TechTrends (2018) 62:190–196
https://doi.org/10.1007/s11528-018-0249-x

ORIGINAL PAPER

Goal Setting and Open Digital Badges in Higher Education

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Published online: 22 January 2018

Abstract
While Open Digital Badges (ODBs) has gained an increasing recognition as micro-credentials, many researchers foresee the role of ODBs as an innovative learning tool to enhance learning experiences beyond that of an alternative credential. However, little research has explored this topic. The purposes of this paper are to 1) argue that one way to expand the impact of ODBs on learning is to integrate them with goal setting, 2) establish how ODBs could offer as an important tool in optimizing goal setting effects on learning, and 3) provide design recommendations for future educational practices that incorporate ODBs as a pedagogical tool.

Keywords Competency-based education · Goal setting · Gamification · Motivation · Open digital badge

As practitioners look for instructional approaches that offer flexibility, personalization, effectiveness and affordability, there has been a growing interest in innovative digital tools that can better facilitate personalized learning (Beetham and Sharpe 2013; Garrick et al. 2016). One innovation gaining recognition is Open Digital Badges (ODB), which are also known in higher education as micro-credentials (Denny 2013; Stetson-Tiligadas 2016; Cucchiara et al. 2014). However, ODB have the potential to realize learning roles beyond that of alternative credentials, becoming a disruptive innovation that can bring an alternative approach to learning that is more affordable, accessible and personalized in higher education (Randall et al. 2013). One way to expand their impact is to integrate goal setting with ODBs. It has been found that goal setting could significantly impact learning performance (Locke and Latham 1990; Locke and Latham 2002). Researchers foresee the potentials of using ODBs to facilitate student goal setting but have not provided much empirical evidence (Chou and He 2017; Frederiksen 2013; McDaniel and Fanfarelli 2016; Randall et al. 2013). An approach to integrate ODBs with goal setting will be elaborated in the following sections.

Goal setting and ODB have a reciprocal relationship that can produce two prominent benefits. First, ODB can manage the connection between goals and learning performance to optimize the effects of goal setting on learning. Secondly, the design of some goal setting related elements of ODB could strengthen learning experiences, improve learner autonomy, and facilitate the achievement of learners' intrinsic learning motivation. This article reviews the literature on goal setting and ODB to establish how ODB could offer an essential tool in facilitating goal setting and to argue that goal setting is an important factor to consider when designing and implementing ODB.

Definitions

Goals and Goal Setting

Rooted in social-cognitive theory (Bandura 1986), goal setting theory defines goals "not only as objects or outcomes to aim for but also as standards for evaluating one's performance" (Locke 1991, p.7). Therefore, stating a goal incorporates two separate meanings – "there is something I want to pursue", and "I need to perform in certain ways to get there".

Since the nature of goals includes both the target object and task performance, the relationship between setting goals and performances on certain tasks (goal effects) has always been at the center of the discussion. Research by Locke and Latham (1990)

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suggests that goal difficulty is closely related to performance. Specifically, setting difficult goals leads to higher performance than only encouraging people to do their best. Different types of goals vary in their impact on learning (Locke and Latham 2002).

Three pairs of goals were identified by previous researchers that have different or even contradictory effects on learning from each other: extrinsic versus intrinsic goals; performance versus learning goals; and, proximal versus distal goals.

Extrinsic Versus Intrinsic Goals Self-determination theory (Deci and Ryan 1985) defines extrinsic goals as those that pursue extrinsic content such as wealth, image, and fame; while intrinsic goals pursue intrinsic content such as relationships, growth, community, and health (Vansteenkiste et al. 2004). Intrinsic goals better satisfy basic psychological needs than external goals (Deci and Ryan 2000) and therefore have a positive impact on learning.

