

Motivational theories related to digital games could lend some unique perspectives to the design of digital badges, especially those related to game reward systems and learners' choices and perspectives. "The parallel between game-space design and learning-environment design reveals some of the potential that the design of popular computer and video games may hold for the field of instructional design." (Dickey, 2005, p. 72) While Moon, Jahng, and Kim (2011) demonstrate that reward systems are structured similarly to exponential learning models, Dickey (2005) states that "game design provides assistance to instructional designers not in the form of a system or a formula to be applied, but rather as a type of architectural model for promoting engaged learning" (p. 79). Game design and motivation theories were major contributors of the proposed framework because games embody many principles necessary for self-regulated learning. Feedback mechanisms in games provide an objective basis for self-efficacy that directly affects learners' ability to self-regulate their learning. Good games scaffold goals and allow for player freedom to choose and engage with those goals on their own volition. Good games also require players to self-manage their time, efforts, and attention and to reflect on their play to optimize their performance. These features and properties provided important insights to the development of the proposed theoretical model.

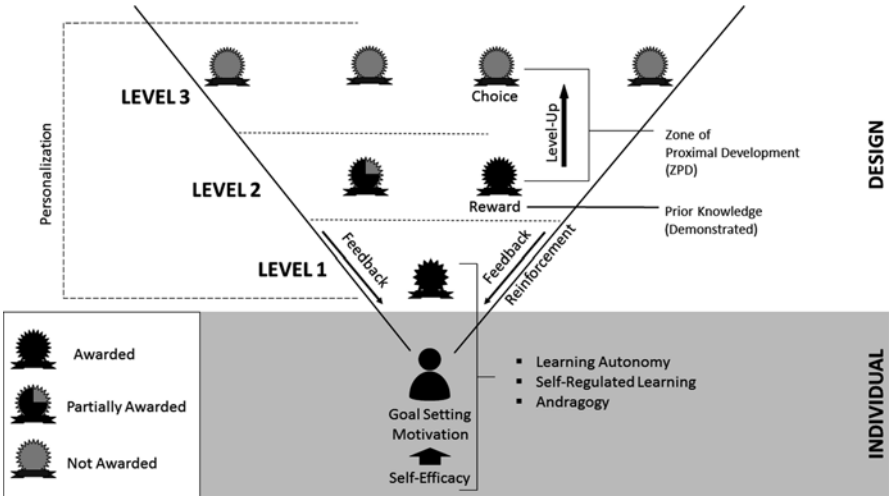

Fig. 14.1 Proposed theoretical framework for digital badge design

3 The Proposed Theoretical Model

Based on the pertinent theories above, a theoretical model is created to offer particular perspectives for digital badge system design. Figure 14.1 shows the model.

The framework consists of two major levels: *individual* and *design*. The individual level depicts the cognitive, psychological, and emotional processes that could affect a learner during his or her goal-setting and badge-pursuing activity. The design level describes the environmental factors to be considered when designing a training curriculum with digital badges. In the section below, we will further discuss each level, their respective elements, and the interaction between the two levels in detail.

3.1 Individual Level

3.1.1 Learning Autonomy, Self-Regulated Learning, and Andragogy

According to Knowles' principles of Andragogy (1984), adults should be the agent to plan and evaluate their instruction. If the learning subjects are of immediate application to their profession or life, they will be more interested and motivated in the learning tasks. As a result, one orientates his or her learning goals based on their needs and motivation. The core ideas of Andragogy are strikingly similar to the concept of learning autonomy in self-regulated learning theory.

Self-regulated learners initiate and direct their efforts in attaining knowledge and developing skills. According to Paris and Paris (2001), a core concept in self-regulated learning is learner autonomy and control through which the individual, being cognizant of his/her strengths and weaknesses, directs their own actions, adjusts learning goals, and expands expertise toward self-improvement. That is, the learner's freedom and sense of control over their learning is required for self-regulated learning.

