OPEN DIGITAL BADGES: A SOLUTION TO IMPROVE LEARNING PERFORMANCE AND FACILITATE GOAL-SETTING

by

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Dedicated to Xiaohong, Hongkun, and Peng

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ABSTRACT

Author: Cheng, Zui. PhD
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Title: Open Digital Badges: A Solution to Improve Learning Performance and Facilitate Goal-Setting
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This dissertation consists of three journal articles about using open digital badges to improve learning performance and facilitate students' goal setting processes. In the first study, we investigated the impact of instructional ODBs on pre-service teachers' perceived technology capabilities and their actual learning performance in a large undergraduate technology integration course. A positive relation between using ODBs and academic learning performance was found in the study. The second study conceptually argued that the use of ODBs can positively impact learning because it helps optimize the effects of goal-setting on learning which then indirectly impacts learning performance. In the third study, we explored college students' experiences of using ODBs as an innovative approach to facilitate their goal-setting processes in a large undergraduate technology integration course. We found that ODBs could support college students' goal-setting processes by helping students connect different types of goals, improving goal commitment, controlling task complexity and providing prompt personalized feedback.

CHAPTER 1. INTRODUCTION

The ability to develop and employ tools has long been identified as one of the defining characteristics of human beings and increasing mastery of ever-more sophisticated tools has been a hallmark in the development of humankind. Instructional technologies play an essential role in dealing with many remaining and new challenges in education, such as enhancing learner motivation and personalized learning. Open digital badges (ODBs) are one type of instructional technology that has gained progressive recognition as a useful tool to enhance learning engagement (Chou & He, 2017), support self-regulated learning (Cucchiara, Giglio, Persico, & Raffaghelli, 2014), recognize accomplishments (Davies, Randall, & West, 2015; Randall, Harrison, & West, 2013; Rughiniş & Matei, 2013), increase motivation (Glover, 2013; Stetson-Tiligadas, 2016), and facilitate the goal-setting process (Chou & He, 2017; Gamrat, Zimmerman, Dudek, & Peck, 2014; McDaniel & Fanfarelli, 2016). Among the initial efforts to explore the potentials of using ODBs in learning, however, little research has provided enough empirical evidence to support the effectiveness of using ODBs in improving academic learning performance and facilitating learners' goal-setting processes in higher education. The purpose of this dissertation is to fill this gap by investigating first, the impact of using ODBs on learning performance and second, learners' individual experiences of using ODBs to facilitate their goal-setting processes in the context of higher education.

By definition 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" (Gibson, Ostashewski, Flintoff, Grant, & Knight, 2013). Open digital badges are digital badges based upon an Open Badge Infrastructure (OBI), which allows different stakeholders to access, obtain, issue, review, comment, and share the ODBs across various online platforms (Devedžić & Jovanović, 2015; Peer 2 Peer University, The Mozilla Foundation, & The MacArthur Foundation, 2011). ODBs have been used in different educational contexts to validate informal learning, to promote engagement, and to improve learning performance. For example, HASTAC provided about $2 million in grant money to support the development of ODB systems and of further research to explore the possibilities of using ODBs as micro-credentials to validate a broad spectrum of learning experiences (Gibson, Ostashewski, Flintoff, Grant, & Knight, 2015). In another example, PeerWise employed ODBs to reward students for their contributions and activities in promoting students' engagement with an online learning tool (Denny, 2013). However, other than a few empirical studies and passionate anecdotal discussions about how ODBs could be deployed in education, the effectiveness of using ODBs to improve learning and facilitate learners' goal-setting processes remains unknown.

Research Purpose and Potential Significance

This dissertation consisted of three related research studies that served two overarching research goals: first, to find empirical evidence for the impact of using ODBs on improving learning performance and skill acquisition perceptions; second, to explore learners' experiences of using ODBs in facilitating their goal-setting processes. Results from this dissertation may contribute to the field of technology integration in education by offering empirical evidence of the effectiveness of using of ODBs in teaching and learning. It also provides one explanation to why this tool can be useful in improving learning performance from the perspective of goal-setting. Additionally, practical implications can be drawn from this dissertation to guide the effective integration of this tool in teaching and learning in higher education contexts.

Researcher Worldview

Before jumping into the main body of this discussion, I will clarify my worldview as a researcher and assumptions based upon which I concluded evidence. The fundamental philosophical stance that I hold leans towards connectivism and constructionism. I believe learning nowadays takes place in a highly networked and connected world (Goldie, 2016) and human beings individually interpret and construct knowledge (Patton, 2015). Based upon this perspective, I think learning takes place through a cycle of stages; learners typically: internalize different resources from a broad network of knowledge, reflect on their prior personal experiences and compare with others', construct their knowledge individually, and share them with others in the learning community. This stance ties in with my beliefs on the importance of goal-setting and reflection in the learning process. When learners can intentionally set learning goals for themselves, strategically select appropriate resources in the network, manage and monitor the goal-pursuing process, purposefully reflect on the learning progress, and communicate with the connected community, true learning can most likely happen. Reflection also plays a vital role of translating experiences into learning. Just as Boud, Keogph, & Walker pointed out in the book *Reflection: Turning experience into learning* (1985), "too often we have seen students subjected to half digested (and half baked) practical work or work experience and to inappropriate academically oriented learning under the guise of professional education and training" (p. 7). Learning is a reflective process in which we turn experiences into knowlege, but for that process to be most effective, learners must be provided with a structure for their reflection.

As a reflective researcher in the field of education, I value the reflective experiences of each learner and believe I can learn from every piece of personal experience to solve educational problems. Engaging in educational research is a pathway for me to understand how different stakeholders – learners, teachers, instructional designers, policy makers, administrators – perceive the issues and challenges facing education today. My research focuses on the effective integration of technology for purposeful learning. When I do research, my connectivism and constructionism stances drive me to pay attention to how learners use technology in their learning processes and to help them connect with different learning networks. I am very interested in exploring how people perceive the use of technologies in learning, how technology could connect learners to a broad range of resources and opportunities, and most importantly, how learners could be more purposeful in using technologies to improve learning outcomes. In accordance with my adherence to the philosophy of connectivism and constructionism, I intentionally look for technologies that could help learners become more goal-oriented in improving learning performance. ODBs are one type of technologies that particularly drew my attention. To explore the potentials of using them in education, I conducted three studies to see the impact of using this tool on students' learning performance and goal-setting processes. Although different research design and methods were applied to match the research questions in each study, all three studies shared one overarching research question: how did learners use open digital badges to facilitate their goal-setting processes and improve learning? In the following sections, I will provide an overview of each study.

Dissertation Structure and Chapter Highlights

This dissertation has five chapters. Chapter One provides an introduction and background of the dissertation, as well as the primary research goals, questions, and methodology overview. Chapters Two, Three, and Four will each address one main research goal. Each of these three chapters focuses on one or more research questions and includes one peer-reviewed publication. Chapter Five includes limitations, implications, and suggestions for future research.

There are three studies in this dissertation. First, we investigated the impact of instructional ODBs on pre-service teachers' perceived technology capabilities and their actual learning performance in a large undergraduate technology integration course. After a positive relation between using ODBs and academic learning performance was found in the study above, we started to investigate why the use of OBDs could improve learning performance. The second study conceptually argued that the use of ODBs can positively impact learning because it helps optimize the effects of goal-setting on learning which then indirectly impacts learning performance. After the argument was made in the study above, we decided to collect some empirical evidence to support this argument. Thus, the third research study explored students' experiences of using ODBs as an innovative approach to facilitate their goal-setting processes in a large undergraduate technology integration course.