Performance Versus Learning Goals Elliott and Dweck (1988) suggest that there are two major goals that individuals pursue that have an impact on task performance: performance and learning goals. Those pursuing performance goals tend to seek positive evaluation of their ability and avoid negative ones. Individuals who pursue learning goals focus more on the development of their ability or the mastery of new tasks. Learning goals have a positive impact on learning in terms of strategy formulation, mastery-oriented response to obstacles, and sustained performance (Locke et al. 1981; Bryan and Locke 1967; Reader and Dollinger 1982).

Proximal Versus Distal goals Proximal goals are attainable sub-goals that provide immediate incentives and guides for action. Distal goals are defined as sub-goals that do not need to be achieved immediately but within a fair amount of time such as weeks, months, or years (Bandura and Simon 1977). Proximal goals can enhance motivation by providing attainable sub-goals in time while distal goals are too far from immediate needs to motivate current actions. (Bandura 1982).

Open Digital Badges (ODB)

Badges Badges are a unique type of symbol that have been used for signaling and communicating information for thousands of years. Roman imperial armies, over two thousand years ago, used shield emblems to show their authority and power. Now we apply badges in various aspects of modern life, such as scouting badges, college alumni shirts, and all kinds of membership cards. (Ahn et al. 2014, Kwon et al. 2015). Badges have also been widely used in the field of education. For example, boy and girl scouts use merit badges to represent competence in skills or completion of activities (Hinz 2006).

Digital Badges Digital badges have been used as an online representation for accomplishments, skills, or awards. According to Gibson et al. (2013), a digital badge is "a representation of an accomplishment, interest or affiliation that is visual, available online, and contains metadata including links that help explain the context meaning, process and result of an activity" (p. 405).

Open Digital Badges Open digital badges are data rich digital badges that are sharable within an open network of organizations and individuals supported by an agreed open infrastructure (Grant 2014). Initiated by Mozilla and the MacArthur foundation, the open infrastructure is a series of agreed upon standards that define how each badge should be created, what information the badge should contain, and how it should be stored and shared (Casilli and Knight 2012). Each badge is embedded with metadata that contains content about the target skills or knowledge, the criteria for accomplishing that skill or knowledge, and links to evidence showing why the badge was earned (Goligoski 2012; Peer 2 Peer University, The Mozilla Foundation, and The MacArthur Foundation n.d.). The current open badge system is still under development. The structure of the ODB provides a platform where it is possible to clarify and explain the writing/submission standards, the competence that needs to be demonstrated, the level of required stakeholder communication, and even how to improve overall credibility.

The research on Open Digital Badges in the field of education has a history of less than ten years. Prior research has identified three main roles that ODB play in education – as motivators of behavior, as pedagogical tools, and as credentials (Ahn et al. 2014). Three typical functions have been identified: capturing (validating prior learning and tracing learning progress), signaling (reviewing progress and reflection), and motivating (awarding achievement) (Cucchiara et al. 2014). However, in addition to the functional discussion on ODBs, little research has explored educators' goals for considering ODB as one of the options in their toolbox. In other words, what do educators expect to get out of using ODB? This article is going to fill this gap by providing a rationale on why ODB can be a valuable learning tool and what we can do to increase its effectiveness from the perspective of goal setting.

Understanding the Value of ODB through Goal Setting

Many researchers have argued that ODB are useful for goal setting in the field of education (Antin and Churchill 2011; Chou and He 2017; Frederiksen 2013; Gamrat et al. 2014; McDaniel and Fanfarelli 2016; Randall et al. 2013). ODB could both support extrinsic goal setting and help realize intrinsic goals. Furthermore, they can structure the meeting of meaningful sub-goals as a way of managing the goal setting

process. This section examines each of these approaches to implementation.