3.1.2 Self-Efficacy

Self-efficacy is the measure in which learners believe in their ability complete tasks and goals. This informs the learner's personal goal setting strategies and is fed by feedback from the learning program with which they are engaged. In the proposed framework, self-efficacy is informed by feedback from the learner's engagement with the badge system, and acts as an affective component in their ability to self-regulate their learning. The feedback from the digital badge system includes goal completion, future goals, goal progress, and overall program standing. This information provides learners with essential information to inform their beliefs about their abilities based on their accomplishments. A learner's self-efficacy would also affect their goal setting behavior and planned engagements with the digital badge system.

3.1.3 Goal Setting

According to Maslow's hierarchy of needs (1943), an individual has innate growth need once the basic needs are satisfied including physiological needs, safety, belongingness and esteem. Self-actualization, as a major need for growth, is characterized as a concern about personal growth. In the pursuit of professional growth and personal competence, one looks for opportunities and sets up academic and nonacademic goals for further development. One's motivation, both intrinsic and extrinsic, affects the individual's commitment to the goal (Malone & Lepper, 1987). Commitment to academic goals relies heavily on the influence of self-efficacy both toward academic achievement and for self-regulated learning, as well as personal goal setting (Zimmerman, Bandura, & Martinez-Pons, 1992). Ones' commitment to goals could be partially described as self-motivation (Bandura & Schunk, 1981). Students' perceived intrinsic value of learning materials acts as a predictor of student motivation to employ cognitive strategies and engage in self-regulated learning (Pintrich & De Groot, 1990). The object of the digital badge system is to foster self-regulated learning through the scaffolding of skills and presence of learner autonomy within the system. In such a system, once learning objectives for a subgoal are met learners are rewarded with a badge recognizes their new skill, ability, or achievement.

The concept of reward is rooted in behaviorists' theories (e.g., Skinner, 1938; Thorndike, 1905). These theories dictate that reinforcements and punishments as consequences to a behavior can influence the association between a stimulus and a behavior. Similarly, Knowles (1984) also recognized the role of one's prior experiences including failure and mistakes in one's goal setting behavior.

Principles derived from behaviorism also cautioned us that stimuli with consequences should be properly arranged in the learning environment. In the case of digital badges, it is important to note that this type of recognition should not be rewarded for mere progression through a program (e.g., "Completed Unit 2"), but specifically mark a skill, ability, or achievement that is meaningful and specific (e.g., "Get Published," "Web Developer-Level 1"). There should be an obvious gain in skill or ability that the badge represents, not replaces. In addition, new competencies should build on, advance, or relate to previous achievements (e.g., "Web Developer-Level 2," "Conference Presenter"). In short, digital badges serve as a certifiable indication of competency and goal completion. Learners will be motivated to gain recognition through learning and demonstrating ability embodied in a badge.

3.2 Design Level

3.2.1 Goal Scaffolding (Within the Zone of Proximal Development)

In the proposed framework, individual badges represent subgoals that should be structured so foundational knowledge and/or skills are achieved before progressing to more advanced subgoals, and build on or utilize earlier competencies. This design consideration is consistent with cognitivists' theories that stress the role of prior knowledge and specifically offered guidelines about the chunking and sequencing of new information to promote understanding. Learning occurs when new knowledge is connected to prior knowledge through mental processes in a meaningful way (Gagné, 1985). Subgoals should also be categorized based on the level of skill required to complete (e.g. entry level, intermediate, advanced, etc.). Distal goals are broken down into proximal subgoals, and are ordered from entry-level skills or competencies to the more the complex as a learner progresses through the digital badge system. Distal goals mark a general domain competency that are achieved through the demonstrated abilities of the learner. Distal goals should represent the culmination of knowledge and skills built from the acquired sub-goal achievements. Finally, subgoals need to have clear criteria for their accomplishment including demonstrated skill through documentation or artifacts.

Using a progressive, scaffolded subgoal system provides enough structure for learners to choose the proximal subgoals that they want to focus on without leaving them completely to their own devices. Ordering progressive skill learning in this way gives learners both choice and structure which will ideally lead to increased autonomy and self-direction.