Chapter Two Overview

Although ODBs have gained increasing recognition as innovative pedagogical tools to enhance learning experiences, the effectiveness of using ODBs as learning tools is still largely unknown. This chapter focuses on the impact of instructional digital badges, one type of ODBs that have been mainly used for delivering instructions and learning activities (Newby, Wright, Besser, & Beese, 2016). It aims to investigate the impact of using instructional digital badges on students' academic learning performance and skill acquisition perceptions. The specific questions that this chapter focuses on are: 1) How did students perceive their general level of technology/computing skills after training with instructional digital badges versus traditional projects? 2) How did students perform on course assignments after training with instructional digital badges versus traditional projects? 3) How did students perform on the overall course grades after training with instructional digital badges versus traditional projects?

This research applied a quasi-experiment design to investigate the impact of instructional digital badges on two groups of students, one that was trained with traditional projects and the other that was trained with badges. Participants in this study were 150 preservice teachers enrolled in a large college-level educational technology course. The independent variable in this research was the use of ODBs, and the dependent variables were perceived technology/computing skills, course grade, and performance on course assignments. The overall construct and set up of two groups were very similar to each other in terms of the instructor, course materials, and grading schema.

In this research, we found significant increases in the perception of technology skills within both groups, and the badge group reported significantly higher gains in the perception of tech skills than did those in the traditional project group. More importantly, we found the badge group significantly outperformed those in the traditional project group on both individual assignment and overall course grade. The findings from this research provided empirical evidence for the positive impact of using ODBs on improving perceptions of technology skills, and performance in course grades and assignments, which offered a way to improve overall learning performance with the support of technology. Details of this study are included in the following publication.

Summary

- Title
    - Open Digital Badges: Effective Learning Tools
- Research Question(s)
    - How did students perceive their general level of technology/computing skills after training with instructional digital badges versus traditional projects?

    - How did students perform on course assignments after training with instructional digital badges versus traditional projects?
    - How did students perform on the overall course grades after training with instructional digital badges versus traditional projects?
- Theoretical Framework
    - Achievement goal theory
- Methods
    - Quasi-experimental study
- Data Analysis Methods
    - Independent samples T-test
- Publication Status
    - Major revision

Chapter Three Overview

In Chapter Two, it was found that the use of ODBs could not only help learners gain greater perception of individual tech skills, but more importantly, it could help learners achieve improved academic learning performance. This chapter served the second purpose of this dissertation (p.13) by conceptually exploring the reasons and rationales behind the effective usage of ODBs as learning tools from the perspective of goal-setting theories.

The core argument made in this conceptual chapter is that ODBs could be effective in improving learning because they optimize students' goal-setting effects on their learning performance. Instead of directly jumping into collecting empirical evidence to support this argument, this chapter included a focused and comprehensive literature review of open digital badge and goal-setting theories, as well as a discussion of the potential of using ODBs to improve the effectiveness of goal-setting on learning performance. Three conceptual claims were made in this chapter: First, ODBs play three important roles in moderating goal effects on learning: enhancing goal commitment, controlling task complexity and providing feedback. Second, there are four major types of ODBs. Each type consists of different components, which allow different types to have different potential impacts on goal effects. Lastly, to implement ODBs as a disruptive technology, the quantity, quality, unitality, and fluidity of ODBs are all important dimensions to consider. Details of this study are included in the following publication.

Summary

- Title
    - Goal Setting and Open Digital Badges in Higher Education
- Research Question
    - How could open digital badges be an essential tool in facilitating goal-setting process?
- Theoretical Framework
    - Goal-setting theory
- Methods
    - Focused literature review and discussion
- Publication Status
    - Published

Chapter Four Overview

This chapter continues the conversation about the reasons and rationales behind the effective usage of ODBs as learning tools from the perspective of goal-setting theories. In chapter three, it was conceptually argued that ODBs could be effective in improving learning because they optimize students' goal-setting effects on their learning performance. In this chapter, we collected qualitative data to support this proposed argument. Specifically, this chapter describes a qualitative multiple case study that investigated the goal-setting processes of four undergraduate students enrolled in a large technology course which applied open digital badges as the main learning tools. This case study answers the research question: how do undergraduate students with different self-efficacy for self-regulated learning skills (SESR) use open digital badges to facilitate their goal-setting processes throughout a 16-week hybrid course?

It was found that students used ODBs to facilitate their goal-setting processes in four different ways: connecting multiple goals, improving goal commitment, scaffolding complex tasks, and offering personalized feedback. The use of ODBs helped students connect performance goals with learning goals, motivating students to learn at their own pace. It also helped the students to become more committed to completing the learning task, providing scaffolds to complex learning tasks, and personalizing prompt feedback. Finally, the study found that students with high and low levels of SESR used ODBs differently. Details of this study are included in the publication of this chapter.

Summary

- Title
    - Using Digital Badges as Goal-setting Facilitators: A Multiple Case Study
- Research Question
    - How do undergraduate students use digital badges to facilitate their goal-setting processes throughout a 16-week hybrid course?
- Theoretical Framework

  - Goal-setting theory
- Methods
  - Qualitative multiple case study
- Data Analysis Methods
  - Qualitative data analysis method
- Publication Status
  - Minor Revision

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CHAPTER 2. IMPROVING LEARNING PERFORMANCE AND PERCEPTIONS ON SKILL ACQUISITION WITH DIGITAL BADGES

A version of this chapter has previously submitted to *Educational Technology Research and Development*.

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Abstract

Digital badges, widely known as alternative credentials, have gained increasing recognition in recent years as innovative pedagogical tools in higher education. Despite of many anecdotal and conceptual statements, the effectiveness of using digital badges to improve learning performance is still unknown. This study addressed this gap by investigating the impact of instructional digital badges on pre-service teachers' perceived technology capabilities and their actual learning performance while studying within a large undergraduate technology integration course. Results from this study offered one way to improve learning performance with the support of technology and drew implications for future scholarship in this area.

Keywords: digital badge; technology integration; learning performance; skill acquisition

Digital badges, widely known as micro-credentials that present learning experiences (Davies, Randall, & West, 2015; Mah, Bellin-Mularski, & Ifenthaler, 2016; Randall, Harrison, & West, 2013), have gained increasing recognition in higher education as innovative pedagogical tools to enhance learning experiences (Gamrat, Zimmerman, Dudek, & Peck, 2014; Santos, Almeida, Pedro, Aresta, & Koch-Grunberg, 2013; Wallis & Martinez, 2013). For example, graphic design and web design badges were used in a college-level visual arts and design course as grade predictors (Fanfarelli & McDaniel, 2017). In another study, Gamrat et al. (2014) used digital badges to personalize and support teachers' professional development. However, the effectiveness of using digital badges to improve learning performance is still largely unknown. The current study begins to address this gap by investigating the impact of instructional digital badges on not only pre-service teachers' perceived technology capabilities but more importantly on their actual learning performance while studying within a large undergraduate technology integration course.

Theoretical Framework

This study was built upon and guided by achievement goal theory (Elliott & Dweck, 1978, 1980, 1988). This theory was developed to explain why people attempt to achieve certain objectives (Urdan & Maehr, 1995). Key elements of the theory are performance goals (frequently referred to as ability goals) and learning goals (also known as mastery goals). According to Grant and Dweck (2003), people focused on performance goals want to validate their ability or avoid demonstrating a lack of ability; whereas people focused on learning goals want to acquire new knowledge or skills, thus improving their abilities. In the face of obstacles and challenges, people with a focus on learning goals are likely to be more persistent and focused on mastery-oriented behaviors such as understanding and growth while those focusing on performance goals tend to give up easier and avoid additional challenges.

Like many other constructs in psychology, scholars defined goal achievement in different ways. Maehr and Zusho (2009) proposed five assumptions that intersect different perspectives of achievement goal theory. First, the theory is built on an assumption that motivation is an operational function that is discernable through students' beliefs and behaviors such as choice of activities, quality of task engagement, persistence, and performance (Nicholls, 1984). Second, competence is at the core of goal achievement theory. From the perspective of learning goals the focus is on the development of competence; whereas, from a performance goal perspective the focus is on the demonstration of competence (Kaplan & Middleton, 2002). Third, goals unify and link behaviors, thoughts, and emotions in coordinate systems. Achievement goals can trigger motivational systems that lead to certain behavioral, cognitive, and affective consequences (Dweck, 1992). Finally, goals are intertwined with self-related processes, that is, people focusing on performance goals hold a stronger awareness of the self than those focusing on learning goals, who concentrate more on the task at hand (Kaplan & Maehr, 2007).