Use as Intrinsic Goals

ODB are often recognized as extrinsic motivators or digital achievement badges (Denny 2013; Stetson-Tiligadas 2016; Cucchiara et al. 2014). However, focusing too much on the badge itself will make it an extrinsic goal that can overwhelm personal goals and intrinsic learning goals. Some researchers propose that ODB could damage intrinsic motivation if the content or learning activities become seen only as ways to collect badges (Elkordy 2016; Rughinis 2013). Intrinsic goals can benefit learners in terms of satisfying basic psychological needs (Deci and Ryan 2000) and support long-term personal development (Elliott and Dweck 1988). ODB could serve as means to motivate and facilitate learners to achieve their intrinsic or learning goals, and they could become learning agents that provide rich learning data and high-quality learning design. Instead of using ODBs as hooks or a reason to engage with a learning activity (Rughinis 2013), we should focus more on the design of effective instructional strategies and learning activities included in the ODB. For example, when designing a badge about how to build a boat, the instructional design could include watching tutorial videos, building a certain part of the boat, and reflecting what works and what does not work.

Use as Meaningful Sub-goals

ODB can also serve as sub-goals or stepping stones in the learning and goal setting progress. The relationship between different learning paths can be illustrated through the metaphor of a map. A mapping mechanism has been incorporated into some badge systems created by early badge adopters, such as Khan Academy, Code Academy, Cousera, and some university initiated programs. For example, the University of Central Florida's information literacy program applies meta-badges of different levels to organize different scopes of learning units (David deMaine et al. 2015). The Computer Science Social Network (CS2N) utilizes badges as curriculum maps and learning pathways for entry-level to industrial-level skills as leaners' past and current progress are highlighted (Higashi et al. 2012). However, constrained by the number of badge options and the quality of the embedded instruction, these early versions of learning maps do not transform learning in a way much better than a checklist in a traditional syllabus or a study agenda written on a blackboard. They offer only a predetermined and prescribed path for learning, allowing for insufficient learner autonomy. (Willis III et al. 2016). To solve this problem, for example, we need a large pool of badge options that allow learners to set sub-goals differently and choose their own learning pathways.

Alternative approaches are necessary to make these ODBs meaningful as sub-goals for pursuing one's intrinsic learning goals. ODB could be more meaningful if they were used to foresee learning paths before learning occurs. This could only happen when the pool of sub-goal selections is big enough and learners are able to choose what learning pathways to pursue (Willis III et al. 2016). ODB could also be used to identify learning trajectories after learning happens, serving as a digital portfolio to learners' accomplishments, experiences, and activities (Gibson et al. 2013). Furthermore, ODB could empower learners with the ability to plan their learning, switch interests when they feel a need to, and make their achievement recognizable for current and future careers. For example, a college student enrolled in a mechanical engineering program could be given a list of competencies that they need to accomplish to earn the degree. In order to gain the competency in system control, he is given a pool of badges of related skills and knowledge units. All the instructional materials have been included in each of the badges. Instead of following a regular chapter by chapter and week by week school schedule, he could choose to select his own sequence of learning. He could also switch to another program like electrical engineering by collecting badges that that program requires.

Roles of ODBs in Moderating Goal Effects

Goal effects are the impact that goal setting acts have on performance, including learning performance. Locke and Latham (2002) identified four mechanisms of goal effects: first, goals direct attention towards goal-related activities; second, higher goals trigger greater effort; third, goals affect persistence; and fourth, goals indirectly affect actions by triggering the application of task-relevant knowledge and strategies. Based on these four mechanisms of goal effects, Locke and Latham (2012) further identified three main moderators in this goal-performance relationship – goal commitment, feedback, and task complexity. If these three factors are moderated in appropriate ways, goal effects on learning performance could be optimized. Utilizing goal effects as a conceptual framework, ODB has the potential to be applied as a means for activating these three moderators by serving as proximal goals, personal scaffolds, and strategy facilitators.