3.2.2 Level-Up Feature

The proposed *level up* feature in digital badge systems shares in Vygotsky's idea of the zone of proximal development (ZPD). The zone of proximal development characterizes mental development *prospectively*, in contrast to actual development which characterizes the development *retrospectively* (Vygotsky, 1978). For the purpose of digital badges, recognizing learners' actual skills through badging, and providing a framework of prospective competencies (i.e., existing in the ZPD), would be advantageous to the development of self-regulated learning behaviors. The level up feature builds on this idea by positioning entry-level goals (e.g., badges) early in the system (e.g., level one), and progressively building on those early competencies to "unlock" higher-order skills and competencies. The level up area acts as a resting point after the completion of a goal in which learners can reflect on their accomplishments and determine a new goal direction. The level-up design also makes the feedback or consequence explicit to learners so that they can adjust their goals accordingly. In the proposed framework, a level can be unlocked through the completion of some or all of the skills of a lower level depending on the nature of the learning program. This is consistent with the cognitive view that prior knowledge must be mastered for further learning to take place.

3.2.3 Choice and Perspective

Dickey (2005) reveals that providing participants with choices in learning and achievement might sustain interest and engagement over time. Dickey (2005) is aligned with Moon et al.'s (2011) assertion that "level up" areas are helpful in grounding participants in their learning environment by serving as a break from the "action" which they receive important information (p. 74). Also, Dickey (2005) suggests that a perspective shift between bird's eye and first-person changes the type of experience, engagement, and strategy of a player from planning to encountering, respectively. This is important to note because it informs how instructional designers should approach the design of their badging environments. Namely, that first person perspectives are much more reactionary and immediate, and the bird's-eye perspectives are more contemplative and strategic. Both of these perspectives have merit and application. The first-person perspective, for example, can be compared to *participating* in a workshop or seminar, while the bird's-eye perspective can represent *planning* to attend a block of workshops or a particular seminar series. The bird's eye perspective also poses an opportunity for digital badge systems to identify and focus learning objectives, and to order them intelligently.

Common and important mechanisms in traditional games are clearly defined victory and loss conditions; with rules that are consistent with both the game and the character (Dickey, 2005). The object of all games is to achieve success through the mastery of the game's objectives. The implication for instructional design is that success, or achievement is attained by conditions that must be satisfied according to a well-defined methodology (i.e., rules) that is consistent with both the learning

objectives and the purposes of the participant within the program. For example, a nurse who is being trained on a new method of obtaining blood from a patient has a set success condition (obtaining the blood sample) that she must complete according to the new method. The rule is that she must follow the new methodology in order to achieve her objective. Any deviation from the rule (or rules) marks a failure condition. This example provides a clear learning objective and clarifies the purpose of the participant in the program. The combination of various victory and loss conditions can make up a program that requires compounded achievement. However, it is important that those conditions are consistent with the purpose of the program's learning objectives and the purpose of the participant within the program.

Dickey (2005) suggests that structuring learning programs with conditions that are consistent to the purpose of both the learner and the learning objectives also allows instructional designers to create a narrative for participants. This narrative situates participants within a learning context within which they have the freedom to pursue learning paths and gain recognition for their success. Game design provides an architecture that can inform motivating, intuitive, and effective learning environments but, there is a need to study narratives which hold interest over time in complex, multifaceted learning environments (Dickey, 2005).

The power of digital badges is in the customization of the system to meet learner needs and promoting their ability to self-regulate. Therefore, choice is central to the design of the proposed framework. The introduction of choice shifts the locus of control back to the learner to where they determine the importance, order, and timing of their learning goals. Instances of choice in the proposed framework occur at the start of the program (level 1) and at the completion of each goal (badge).