The achievement goal theory informed our study by providing an approach to understand student motivation and performance in achievement situations, thus offering a framework to understand why and how digital badges may help students increase their learning performance. We believe the use of technology can help students achieve better learning performance by triggering motivational systems that unify cognitive, affective, and behavior processes. Thus, we drew on achievement goal theory to explore the impact of using instructional digital badges on student learning performance and skill acquisition perceptions.

Literature Review

Badges have been used for centuries as a form of visual representation. They have come to signify group membership, authority, experience, and even achievement (Halavais, 2012). For example, the corporate name badge signifies a person's membership to a specific group; whereas, a police officer's badge not only represents membership but also a specific type of authority. Military campaign ribbons serve to identify experiences an individual has gone through; while, an Olympic medal is a type of badge that clearly signifies a specific accomplishment or achievement. In each of these cases, the badge functions as a visual documentation or credential.

In recent years there has been a growing interest in digital badges, widely known as one type of alternative credential. Digital badges have been defined as "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" (Gibson, Ostashewski, Flintoff, Grant, & Knight, 2013, p. 404). From another viewpoint, Gamrat et al. (2014, p. 1136) describes digital badges as "online representations of learning experiences and activities that tell a story about the learner's education and skills." Digital badges can provide: a) a list of criteria needed to demonstrate proficiency with a given skill, knowledge, etc.; b) a means for the badge earner to demonstrate what has been learned or experienced; and c) a summative earned credential that signifies the experience that has been accomplished, as well as what was required and what was actually completed to successfully achieve the badge. Being awarded a digital badge indicates that an established criterion (or set of criteria) has been achieved by the badge recipient. Moreover, with the addition of metadata, today's digital badges can now include explanations of what the criteria were for attaining the badge, as well as what the individual did to actually earn it. Thus, potentially increasing the value or richness of what the badge actually represents while allowing individuals to demonstrate competencies that may have been acquired through traditional classroom settings and/or non-traditional learning experiences (e.g., on the job training, workshops, MOOCs) (Devedžić & Jovanović, 2015; Dyjur & Lindstrom, 2017).

Ahn, Pellicone, and Butler (2014) have suggested three key functions of digital badges – providing alternative credentials, motivating behavior, and integrating instructional elements and strategies. With these functions, digital badges could be used to diversify more traditional credentialing systems, incentivize increased levels of invested effort, and provide more effective and/or efficient instructional support. Thus, offering more opportunities for informal and lifelong learning.

Digital Badges as Alternative Credentials

A badge can serve as a signal or credential for participation in specific experiences, and/or gaining specific knowledge and skills. For example, a badge could signal that an individual has gone through a CPR training course and has demonstrated that specific skills of CPR have been learned. Researchers have investigated the credentialing function of digital badges and they found differing levels of acceptability and perceptions of using digital badges to provide alternative credentials (Diamond & Gonzalez, 2014; O'Connor & McQuigge, 2013). For example, a case study by Erickson (2015) examined the perceptions of employers regarding the acceptability of job applicants with earned badge credentials and found that employers were very interested in the use of digital badges because they could reduce training costs. However, in a different design-based study exploring the perceptions and uses of digital badges by instructors and graduate students, 86% of the participants disagreed or were unsure that digital badges are better than paper certificates (Dyjur & Lindstrom, 2017).

Digital Badges as Motivators

Digital badges may also serve to motivate behavior and increase invested effort. For example, they had been widely adopted as a game element to incentivize user activity in traditionally non-game services such as websites, TV channels, libraries, and educational settings (David deMaine, Lemmer, Keele, & Alcasid, 2015; Hamari, 2017). Their use incentivized learning, identified progress, increased time on task, and helped generate credits (Kwon, Halavais, & Havener, 2015; McDaniel & Fanfarelli, 2016). As motivators, digital badges can provide a source of positive feedback, can be viewed as an incentive to complete a specific task, and can provide a sense of accomplishment. A study by Anderson, Huttenlocher, Kleinberg, and Leskovec (2013), for example, explored the use of badges and how they can come to incentivize and increase participation in specific web-based activities. Using separate groups of subjects that had or didn’t have access to badges they compared rates of participation when badge attainment was available versus when they were not. Based on their research, they created a model for explaining and analyzing the ways in which badges can direct users’ behavior on a site. Similarly, badges were used in conjunction with an introductory tutorial to increase learners’ participation and engagement in using SAPO Campus, an institutionally supported social web platform (Santos et al., 2013). However, contradictory evidence regarding the motivational function of digital badges was found in different studies (Denny, 2013; Saxton, 2015; Stetson-Tiligadas, 2016). Although many studies found that digital badges increased participation in online communities (Meng, Webster, & Butler, 2013; J. L. Santos et al., 2013) and predicted a decrease in performance avoidance goals (negative learning goals) (Higashi, Abramovich, Shoop, & Schunn, 2012), other studies found no significant differences in the motivation level between learners who use digital achievement badges and those who do not (Haaranen, Ihantola, Hakulinen, & Korhonen, 2014; Stetson-Tiligadas, 2016). In addition, students with different goal orientations had different perceptions on motivation towards badges (Hakulinen & Auvinen, 2014), for example, only high expectancy-value learners felt more motivated to earn badges (Reid, Paster, & Abramovich, 2015).

Digital Badges as Instructional Tools

Finally, digital badges can be used as instructional tools. That is, if structured correctly, digital badges can effectively deliver instructions and facilitate learning of required skills and knowledge. Besides what digital badges can afford in education, such as recognizing informal or granular learning experiences and serving as a roadmap for how specific experiences and learning could be sequenced for optimal learning, instructional digital badges can also be used to: a) clarify learning objectives and help set goals; b) deliver instructional materials and learning activities; and c) offer a means for performance evaluation and feedback. They are portable learning platforms that can carry effective learning experiences to individual learners. The digital badges used in this study were instructional digital badges.

Researchers have started exploring the use of instructional digital badges in teachers' professional development, technology integration courses, and research training (Abramovich, Schunn, & Higashi, 2013; Agans, 2013; Gamrat et al., 2014; Reid et al., 2015; Robles, Thrash, Walker, & Brush, 2017). For example, NASA created instructional digital badges to teach middle school (grades 6-8) science topics like Earth Science and Aeronautics. A NASA STEM educator and a NASA Langley Research Center Education Specialist worked together to create instructional badges that included examples from NASA's workforce, applications of NASA's research, and other similar problem-based activities. Researchers found an excitement among educators with the structure and activities in these instructional digital badges and called on more educators to use digital badges for teaching (Robles et al., 2017). Likewise, Newby, et al (2016) discuss instructional badges as digital badges with added instructional elements/features used in a technology integrated course. In their case, instructional digital badges include not only a list of criteria for accomplishment, but also pedagogical structures, such as information, examples, demonstrations, and instructional materials that are needed to teach the content and skills crucial for the list of requirements.

With the expanded functions of digital badges, the research potential can also be expanded. From focusing on the credentialing and motivational impact of badges, potentially, the impact of the badge on learning may also now be investigated. In this study, the primary focus was on the use of instructional digital badges and the performance of pre-service teachers tasked with learning specific tasks via the badges versus a control group that completed similar course assignments using a traditional project approach. Comparisons between perceived levels of technology growth were measured between the groups, but more importantly, actual performance on both individual course assignments, as well as overall course grades were examined and compared. Specifically, we focused on answering three research questions:

- How did students perceive their general level of technology/computing skills after training with instructional digital badges versus traditional projects?
- How did students perform on course assignments after training with instructional digital badges versus traditional projects?
- How did students perform on the overall course grades after training with instructional digital badges versus traditional projects?