Enhancing Goal Commitment

There are several ways to enhance goal commitment. One of them is publicness. When goals are made more public than private, learners have greater commitment to their goals, especially difficult goals (Salancik 1977). Supported by an open infrastructure, ODB allows learners to publicly carry and display badges wherever they go or feel is valuable (Peer 2 Peer

University, The Mozzila Foundation, and The MacArthur Foundation n.d.). For example, Khan Academy encourages learners to publish their badges on Facebook (Khan Academy 2012). As a representation of learning in an open atmosphere, ODB could also be used to make a public statement of one's learning goals even before learning happens. However, little research has explored the potentials of using ODB to enhance goal commitment.

Self-efficacy also is one of the key categories of factors that facilitate goal commitment (Locke and Latham 2012) and is a strong predictor of academic persistence and performance (Zimmerman 2000). Theoretically, ODB has the potential to improve learners' self-efficacy because it grants recognition for every learning milestone so that learners can feel satisfied and confident in continuing to set new and challenging goals (Randall et al. 2013). However, little empirical evidence has been found to support this.

Providing Feedback

Summative feedback enhances goal effects because learners need to know how they are performing, whether they are on target, and how to adjust their performance strategies to match the goal (Locke and Latham 2002). ODB has the capabilities to provide prompt feedback (Besser 2016; Fanfarelli et al. 2015; Stetson-Tiligadas 2016). For ODBs that are used for pedagogical or instructional purposes, a feedback mechanism is usually built in the badge system like the *Passport* badge platform created by Purdue University (Besser 2016). But, ODBs themselves already serve as summative feedback, signaling what has been achieved and what has yet to be accomplished. ODB can also offer specific and personalized scaffolds or levels of challenge for learners to focus on small and precise goals to gradually develop their skills (Fanfarelli et al. 2015). Depending on different scopes of learning, ODB of lower levels can also be a form of formative assessment when badges build upon each other in order to master larger concepts.

Control Task Complexity

A complex goal with little scaffolding will cause evaluative pressure and performance anxiety (Locke and Latham 2002). Goal effects on performance are greater on simple tasks than on complex tasks. They are mediated by strategy development, including cognitive abilities (Wood et al. 1987). This means that if two learners have the same level of cognitive abilities and the same goal to achieve, the one who is trained in proper strategies will outperform the other. Acting as both motivators and pedagogical tools, ODB have great potential to facilitate the development of strategies. For example, different self-regulated strategies, such as metacognition, self-monitoring, planning, and modifying, could be incorporated in the design of different challenge levels within the ODB.

Discussion and New Directions

Looking at ODB as pure micro-credentials or credential presentations would limit their potential in education. ODB could also be a valuable personalized learning tool that facilitates goal setting and improves the quality, effectiveness, flexibility, and accessibility of learning.

One strong advantage of using ODB as a personalized learning tool is to optimize goal effects on learning performance. After a review of prior literature, it was shown that ODB can play a fourth role – as goal-setting facilitators in addition to motivators, pedagogical tools, and credentials. We can incorporate ODB in certain ways to enhance goal commitment, provide feedback, and control task complexity. In the following sections, we provide some recommendations for future research and possible standards that offer better promises of an effective learning in a badge-supported environment.

Define Layers/Tiers of ODB

Some early badge adopters have applied a series of badges to represent the different levels of knowledge, skills, or competencies that would indicate a progression of learning towards completing an educational goal, similar to earning a degree or diploma (Bowen and Thomas 2014; David deMaine et al. 2015; Higashi et al. 2012). For example, David deMaine et al. (2015) mention the notion of "metabadges" (p. 63) used in the University of Central Florida's information literacy badge program. In that program, students can collect a certain number of basic badges in a level to get a "metabadge" that represent the mastery of that level of knowledge or competency. However, it would be very difficult to build an open standard and develop good communication among stakeholders if people are using different "sizes" of badges in such a variety of ways. It is also very difficult to control complexity because designers have little guidance on how much information to put in a single badge. Therefore, we propose that at least within the same discipline or content area, an agreement should be reached on the categories of knowledge, goals, and competencies of each badge layer/tier; the label of badges on each level; and the amount of information a single badge should carry. Future research should explore the knowledge/skill taxonomy in a badge-supported learning environment.