3.2.4 Personalization

Personalization is important in learning programs because of the motivational benefits participants receive (Gamrat et al., 2014). Similarly, according to Malone and Lepper (1987), the ability to control is one factor in promoting intrinsic motivation. Flexible programs in which participants can choose their learning paths and level of involvement allows them to customize their experience based on their personal needs, expertise, and the demands of their affiliate organizations. Similarly, in programs such as scouting, a display of a participants earned badges "represents a type of curriculum vitae of their learning and allows other to learn both about what a scout knows and what the scout values" (Abramovich et al., 2013, p. 219). The issuers of educational badges, whether an educator or educational organization, recognize skill, knowledge, or achievement through badges much in same way in which they award degrees or certificates; yet the recognition is much more particular. A badge display gives outsiders a more granular understanding of the learners' competencies and values compared to more traditional achievement objects such as certificates or titles. In this way, badge displays reveal the uniqueness of the learner's skill set and expertise.

Gamrat et al. (2014) explored the use of a digital badge system and in a self-regulated online environment to study how online professional development interactions and design should be supported. Their program, Teacher Learning Journeys (TLJ), was piloted as an approach to professional development that allowed participants to "customize their experience based on their workplace needs, as well as on their own expertise and interests" (p. 1). The researchers utilized a badge system with the TLJ program to mark achievement. The metadata for these badges included the following: "(1) a description of the tasks required by each PD activity, (2) the evidence of the learner's mastery, and (3) feedback provided by the expert practitioner." (p. 6). The program also provided participants with an online self-assessment tool and required them to set initial goals at the start of the program.

The researchers found that most participants chose learning paths that were sensitive to the needs and goals of their workplace, and customized their content selection based on their own particular needs. Participants also "customized the level of assessment and the specific content depth to personalize the PD training for workplace constraints" (p. 1). By planning their objectives from the beginning, participants were more prepared to articulate and assess their own needs. It is interesting to note, however, there was one participant in the study who did not start goal setting until after participating in a few sessions using TLJ. Yet, this individual still reported a benefit from using the system. In this instance, the flexibility of participants to conduct initial and emergent goal setting helped support their needs and develop expertise. The advantage of the digital badging system for the participants in this study was that it provided visual reminders of accomplishments as well as feedback and direction for their continued development using the TLJ system. Using the digital badge system as a way to personalize learning experiences proved beneficial to all learners involved in the study. While some participants needed an in-depth understanding and mastery of a concept or skill, others only needed superficial understanding or exposure to fulfill their personal or organizational needs. Allowing this form of flexibility and the inclusions of an assessment system, which provided appropriate credits for the level of competency or skills attained by participants, is important for program designers to consider when creating learning environments using digital badges.

3.2.5 Feedback

Feedback (or consequences in Behaviorism), in essence, can serve as a reward for a learner's effort. Reward systems in games use extrinsic motivators as a way of recognition for displaying certain behaviors, skills, or a complex demonstration of both (Malone & Lepper, 1987), Often performance and excellence are rewarded with new items, titles, or player status (e.g., leaderboard advancement). These rewards may not only benefit the player in the game and serve as a social status symbol to peers, but also embody real demonstrations of skills and competencies—and may be desired explicitly for that purpose (Dickey, 2005). Digital badges could be considered a form of reward for accomplishment within learning programs to boost one's confidence level according to Keller's ARCS model (1987). Therefore,

research on reward systems might provide useful insight into how to design a digital badge reward system within a learning environment. Moon et al. (2011) lend credibility to the use of game reward systems in learning programs in order to promote self-regulated learning. Their research finds that "the reward system (in digital games) is designed similar to an exponential learning model" (p. 1) and that these systems are designed in slightly different ways depending on the game's genre and their intended audience. Moon et al. (2011) also state that "[a] similar framework to the [sic] self-regulated learning (SRL) constantly emphasized by educators in the field is actually occurring naturally during digital gameplay" (p. 12). Because of the appeal of flow induction mechanisms present in these games, there have been many attempts to reconstruct it in learning model design. The authors' research examines the reward system of digital games and investigate the possibility of using similar reward systems in learning model applications. In their study, they examine both education-oriented video games and entertainment-oriented video games to find models that could be applied to learning programs. They collected data from new and experienced players and collected experience point (EXP) data from the game production companies in both categories, analyzed the level-up systems in each, and compared the data with an exponential learning model.