Methods

Sample

This study was conducted in a large land-grant Midwestern university. The total sample consisted of 150 preservice teachers, in two lecture sections of a college-level educational technology course, each with 78 and 72 students respectively. One lecture section was designated as the *instructional digital badge section* (DB); whereas, the other lecture section became the *traditional project section* (TP). Each lecture section met for one hour each week during the course of the semester. Students in each lecture were subdivided into smaller labs (20-25 students/each) that met for one two-hour lab session each week. Each lab was conducted by a graduate teaching assistant. Given that both lecture sections were conducted by the same course instructor and all graduate teaching assistants were trained and monitored by the course instructor, the overall construct of both groups was very similar. Additionally, as shown in Table 1, the make-up of participants in the two groups was also very similar. Pre-course surveys showed no significant differences between groups based on student age, school experience, school major, or personal perception of technology capabilities.

Table 1

Participant Demographics in the Two Different Lecture Sections

	Digital Badge Section (DB)	Traditional Project Section (TP)
Gender	82% Female 18% Male	75% Female 25% Male
Age 18-20	85%	88%
Yeah in College	84%	84%
College Major	47% El. Ed. 33% Secondary Ed. 20% Other	40% El. Ed. 42% Secondary Ed. 18% Other
Total number of participants	78	72

Materials

Students within one of the course large lecture sections (DB), and their corresponding lab sections, received all course projects and assignments in the form of seven distinct instructional digital badges. The instructional digital badges were all created and administered within the Purdue University Passport badge system. All instructional digital badges included the following features (see Table 2):

Table 2

Instructional Digital Badge

Instructional Digital Badge Feature	Description
1. Visual Representation	Each badge had a visual badge representation of a learning task that students needed to accomplish in this course. Some were hard technology skills, such as how to use video editing tools or information management tools. Others were soft skills such as digital literacy and information literacy.
2. Learning Task Introduction	Each badge had an introduction to the badge with an explanation of what the focus of the badge would be, learning objectives, and introductory video or text that explained the purpose of the badge.
3. Multiple Scaffolding Levels (Challenges)	Each badge had one or more scaffolding levels (challenges) that provided background information and instruction about the skills or information that was to be learned to successfully complete the required learning task. Moreover, a list of all required criteria for performance was provided.
4. Multiple Submission Options	Student could submit their completed work at each scaffolding level. Submission options included text information, documents, links to Internet sources, or movies.
5. Mastery-based Feedback	Student submitted work were given corrective or reinforcing feedback based on a mastery-based learning approach. If a student submission did not reach the requirements, it was denied by the instructor. Corrective feedback was then provided and potential permission for resubmission was granted. Students then received notification that the challenge level had been returned and they could retrieve their feedback. They could keep resubmitting until successfully accomplishing that challenge by a given due date.

Once all competency levels had been achieved, the badge was awarded. Each badge level also was graded with a specific amount of points. A student's grade was based on overall performance of each challenge level. A score of 90 % of possible points was required in order for the badge competency level to be successfully achieved. In some cases, the student may have received some points for his/her efforts but still did not successfully complete the badge competency and thus was not awarded the badge.

Those students in the project section (TP) were asked to accomplish seven small projects that matched closely to the respective instruction, performance criteria, and scaffolding levels of the seven instructional digital badges. Completed projects were due on a specific date and feedback was provided as part of the final grade for that respective project. In most cases, students turned in their final projects one time on the given due date. Summative feedback was provided with the final grade on the project.

Measures

Course performance. The total points that a student gained at the end of the semester was used to assess students' course performance. Each badge/small project was scored certain points according to a grading schema. Both sections (DB and TP) received the same amount of points in total.

Performance on technology related assignments. Each of the assignments were graded using a rubric system with point values. Each element of the project was matched up with a badge in terms of instructions, submission requirements, and grading rubrics. Teaching assistants met every week to discuss grading criteria for each assignment to increase the degree of grading consistency.

Perceived technology capabilities. To assess the students' personal perceived technology capabilities, each study participant was asked to rate "Your perception of your current general technology/computing skill level" on a scale of 1 to 5 (1 = *extremely low*, 2 = *somehow low*, 3 = *okay*, 4 = *somehow high*, 5 = *extremely high*).

Procedure

To address each of the research questions, three types of data were collected and analyzed. Technology perceptions (Research Question 1), were collected through pre- and post-course surveys where students were queried about their perceptions regarding capabilities of using technologies. During the first and again during the last week of the 16-week semester, students in both groups were given identical surveys. For Research Question 2 (badge vs project assignment scores), total points for every badge/small project were collected and calculated for each student in the two groups. These points were awarded for student performance on each of the respective projects/badges. Each project/badge represents an individual assignment in this course. Finally, for Research Question 3 (comparing course grades across groups), the total grade was calculated by adding all points for the course projects or badges, as well as for all quizzes, online discussions, and lecture participation. Data for each of the research questions were analyzed using independent samples T-tests.

Results

In this study, two groups of students learning the same specific technology skills were trained using either traditional course projects (TP group) or instructional digital badges (DB group). The primary research questions focused on comparing how those groups of students rated their perceptions of their general level of technology/computing skills following the training and more importantly how their performances compared on the technology assignments, as well as their overall course grades.

To compare student perceptions of their general level of technology/computing skills both prior to and then again following the semester long training, a pre-post course survey was given to all students in both groups of the study. Pre-course surveys indicated that both groups reported similar levels of perceived technology skills (TP Mean = 3.4 and DB Mean = 3.4, $t=0.428$, $p. < .669$). As predicted, following the full course on technology applications, significant increases in perception of technology skills were reported within both groups (TP Mean = 3.7; DB Mean = 4.0; pre/post comparison $t = -3.283$, $p. < 0.001$). Although one would expect perceptions of technology skills to improve following a semester of training, an interesting finding comes to the forefront when comparing the amount of gain in perception reported by the two groups. That comparison showed the badge group reported significantly higher gains in perception of tech skills than did those in the traditional project group ($t=-2.836$, $p.<0.005$). Thus, both groups improved in their perceptions of their personal technology skills between the pre and post course surveys; however, the badge group increased their perceptions to a significantly greater degree than those who learned the skills via the traditional projects.

Beyond perceptions, the overall performances of students in the two groups were also compared. Using similar rubrics, performances on all technology related assignments for both groups of students were assessed. Performance assessments indicated those in the instructional digital badge group significantly outperformed those in the traditional project group ($t= 2.922$, $p. < 0.004$). Moreover, when comparing overall course performance, again significant differences were reported with the digital badge trained students significantly outperforming those in the traditional project group ($t= 2.273$, $p. < 0.025$).

Discussion and Implication

The purpose of this study was to investigate the impact of instructional digital badges on student skill perceptions and overall learning performance. Although prior research showed that using digital badges and badging systems could increase participation and engagement (Denny, 2013; O'Connor & McQuigge, 2013; Stetson-Tiligadas, 2016) and support professional development (Diamond & Gonzalez, 2014; Gamrat et al., 2014), few studies have explored the impact of using digital badges on students learning performance and skill acquisition. Among the few investigations focusing on perceived effectiveness, researchers have shown that students have positive perceptions of digital badges in large enrollment classroom (Denny, 2013) as well as professional development programs (O'Connor & McQuigge, 2013). Although the current study confirmed these findings of participants' positive perceptions of using digital badges, it also investigated the impact of digital badges on behavior. Specifically, we found that digital badges could help pre-service teachers not only gain better skill acquisition perceptions, but more importantly could help them achieve better learning performance on both specific assignments and overall course grades in an undergraduate technology integration course. The findings offer one way to improve learning performance with the support of technology and have implications for future scholarship in this area.

Supported by achievement goal theory, several potential explanations for these differences in perceptions and overall levels of performance between the two groups may be forthcoming.