Select Appropriate Components to Customize the Application of ODBs

Depending on different goals and contexts, ODBs could play different roles and take on different combinations of add-on functions for different purposes. A category of ODB can be created based on the function of its components (see Table 1). A single ODB could be as simple as just a symbol to extrinsically motivate actions or serve as a micro-credential to

Table 1 Types of Open Digital Badges

Label	Definition	Components	Potential Positive Impacts on Goal Effects
Candy ODB	Positive reinforcements or extrinsic motivators	Digital image	Enhance goal commitment and self-efficacy
Recognition ODB	Recognition of accomplishments.	Digital image + Knowledge /skill specification	Enhance goal commitment and self-efficacy
Credential ODB	Detailed formal certificate proving a learner's qualifications.	Digital image + Knowledge/skill specification + Other metadata + Open standard	Enhance goal commitment and self-efficacy; Provide summative feedback
Instructional ODB	Instruction platform and content management system.	Digital image + Knowledge/skill specification + Other metadata + Open standard + Instructional Elements	Enhance goal commitment and self-efficacy; Provide summative feedback; Control task complexity; Facilitate strategy development

recognize the completion of a certain learning task. It could also be as complex as a self-regulated learning system that fosters the mastery of knowledge and skills. These components could be used differently, depending on different purposes and contexts. For example, the digital image of a badge can be used as positive feedback to praise good work and recognize achievement, but using the embedded feedback system within the instructional badge is different (see Table 1 below). The embedded feedback system can enable personalized contextual feedback from badge owner/facilitator to collector. Future research could explore how to use these add-ons differently to better understand the conditions and parameters that enhance the promise for effective learning in certain types of badge-supported learning environments.

Using ODB at Different Stages of Learning

When thinking about ODB as recognition of accomplishments or micro-credentials, we are looking at ODB after learning has already occurred (Willis III et al. 2016). The potential of ODB goes beyond that. There is a lot of space left for future research to explore distinctive instructional and learning strategies that can be applied to different stages of learning.

Before Learning All types of ODB are useful in helping learners see the scope of learning they *will be* interacting with. Instructional strategies in this stage include interest exploration, goal identification, goal communication, and self pre-assessment. Guided by the "learning territory" consisting of ODBs, learners could foresee the pathways to accomplish their personal goals. Educators could take advantage of this learning stage to help learners explore their interest and show sequences of different possible learning pathways. Learners could also foresee what it takes to achieve certain competencies and some of the alternative pathways to achieving the same or similar goals.

During Learning Often a student recognizes a lack of interest in a program or course but is prevented by the system from making any changes (Christensen et al. 2017). To make learning flow more naturally, ODB provides new opportunities. Learning with ODB means learning with adjustable goals and interests. Many learners start with extrinsic goals and gradually find their intrinsic goals. Instead of tracking time spent on structured courses, the modularity or even atomicity of skills and knowledge recorded by ODB can represent very nuanced progress in learning. It makes it possible to switch interests and adjust learning pathways to fit one's individual goals that are always changing. For example, future ODB design could consider including a "navigation panel" that connects different layers/tiers of knowledge or skills, providing opportunities for learners to jump down or up among different tiers of competencies and to try different teaching styles for the same skill or knowledge at the same tier.

After Learning ODB that have been accomplished could be used to help set the trajectory for what needs to be done in the future. Learning with ODB allows learners to reflectively consider task requirements, review and compare their current capabilities, and then become challenged to "meet the mark that is set for them" (Antin and Churchill 2011, p. 2). This would be very important for learners to set next goals of where they want to go.