The researchers conclude that "if the powerful level-up area does not function distinctively or if irregular events happen without any relation to education it would be difficult to accomplish the primary goal of learning with this system." (p. 11) The "level up" area that Moon et al. (2011) describe also serves to situate learning and promote cognitive apprenticeship for participants, and could signify an appropriate application of a digital badge system. By situating the learning material, such programs allow for greater creativity and personal application (Gamrat et al., 2014). These new skills, and the recognition of such skills, provide a form of entertainment through the reward structure that parallels the achievement of success within a game context. It is as if to say "I've learned/mastered a new skill that I can use to progress even further on my journey," and to have this achievement represented in a respected icon (e.g., a sanctioned badge). Reward systems must reflect the values of both the participant and the program in which they are engaged (Gamrat et al., 2014). Ideally, a program modeled on the reward system in entertainment-oriented digital games in learning environments would create a context where growth was perpetually motivational and predictably rewarding. The appeal here is that participants would persist in programs that further their knowledge and ability.

Goal systems and feedback mechanisms have shown to increase subjects' performance and motivation resulting in greater gains in achievement (Bandura & Cervone, 1983). Students' self-efficacy perceptions are important here, as those who feel able to reach their goals but are unsatisfied with their performance are motivated to make greater gains. This effect dissipates if the discrepancy between perceptions of self-efficacy and performance feedback are too great (Bandura & Cervone, 1983) or if the goals are too general (Bandura & Schunk, 1981). Simply stating that one's goal is to be better at math for instance does not allow for the informative feedback necessary for motivation because of its expanded meaning—resulting in abstracted feedback. Therefore, it is important that distal goals are

structured into specific and attainable subgoals in order to be effectively motivating in self-regulation (Bandura & Schunk, 1981). By combining goals and performance feedback, subjects display higher gains in both performance and effort (Bandura & Schunk, 1981) and knowledge of their perceived skills and abilities are benefited by goal systems—helping them to better self-regulate (Cheung, 2004).

3.3 Design Summary

In summary, in a learning environment utilizing digital badges, learners must exercise their own learning autonomy by setting up learning goals based on their belief about their own knowledge and abilities. Beyond the individual level, the training program should not only provide level-up goals and subgoals, but also allow personalization of one's learning paths. In this way, within their zone of proximal development learners could possibly make choices appropriate for their own chosen paths. Digital badges as reward mechanisms offer feedback to the learners so that they can further adjust their choices toward achieving new goals.

4 Conclusions

This chapter has attempted to provide contributions toward a comprehensive theoretical framework to address the design and application of digital badges. Digital badges are unique in solving the problem of recognizing achievement across distributed learning programs in both formal and informal contexts. They provide educators and instructional designers a new assessment in the form of granular microcredentials that offer flexibility for both learning and assessment. Well-designed digital badge systems might also encourage self-regulated learning behaviors in learners by acting as both a goal setting system and feedback mechanism which situates learner experience and provides them with a significant degree of learning autonomy. However, there are considerable administrative and technological concerns that would prevent such a system from being put into effective use. Notably, in order to benefit as described, adoptive learning programs would by nature need to be heterogeneous and individualized. This is in stark contrast to the homogenized nature of conventional learning programs where often all learners typically focus on the same particular goals set at rigidly defined points in time. While these programs should not necessarily be discouraged from adopting digital badges as a form of alternative assessment, it is the authors' belief that digital badge systems work best when learner autonomy is central to the design of both the badge system and the learning program. This will be an administrative challenge that should be addressed in advanced. Additionally, the technological nature of both digital badges and of autonomous learning may be a challenge for learners in contexts where the implementation of either might be a significant challenge to overcome before the adoption of a digital badge system.

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