IDBs Helped Students Focus More on Learning Goals

According to achievement goal theory, learning goals have a positive impact on sustained learning performance, strategy formulation, and the development of a positive mindset towards obstacles (Elliott & Dweck, 1988; Grant & Dweck, 2003). Moreover, when the external learning environment and instructions emphasize improvement and effort, learners are more likely to adopt mastery-oriented goals (Anderman & Maehr, 1994; Anderman & Anderman, 1999). In the present study, the IDBs afforded a learning environment which may have helped students develop and focus on learning goals and the tasks at hand. For example, each badge was graded based on a mastery-oriented grading schema. For each challenge in a badge, the submitted work was evaluated and accepted or rejected. Guidance coupled with the possibility for resubmission provided an environment that more readily supported a focus on learning goals and overall achievement.

IDBs Integrate Performance Goals with Learning Goals

Performance goals and learning goals exist simultaneously in most educational settings (Dweck & Leggett, 1988). While students concentrate on learning goals, they also have the need and desire to demonstrate competence, which means they pursue learning goals and performance goals usually at the same time in most learning contexts. Badges have for years been viewed as representations of accomplishments. Digital badges today are “online representations of learning experiences and activities that tell a story about the learner’s education and skills” (Gamrat et al., 2014, p. 1136). In this study, those trained with IDBs were afforded a platform to show their accomplishments. After finishing a learning task, each student was given a notice of “challenge completion”, and after finishing a series of related learning tasks, a badge was awarded. Students were given credits for accomplishing each learning task and granular skill or knowledge, thus helping them to integrate learning goals with performance goals. The awarded badges offered a tangible way for learners to demonstrate their competence, thus potentially increasing overall motivation and the investment of effort into the learning task.

IDBs Provide Mastery-Oriented Feedback to Foster the Pursuit of Learning Goals

Different feedback conditions should be applied to education contexts that are dominated with different goal orientations. For example, mastery orientations (learning goal orientation) usually apply comments as feedback while ego-involved orientations (performance goal orientation) usually apply grades and praise as feedback (Butler, 1987). In this study, students trained with IDBs may have outperformed those trained with traditional project because instructional digital badges could afford personalized comments as feedback that support the pursuit of learning goals. Instructional digital badges could provide prompt feedback, scaffold students' immediate learning needs, provide summative assessment, improve motivation, and encourage learning sharing. Feedback provided through instructional digital badges are mostly mastery-oriented, falling into five different categories: outcome, motivation, and interaction, clarification, learning extensions, and decreasing learning gaps (Besser, 2016). With mastery-oriented feedback, students learning with instructional digital badges could not only get summative feedback signaling the accomplishment of each skill or knowledge, but more importantly, they could get specific and personalized feedback to guide them towards the mastery of higher-level skills (Fanfarelli et al 2015).

Limitations and Future Research

There were limitations in this study. First, although badge and grading rubrics were matched and training was provided, there was a variety of teaching assistants assigned to the grading of the assignments. Variability between the graders could have impacted the measure of performance on the learning tasks and the overall course grade across labs. Additional comparison studies between learners receiving badge related instructional interventions with those receiving more traditional instructional interventions should make efforts to ensure equality of grading of the assignments. Efforts were made within this study to train graders on expectations, but individual differences in interpretation of how to apply those general rubrics led to possible subjectivity and potential variability.

Second, instructional digital badges as instructional interventions are still fairly novel for most learners. Thus, a novelty effect may have increased motivation and invested effort. In such cases, as familiarity is gained with such an intervention, temporary increases in motivation may be shown to be limited. From another viewpoint, a novelty effect could also limit the degree of increased perceived skill capabilities and performance gains. In such cases, as the acceptance of this innovation is gained and more supporting instructional design guidance for this intervention are developed, students might show greater gains in perceptions and learning performance in similar learning contexts. Finally, self-reported Likert-type surveys were used to measure perceived technology skills, which could have a weakness in predicting accuracy as a data collection tool.

If instructional digital badges are shown to lead to consistently greater learner performances, future research needs to focus on what elements within the badges are most effective in bringing about those learner gains. Informal responses from learners in our present study indicated that some badges were preferred over other badges; moreover, some badges were viewed as more effective and more efficient. Research comparing badges with various integrated instructional elements may help to identify which of these elements have significant impact on learner enjoyment, satisfaction, motivation, and overall desire for task mastery and competence.

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CHAPTER 3. GOAL-SETTING AND OPEN DIGITAL BADGES IN HIGHER EDUCATION

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Introduction

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 & Sharpe, 2013; Garrick, Pendergast & Geelan, 2017). 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, Giglio, Persico & Raffaghelli, 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, Harrison, & West, 2013). One way to expand their impact is to integrate goal setting with ODBs. It was found that goal setting could significantly impact learning performance (Locke and Latham, 1990; Locke, & Latham, 2002). Researchers foresee the potentials of using ODBs to facilitate student goal setting but have not provided much empirical evidence (Chou & He, 2017; Frederiksen, 2013; McDaniel & Fanfarelli, 2016; Randall, Harrison & West, 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" (Lock, 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) 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, & 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 & 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, Simons, Lens, Sheldon & Deci, 2004). Intrinsic goals better satisfy basic psychological needs than external goals (Deci & 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 (Lacke, Shaw, Saari, & Latham, 1981; Bryan & 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 & 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 many 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, Pellicone & Butler, 2014, Kwon, Halavais & Havener, 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 (Hintz, 2009).

Digital Badges. Digital badges have been used as an online representation for accomplishments, skills, or awards. According to Gibson, Ostashewski, Flintoff, Grant, and Knight (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 & 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, 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, Pellicone, & Butler, 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, Giglio, Persico & Raffaghelli, 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, & Churchill, 2011; Chou & He, 2017; Frederiksen, 2013; Gamrat, Dudek & Peck, 2014; McDaniel & Fanfarelli, 2016; Randall, Harrison & West, 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, Giglio, Persico & Raffaghelli, 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; Ruginis, 2013). Intrinsic goals can benefit learners in terms of satisfying basic psychological needs (Deci & Ryan, 2000) and support long-term personal development (Elliott & Dweck,1988). ODB could serve as means to motivate and facilitate learners to achieve their intrinsic or learning goals. 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 (Ruginis, 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 (deMaine, Lemmer, Keele & Alcasid, 2015). 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, Abramovich, Shoop & Schunn, 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 pre-determined and prescribed path for learning, allowing for insufficient learner autonomy. (Willis, Flintoff & McGraw, 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 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, Flintoff & McGraw, 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, Ostashewski, Flintoff, Grant & Knight, 2013). 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 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 & 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 is also one of the key categories of factors that facilitate goal commitment (Locke and Latha, 2012) and 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, Harrison & West, 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 & Latham, 2002). ODB has the capabilities to provide prompt feedback (Besser, 2016; Fanfarelli & McDaniel, 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 & McDaniel, 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 & 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, Mento & Locke, 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 facilitate goal setting and improve 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 & Thomas, 2014; David deMaine, Lemmer, Keele & Alcasid, 2015; Higashi, Abramovich, Shoop & Schunn, 2012). For example, David deMaine, Lemmer, Keele & Alcasid (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 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 3 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.

Table 3

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

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, Flintoff & McGraw, 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, Horn & Johnson, 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 & 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, Horn & Johnson, 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. 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, Flintoff & McGraw, 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, Wright, Besser & Beese, 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, & Thomas, 2014; Devedžić, & 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 support 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.