Implementing ODB as Disruptive Technology

According to disruptive theory, implementing an innovation in a way that disrupts the traditional trajectory of improvement in an area, a disruptive innovation does not provide better or even the same quality of products to the current market, but instead, opens a new market by providing affordable and simple-to-use products to "nonconsumers" (Christensen et al. 2017). In higher education, ODB could also be implemented in a way that disrupts how we traditionally teach and learn. This does not mean that applying ODB as valuable supplements to traditional courses is not disruptive. First, we need to define who are the "nonconsumers" in higher education. "Nonconsumers" could be high school students who

need AP classes to prepare for college, employees who need training and professional development in industrial settings, and learners who are home schooled or could not afford to attend formal college because of low socioeconomic status. "Nonconsumers" could also be students who are already in college but have difficulty keeping up with the school schedule, want to make up credits, feel unmotivated, or even those who just feel that they are not learning much in the traditional system. As long as ODB could provide more options for these learners who are not satisfied with the current system, then ODB are implemented in a disruptive way. In order to do that, we need to especially pay attention to four important parameters:

Quantity We need a pool of open ODBs that provide a fair number of options to free learners from pre-determined learning pathways, giving them autonomy to pursue intrinsic interests and personal goals (Willis III et al. 2016).

Quality The quality of the instructional design of each badge is at the core. All ODBs should be well designed to ensure that the instructional strategies are properly applied, substantial feedback is provided, and task difficulty is carefully monitored. For example, the instructional badges developed by Purdue University carry effective instructions, examples, explanations, demonstrations, and simulations (Newby et al. 2016).

Utility The use of ODB should be kept as simple and feasible as possible so that users from all backgrounds can easily get started on using it.

Fluidity One important value of ODB is that we can easily use them as currency to communicate acquired skills or knowledge across institutions and different stake holders (Bowen and Thomas 2014; Devedžić and Jovanović 2015). This requires more detailed standards of sharing criteria.

Learning with ODB demands continuous and iterative selecting and locating. ODB support selecting what and how we are going to learn. ODB also supports locating where we are in our intellectual travel map and select which direction to go next. Future research will enjoy tremendous space to explore what types of learners (characteristics, prior experiences, traits, and capabilities) are the best match for a customized badge-supported learning environment, what instructional strategies could support learners and educators with different goals, and how to use ODB as a bridge to connect different goals of learners, employers, educators, and other stakeholders. Moreover, an instructional design framework based on goal setting theories is also needed to plan, design, teach, and evaluate instructions in a badge-supported learning environment.

References

Ahn, J., Pellicone, A., & Butler, B. S. (2014). Open badges for education: what are the implications at the intersection of open systems and badging? *Research in Learning Technology, 22*(1), 1–13.

Antin, J., & Churchill, E. F. (2011). Badges in social media: A social psychological perspective. *Proceedings of CHI 2011 Gamification Workshop*. Canada. ACM 978-1-4503-0268-5/11/05.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122.

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology, 4*(3), 359–373.

Bandura, A., & Simon, K. M. (1977). The role of proximal intentions in self-regulation of refractory behavior. *Cognitive Therapy and Research, 1*(3), 177–193.

Beetham, H., & Sharpe, R. (Eds.). (2013). *Rethinking pedagogy for a digital age: Designing for 21st century learning*. New York: Routledge.

Besser, E. D. (2016). *Exploring the role of feedback and its impact within a Digital Badge system from multiple perspectives: A case study of preservice teachers* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses. (ProQuest No. 10151547).

Bowen, K., & Thomas, A. (2014). Badges: A common currency for learning. *Change: The Magazine of Higher Learning, 46*(1), 21–25. https://doi.org/10.1080/00091383.2014.867206

Bryan, J. F., & Locke, E. A. (1967). Goal Setting as a Means of Increasing Motivation. *Journal of Applied Psychology, 51*(3), 274–277.

Casilli, C., & Knight, E. (2012). 7 things you should know about badges [Web log post]. Retrieved from http://www.educause.edu/library/resources/7-things-you-should-know-about-badges.