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CHAPTER 4. FACILITATING GOAL-SETTING WITH OPEN DIGITAL BADGES

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Abstract

Students' goal-setting skills are highly related to their academic learning performance and level of motivation. A review of the literature demonstrated limited research on both applicable goal-setting strategies in higher education and the support of technology in facilitating goal-setting processes. Addressing these two gaps, this study explored the use of digital badges as an innovative approach to facilitate student goal-setting. The digital badge is a digital technology that serves as both a micro-credential and a micro-learning platform. A digital badge is a clickable badge image that represents an accomplished skill or knowledge and includes a variety of metadata such as learning requirements, instructional materials, endorsement information, issue data and institution, which allows the badges to be created, acquired and shared in online space. In higher education, digital badges have the potential for assisting students by promoting strategic management of the learning process, encouraging persistence and devoted behavior to learning tasks, and improving learning performance. A qualitative multiple case study design (n = 4) was used to answer the research question: how do undergraduate students use digital badges to facilitate their goal-setting process throughout a 16-week hybrid course? Results from this

study contribute to understanding how to effectively integrate digital badges to meaningfully improve self-regulated learning in higher education.

Keywords: digital badge; goal-setting; motivation; self-regulated learning; case study

Students' lack of goal strategies can result in lower learning performances (Locke & Latham, 1990). For example, students who set higher goals have more positive learning outcomes than those who just do their best, and students who set specific goals outperform those who set general goals (Hollenbeck & Klein, 1987; Locke & Latham, 1990, 2002). Although scholars in the field of psychology and education have extensively discussed the effects of goal-setting on learning performance, they have found few practical solutions and strategies for college students to facilitate goal-setting (Hakulinen & Auvinen, 2014; Locke & Latham, 1990, 2002). Recently, researchers predicted that digital badges (DBs), an innovative credentialing and pedagogical technology, may be an effective tool to facilitate the goal-setting process (Cheng, Watson, & Newby, 2018; Chou & He, 2017; Frederiksen, 2013; Gamrat, Zimmerman, Dudek, & Peck, 2014; McDaniel & Fanfarelli, 2016; Randall, Harrison, & West, 2013). Despite the promise of DBs, little research has provided enough empirical evidence to support their integration and application into courses in higher education. Therefore, the purpose of this study was to address this gap in the literature by using a qualitative, multiple case study to investigate college students' experiences in using instructional DBs to facilitate their goal-setting process, in order to achieve higher learning performance.

Theoretical Framework

This study was built upon and guided by goal-setting theory (Locke & Latham, 1990). According to this theory, a goal is an integration of objectives and evaluation standards (Locke, 1991), whereas goal-setting is a process of establishing standards for performance (Locke & Latham, 2002). Goal-setting is an essential part of the motivational and self-regulated learning process (Schunk, 1990; Zimmerman, 1989), because learners need to have both the capabilities and beliefs to self-observe, self-judge, and self-react to achieve specific goals (Bandura, 1990; Zimmerman, 2000; Zimmerman, Bandura, & Martinez-pons, 1992). The relation between goal-setting and performance is at the core of goal-setting theory (Locke & Latham, 2002; Schunk, Meece, & Pintrich, 2014; Zimmerman, Bandura, & Martinez-pons, 1992). Scholars have found three motivational mechanisms of goal-setting that have a beneficial effect on performance – effort, persistence, and concentration. Goal-setting encourages people to devote more effort and time on achieving tasks with fewer distractions (Locke & Latham, 1990), contributing to better performance. However, when a goal related to a complex task is not achieved, dissatisfaction occurs, which might hurt the subsequent performance (Cervone, Jiwani, & Wood, 1991; Strecher et al., 1995).

Goal-setting theorists have identified the key moderators of goal-setting effects on performance as feedback, commitment to the goal, and task complexity (Latham & Locke, 1991a; Locke & Latham, 1990, 2006). The use of digital badges could be a potentially useful tool to facilitate the feedback process to moderate goal-setting effects. The success or failure of accomplishing a badge represents feedback given to a learner at certain points of their learning progress. Also, some digital badge systems include a mastery-based learning mechanism, which allows learners to receive multiple rounds of feedback about their learning progress towards achieving goals. With these supports to feedback, learners who learn with digital badges could increase self-efficacy, keep track of their learning progress, reflect on their goals, and adjust accordingly. The implementation of digital badges could also be useful to enhance commitment to the goal and thus amplify the goal-setting effects. With gamified rewards and accomplishment presentation characteristics, digital badges could potentially enhance learners' self-efficacy to achieve the goal. In addition, within each badge, instructional materials and interactive learning activities are included to scaffold the learning process. With these characteristics, the use of digital badges could also be practical in scaffolding complex tasks to amplify goal-setting effects.

In this study, we examined learners' experiences using digital badges to facilitate their goal-setting process in order to achieve better learning outcomes. Goal-setting theory informed our study by providing one explanation of the relation between goals and performance, and more importantly, offering a framework of how different components of the goal-setting process that technology could act on may improve learning performance. Therefore, we drew on goal-setting theory when discussing the students' perspectives on using digital badges as a goal-setting facilitating tool.

Literature Review

As higher education becomes more open and digital, institutions of higher education are searching for new ways to verify the accomplishment of learning and make learning more accessible to all learners (Matkin, 2012). The application of digital badges is one current endeavor being utilized to achieve this goal. Human beings have a long history of using badges (Ahn, Pellicone, & Butler, 2014), from the shield emblems in Roman imperial armies (Kwon, Halavais, & Havener, 2015), to many aspects of our modern life, such as merit-badges in scouting (Abramovich, Schunn, & Higashi, 2013), and digital games (Kriplean, Beschastnikh, & McDonald, 2008). Digital badges appeared in the information age. Just as the name implies, digital badges are digitalized symbols that represent differentiated levels of knowledge or experience to encourage, recognize, and communicate achievements (Halavais, Kwon, Havener, & Striker, 2014). What makes this type of technology unique and valuable in education is that a digital badge includes important credentialing and learning metadata, such as badge issue date and authority, criteria to demonstrate the accomplishment of a skill or acquisition of knowledge, supporting instructional materials and activities, duration of credential effectiveness, and endorsement information.

Types and Roles of Digital Badges in Education

Different types of digital badges have different metadata. There are four different types of DBs used in education – candy badges for positive reinforcements, recognition badges for recognizing accomplishments, credential badges for certification qualifications, and instructional badges that serve as a micro-learning platform and content management system (Cheng et al., 2018). The four types of DBs serve three major roles in education – as motivators of behavior, as pedagogical tools, and as verification of credentials (Ahn et al., 2014). Prior studies have found positive perceptions on using DBs as credentials to recognize and document achievements (Dyjur & Lindstrom, 2017). Learner engagement and participation increased when DBs were used as recognition and rewards for the attainment of specific levels of performance (Denny, 2013; Hamari, 2017). However, researchers found mixed results on the utilization of badges as extrinsic rewards (Abramovich et al., 2013; Hakulinen, Auvinen, & Korhonen, 2013).

Digital badges used in this study were instructional badges that encapsulated metadata about subject skills or knowledge, the required instructional materials and activities for its accomplishment, and links to evidence showing how the badge was earned (Cheng et al., 2018; Grant, 2016; Newby, Wright, Besser, & Beese, 2016). They were used to deliver various forms of learning modules, validate prior learning experiences, trace learning progress, reflect on prior achievement, and motivate learners to pursue higher goals (Ahn et al., 2014; Cucchiara, Giglio, Persico, & Raffaghelli, 2014). Detailed information about the instructional badges used in this study is included in the methods section.

Goal Effects on Learning Performance

Goal effects on learning performance have been found in previous research within both laboratory and field settings (Latham & Locke, 1991b; Locke & Latham, 1990, 2006). There are three main moderators in this goal-performance relationship – goal commitment, feedback, and task complexity. When people are more committed to specific goal(s), they devote more significant effort, persistence and focus toward accomplishing those goals. There are several ways to enhance goal commitment; one is publicness. When goals are made more public than private, learners have a greater commitment to their goals, especially the difficult ones (Salancik, 1977). 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. The complexity of tasks also influences the goal effects, often negatively, because individuals cannot easily find appropriate strategies when their higher-level skills have yet to be developed to handle complex tasks beyond their capabilities (Locke & Latham, 2002).