Chou, C. C., & He, S. J. (2017). The Effectiveness of Digital Badges on Student Online Contributions. *Journal of Educational Computing Research, 54*(8), 1092–1116. https://doi.org/10.1177/0735633116649374

Christensen, C. M., Horn, M. B., & Johnson, C. W. (2017). *Disrupting class: How disruptive innovation will change the way the world learns* (Vol. 98). New York: McGraw-Hill.

Cucchiara, S., Giglio, A., Persico, D., & Raffaghelli, J. E. (2014). Supporting self-regulated learning through digital badges: A case study. *New Horizons in Web Based Learning*, 133–142. https://doi.org/10.1007/978-3-319-13296-9_15.

David deMaine, S., Lemmer, C. A., Keele, B. J., & Alcasid, H. (2015). Using Digital Badges to Enhance Research Instruction in Academic Libraries. In B. L. Eden (Ed.), *Enhancing Teaching and Learning in the 21st-Century Academic Library: Successful Innovations That Make a Difference (pp.59–78)*. Lanham: Rowman & Littlefield.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227–268.

Denny, P. (2013). The effect of virtual achievements on student engagement. *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 763–772). New York: ACM. Retrieved from ACM Digital Library. https://doi.org/10.1145/2470654.2470763.

Devedžić, V., & Jovanović, J. (2015). Developing Open Badges: A comprehensive approach. *Educational Technology Research and Development, 63*, 603–620. https://doi.org/10.1007/s11423-015-9388-3

Elkordy, A. (2016). Development and Implementation of Digital Badges for Learning Science, Technologly, Engineering and Math (STEM) Practices in Secondary Contexts: A Pedagogical Approach with Empirical Evidence. In D. Ifenthaler, N. Bellin-Mularski, & D.

Mah (Eds.), *Foundations of digital badges and micro-credentials* (pp. 483–508). Switzerland: Springer International.

Elliott, E. S., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology, 54*(1), 5.

Fanfarelli, J., Vie, S., & McDaniel, R. (2015). Understanding digital badges through feedback, reward, and narrative: a multidisciplinary approach to building better badges in social environments. *Communication Design Quarterly Review, 3*(3), 56–60.

Frederiksen, L. (2013). Digital Badges. *Public Services Quarterly, 9*(4), 321–325. https://doi.org/10.1080/15228959.2013.842414

Gamrat, C., Zimmerman, H. T., Dudek, J., & Peck, K. (2014). Personalized workplace learning: An exploratory study on digital badging within a teacher professional development program. *British Journal of Educational Technology, 45*(6), 1136–1148.

Garrick, B., Pendergast, D., & Geelan, D. (2016). Personalised learning, pedagogy, and E-mediated tools. *Theorising Personalised Education*, 27–46. https://doi.org/10.1007/978-981-10-2700-0_3.

Gibson, D., Ostashewski, N., Flintoff, K., Grant, S., & Knight, E. (2013). Digital badges in education. *Education and Information Technologies, 20*(2), 403–410.

Goligoski, E. (2012). Motivating the learner: Mozilla's open badges program. *Access to Knowledge, 4*(1). Retrieved from http://web.stanford.edu/group/ojs3/cgi-bin/ojs/index.php/a2k/article/view/381.

Grant, S. (2014). *What Counts as Learning: ODBs for New Opportunities*. Pennsauken: BookBaby.

Higashi, R., Abramovich, S., Shoop, R., & Schunn, C. (2012). *The roles of badges in the computer science student network.* Paper presented at the Games+ Learning+ Society conference, Madison, WI. Retrieved from http://ri.cmu.edu/pub_files/2012/6/GLS_Conference_Proceedings_June_2012.pdf.