Integrating the Use of Digital Badges with the Goal-setting Process

There have been many in-depth discussions on the relation of digital badges and goal-setting in education (Antin & Churchill, 2011; Chou & He, 2017; Gamrat et al., 2014; Randall et al., 2013). For example, some researchers have proposed that DBs usually serve as external goals that are related to pursing external rewards, such as wealth and fame (Deci & Ryan, 1985; Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004), which may serve to inhibit students' intrinsic motivation. In contrast, others have argued that DBs can be used as hooks or reasons to engage in a learning activity (Rughiniș, 2013). Scholars have also proposed that DBs may support goal-setting by providing alternative ways to set personalized learning paths and provide feedback (Antin & Churchill, 2011; Chou & He, 2017; McDaniel & Fanfarelli, 2016; Randall et al., 2013). In the meantime, a number of organizations have started to practice using DBs as sub-goals or stepping stones in the learning and goal-setting process to help students foresee and reflect on their learning. For example, Computer Science Social Network (CS2N) utilizes badges as curriculum maps and learning pathways for students to visualize and track their learning progress (Higashi, Abramovich, Shoop, & Schunn, 2012). Similarly, Khan Academy encourages learners to earn different skill badges and publish their badges on Facebook; each badge becomes a public statement of one's learning goals (Khan Academy, 2012). Keller (2010) notes that goal orientation is important for individuals to be motivated for a task. Based on the ARCS model of motivation, DBs could potentially be structured to help individuals recognize the relevance of a learning task by highlighting what the goal is and orienting the learner to that goal.

Although researchers and practitioners foresee great potential in how DBs could be used to facilitate goal-setting, we found little empirical evidence showing how and why DBs serve as a tool for learners to guide and facilitate their goal-setting process. Thus, this study will address this gap by exploring undergraduate students' experiences of using DBs as a part of their goal-setting process in a college-level technology integration course. Based upon literature on DBs and goal-setting theory (Locke & Latham, 2002), this multiple case study focused on answering this research question:

> How do undergraduate students use digital badges to facilitate their goal-setting process throughout a 16-week hybrid course?

Methods

Study Design

Informed by goal-setting theory that considers goal-setting as an important part of the motivational and self-regulated learning process (Schunk, 1990; Zimmerman, 1989), this study adopted a multiple-case (n=4) research design (Yin, 2018) to compare the experiences of two undergraduate students who had high self-efficacy for self-regulated learning (SESR) with two undergraduate students who had low self-efficacy for self-regulated learning in using digital badges to facilitate their goal-setting process. According to goal-setting theories, these two subgroups might have valuable implications for goal-setting experiences because goal-setting and perceived self-efficacy are two self-regulated learning processes (Schunk, 1990). The perceptions and belief about one's capabilities to use specified strategies to self-observe, self-judge, and self-react is highly related to how well one can reach the expected level of performance (goals).

Participants (Cases) and Context

The two groups of students, one group with high and the other group with low self-efficacy for self-regulated learning were selected as cases in this study. A theoretical replication logic was used to select cases *across groups* aimed at predicting contrasting results for anticipatable reasons derived from theories and literature. And a literal replication logic was used to identify two identical cases *within each group* (Yin, 2018). In this study, Kevin and Anna (pseudonyms) had high SESR scores while Kate and Liza (pseudonyms) had low SESR scores.

The perceptions and belief about one's capabilities to use specified strategies to self-observe, self-judge, and self-react are highly related to how well one can reach their goals (Fontana, Milligan, Littlejohn, & Margaryan, 2015). Considering the lack of comprehensive measurement on the level of goal-setting, we selecte*d Self-Efficacy for Self-Regulated Learning Subscale* of *Multidimensional Scales of Perceived Self-Efficacy (SESR-MSPSE)* (Bandura, 1990) as the case selection criteria in this study. This scale was selected based on two primary reasons. First, students perceive self-regulatory efficacy, goal-setting, and academic achievement as influential factors to each other (Zimmerman et al., 1992a), providing an approximation for students' goal-setting characteristics. Second, self-efficacy for self-regulated learning is a key factor that facilitates goal commitment (Locke & Latham, 2002), and a strong predictor of academic persistence and performance (Zimmerman, 2000). The validity and reliability of MSPSE scale has been established in previous research (Williams & Coombs, 1996, p. 9). The scale was found to be reliable (11 items; $\alpha = .86$) (Choi, Fuqua, & Griffin, 2001). The items of the self-regulated learning sub-scale are listed in Appendix A. For each item, students rated their perceived self-efficacy according to a 7-point scale (Bandura, 1990). Although this scale is typically applied to study childhood depression and middle school students' academic achievement, research shows that this scale is also appropriate to be used with college students (Choi et al., 2001).

Context. This study was conducted in a 16-week hybrid instructional technology course in a large, land grant, Midwestern university. This course was mandatory for pre-service teachers to take in their first or second year. The goal of the course was to help students plan, implement, and evaluate technology for teaching and learning. Students were expected to evaluate various instructional technologies and determine how, when, and why such technologies could/should be used for their teaching and learning. A total of 150 pre-service teachers were enrolled in this course and four of them were selected as cases in this study. The course was comprised of three components: case discussions, lab practice, and online content. It used a flipped instructional model, where students engaged in course content in both the learning management system (Blackboard Learn) and the digital badge platform (Passport) before and after attending weekly lectures where they discussed course content in a face-to-face format. Students also spent time in weekly lab sessions to individually work on learning with DBs. A teaching assistant (TA) was in the weekly lab sessions for student questions, grading badges, and giving feedback.

Passport Badging System and Instructional Digital Badges

The Passport digital badge system is where the digital badges were created, stored, displayed and delivered. After starting a badge, the student was presented with introductory materials, prerequisites, instructions, guidelines, and specific criteria to complete each challenge. Instructional materials were presented by text, hyperlinks, images, or multimedia. In each badge, a learning task was presented as a challenge. Different badges had a different number of challenges depending on the complexity of that knowledge/skill. For most of the badges, students were able to finish in a week while some other badges were more complex in nature and typically took students two or three weeks to accomplish. Once a student submitted a challenge, the TA would get an email notification and was required to provide feedback within 24 hours. A student could submit multiple times before a specific deadline. Each submission received some form of feedback. The badge was awarded once all challenges had been achieved. Each challenge was graded with a specific number of points. A student's grade was based on the overall performance on each challenge level.

Students were required to complete eight badges in total as the main bulk of assignments in this course, in addition to four case studies, two online discussions, three quizzes, and a final exam. Students completed four required and four elective badges throughout the entire semester. Each week a badge was assigned, and students were asked to complete it in a specific duration of time, which varied depending on the complexity of that badge. The four required badges included a digital literacy badge, an information literacy badge, a writing learning objectives badge, and an interactive e-learning module badge. These required badges focused on understanding specific content topics by asking students to read texts or watch videos, to apply knowledge by engaging in some activities like finding specific journal articles in the university library website or creating an e-learning module by integrating different types of technologies, and then to internalize the knowledge/skill with the students' own experiences by asking them to write reflections. In addition to the four required badges, students were also asked to select four additional badges from a total of 24 optional tool badges in categories such as research tools, brainstorming tools, video production tools, presentation tools, and audio editing tools. In each of these tool badges, students were asked to explore one instructional technology, practice the use of this tool by creating a project, and then reflect on the value of using this badge in teaching and learning by writing a reflective paragraph.

Procedure

Case selection. The SESR-MSPSE was included in a questionnaire sent to all students (N=150) at the beginning of the semester. In addition, the students were asked to provide demographic information. An email invitation for the interview with a consent form was sent to students who scored the highest in MSPSE sub-scale. If the student agreed to participate in the interview, he/she would be selected as one case in the high SESR group. If he/she did not agree to participate, we would invite the student with the second highest score. This selection process continued until the two cases were found. The same selection logic applied to the low SESR group. Each participant was assigned a pseudonym to provide anonymity and protect confidentiality. Participants' basic information and their scores on the SESR-MSPSE scale were included in Table 4.