Hinz, C. (2006). You can't get in without 'em: Badges needed for the Super Bowl come from a Maidencreek firm. *Reading Eagle*. pp. A

Khan Academy. (2012). *Share your Khan Academy badges on Facebook in style*. Retrieved March 7, 2017, from https://www.khanacademy.org/about/blog/post/23071271279/facebook-opengraph.

Kwon, K. H., Halavais, A., & Havener, S. (2015). Tweeting Badges: User Motivations for Displaying Achievement in Publicly Networked Environments. *Cyberpsychology, Behavior and Social Networking, 18*(2), 93–100.

Locke, E. (1991). The motivation sequence, the motivation hub, and the motivation core. *Organizational Behavior and Human Decision Processes, 50*(2), 288–299.

Locke, E., & Latham, G. (2012). *New Developments in Goal Setting and Task Performance*. Hoboken: Taylor and Francis.

Locke, E. A., & Latham, G. P. (1990). *A theory of goal setting and task performance*. Englewood Cliffs: Prentice Hall.

Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation. *American Psychologist, 57*, 705–717.

Locke, E., Shaw, K., Saari, L., & Latham, G. (1981). Goal setting and task performance: 1969-1980. *Psychological Bulletin, 90*(1), 125–152.

McDaniel, R., & Fanfarelli, J. (2016). Building better digital badges: Pairing completion logic with psychological factors. *Simulation & Gaming, 47*(1), 73–102.

Newby, T., Wright, C., Besser, E., & Beese, E. (2016). Passport to Designing, Developing and Issuing Digital Instructional Badges. In D. Ifenthaler, N. Bellin-Mularski, & D. Mah (Eds.), *Foundation of Digital Badges and Micro-Credentials* (pp. 179-201). Springer International Publishing.

Peer 2 Peer University, The Mozilla Foundation & The MacArthur Foundation. (n.d.). *An Open Badge System Framework: A foundational piece on assessment and badges for open, informal and social learning environments.* Retrieved from https://dmlcentral.net/resources/an-open-badge-system-framework-a-foundational-piece-on-assessment-and-badges-for-open-informal-and-social-learning-environments/.

Randall, D. L., Harrison, J. B., & West, R. E. (2013). Giving credit where credit is due: Designing open badges for a technology integration course. *TechTrends, 57*(6), 88–95. https://doi.org/10.1007/s11528-013-0706-5

Reader, M., & Dollinger, S. (1982). Deadlines, Self-Perceptions, and Intrinsic Motivation. *Personality and Social Psychology Bulletin, 8*(4), 742.

Rughinis, R. (2013). Talkative objects in need of interpretation. Rethinking digital badges in education. CHI '13 Extended Abstracts on Human Factors in Computing Systems (pp. 2099–2108). https://doi.org/10.1145/2468356.2468729.

Salancik, G. R. (1977). Commitment and the control of organizational behavior and belief. In B. M. Staw & G. R. Salancik (Eds.), *New directions in organizational behavior* (pp. 1–54). RE Krieger Publishing Company.

Stetson-Tiligadas, S. M. (2016). *The impact of digital achievement badges on undergraduate learner motivation* (Doctoral dissertation, Capella University).

Vansteenkiste, M., Simons, J., Lens, W., Sheldon, K. M., & Deci, E. L. (2004). Motivating learning, performance, and persistence: the synergistic effects of intrinsic goal contents and autonomy-supportive contexts. *Journal of Personality and Social Psychology, 87*(2), 246.

Willis III, J. E., Flintoff, K., & McGraw, B. (2016). A Philosophy of ODBs. In D. Ifenthaler, N. Bellin-Mularski, & D. Mah (Eds.), *Foundation of Digital Badges and Micro-Credentials* (pp. 23–40). Cham: Springer International Publishing.

Wood, R. E., Mento, A. J., & Locke, E. A. (1987). Task complexity as a moderator of goal effects: a meta-analysis. *Journal of Applied Psychology, 72*(3), 416.

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary educational psychology, 25*(1), 82-91.