Table 4

Participants Basic Information

Participant (Pseudonym)	Program	Year in College	Gender	Level of SESR (Highest: 4 Lowest: 1)	TA	Final Grade
Kevin	Pre-Athletic Training	Sophomore	M	High (M = 3.90)	Teri	B
Anna	Elementary Education	Sophomore	F	High (M = 4.00)	Teri	A
Lisa	Exploratory Studies	Sophomore	F	Low (M = 2.36)	Jane	A
Kate	Human Development and Family Study	Freshman	F	Low (M = 1.91)	Peter	A

Note: SESR means self-efficacy for self-regulated learning.

Data collection. The primary type of data included in this study was semi-structured interviews. The interview protocol was created to elicit the learning experiences of the four students (see Appendix B for interview items). To increase face validity, the interview protocol was reviewed by two students enrolled in this same course to evaluate the extent to which the questions made sense to them. To increase content validity, a professor in instructional technology evaluated the extent to which the interview questions reflected students' application of digital badges in their goal-setting processes (Polit & Beck, 2006). One of the researchers conducted one interview with each of the four participants two weeks following the conclusion of the course. Each interview lasted approximately 45 minutes, and was recorded and transcribed verbatim. One of the researchers transcribed the interviews, and another researcher checked the accuracy of the transcripts. Each transcript was between eight to 12 pages.

Data analysis. One researcher served as the coder. Each specific case was coded first as a whole and then by responses per question. Pseudonyms were given prior to the coding process. The coder knew that there were two participants with high SESR and the other two participants had low SESR but was not aware of the correspondence between scores and pseudonyms.

Two major stages of coding were conducted: the first and second cycle of coding (Miles M.B., Huberman A.M and Saldaña, 2014). In the first cycle, four predetermined code categories were derived from goal-setting theory - goal difficulty, goal commitment, task complexity, and feedback. The coder used a holistic coding strategy to make sense of the overall meaning of the responses to each question in an interview transcript, before a more detailed coding of the sentences was applied.

A descriptive coding strategy was also used to assign labels to sentences and group them in general main categories and sub-categories. There were six first-level categories, 13 second-level categories, and four third-level categories. The first-level included personal and professional goals, persistence and commitment, task complexity, the design of the badge, course structure, and TA feedback.

In the second-level cycle of coding, inferential codes (or pattern codes) were created to regroup the main categories and sub-categories and identify emergent themes. Four themes were identified: goal identification, digital badges and goal commitment, digital badges and task complexity, as well as digital badges and feedback. Pattern-matching was then used to compare the identified themes with the goal-setting theoretical propositions (Miles, Huberman, & Saldaña, 2014). After that, we compared patterns of similarities and differences across the four cases.

Results

After two cycles of coding, we generated four major themes focusing on our research questions and theoretical propositions: goal identification, DBs and goal commitment, DBs and task complexity, as well as DBs and feedback. Three of the major themes had two sub-themes.

Theme 1: Goal Identification

Personal goals. Each of the four students came to the course with a general professional goal in mind. Their perceptions of personal goals were similar to professional goals in the context of university life. Kevin wants to teach on the primary level, specifically as a physical education teacher. Anna wants to teach third- or fourth-graders in public schools because she has been in private school most of her life as a student and wants to make a difference in the future in improving students' lives. Lisa is in an exploratory program and chose the Hospitality and Tourism Management program this semester because she loves to travel and thought it might be a good fit for her. Kate wants to be a preschool or a special education teacher because she loves children and enjoys teaching.

Course-related goals. The students indicated that they did not formulate course-related goals at the beginning of the semester but, instead, formulated them gradually as the course progressed. Although all four students identified passing or getting a high grade as their primary goal in this course, students with different SESR varied in their ability to connect their course-related goals to other personal goals. The two students who had high SESR (Kevin, Anna) could make more explicit connections among intrinsic values, past experiences, and course-related goals than the two that had low SESR (Kate, Lisa). For example, Kevin connected his goal of passing the course to his professional goal of becoming a teacher in the future. He said, "[I wanted] to pass the class because it is a required class, so I have to take it … and because it is technology-based maybe [it will be] useful in my teaching."

Similarly, Anna connected her goal of getting a high grade in this course to her prior experiences and passion for learning more about technology. She said, "So in the past, I have taken many technology courses, but with this course, it was like some applications that I have never used before. So it was a great way to learn more about that." In comparison, the two students with low SESR had more difficulty in formulating course-related goals on their own and relied on other people to help them identify what they wanted to accomplish in the course. For example, Kate found the question, "What did you want to get out of the course?" hard to answer, repeating, "I do not know" twice in the interview with intermittent silence. The students with low SESR seldom connected their related goals to other personal goals and extended interests. Lisa, for example, did not know what courses to take at the beginning of the semester, so she followed peers' suggestions to take this course, which was required for all undergraduate students in the college. She claimed, "My goal for all classes is to get an A."

Theme 2: DBs and Goal Commitment

DBs as external rewards. Students' commitment to their course-related goals was affected by rewarding badges or accomplishing challenges as external incentives. Although all four students considered DBs as assignments to complete for credits, the impact of DBs as an external reward for students with high SESR was not as strong as for students with low SESR. Students with high SESR perceived being rewarded a badge as "Checking one assignment off the to-do list," while students with low SESR perceived the reward as a signal of accomplishment. For example, Lisa, a student with low SESR, felt a sense of accomplishment when a challenge had been accepted. She said, "I just feel [something has been] accomplished because then I can put the badge on a little accepted page." Similarly, Kate expressed "feeling really good" when an email showed a challenge had been accepted.

In comparison, Kevin liked being awarded a badge because it signaled completing a mandatory task rather than accomplishing something exciting. He said, "It [being awarded a badge] was like completing anything, like a to-do list. You know you're just, like, I can move on and do more exciting stuff. Passport [DBs] isn't like the most fun thing to do." Similarly, Anna considered being awarded a badge more like a work evaluation than an accomplishment. She said, "It's nice knowing that you did everything correctly."

DBs as internal rewards. All of the students found the interactive, hands-on activities included in the badge motivating. For example, Lisa "thought this [badge] was more motivating than, like, writing a paper (…) because it is more interactive and creative." Also, Kevin said, "I love the visual, hands-on stuff." Similarly, Anna said, "I never made a screen cast… that [DB] was kind of cool for me to play with. That one was pretty helpful to me." Likewise, Kate also loved DBs that allowed her to create something, as she described in the interview: "I like the Powtoon [an animated online presentation tool] badge or some other badges where you can create something, and it gives you a result."

Moreover, for students with high SESR, using DBs made their learning more flexible, and they had more autonomy in learning. DBs provided them with opportunities to plan their learning ahead of time and finish work in advance based on their self-driven learning paths. For instance, Anna said "… I am somebody who likes to get stuff done right away. So, I would submit those [DBs] in advance. It was nice that you had the opportunity to do badges before or, at any point." Kevin liked working with DBs because he had more choices on what to learn. In one example, he observed, "So for the website badge, we could do, like…three or four websites…I tried Weebly [one website building tool] first…but I never really liked the layout of Weebly… but I believe it will be easy but then I was, like, wait a second, let me look at the other ones…and then I finally go with Wix [another website building tool].” The structure of the DB encouraged him to explore multiple learning paths, which he might not otherwise have done. In comparison, students with low SESR became more persistent in pursuing learning goals because DBs gave them specific deadlines for each granular learning task. For example, Kate said, “[DBs] were helpful…they clarified what should you do at certain weeks.” And Lisa said, “I waited until [the badge for that week] was given to us. So I didn't start and get them done in advance like some other people in my class. It just worked for me.”

Theme 3: DBs and Task Complexity

There were two different types of learning tasks that students needed to complete in this course: basic applications of instructional technologies and the creation of an online learning module. Both were delivered via badges. Applications of instructional technologies asked students to know how to use the basic functions of some software that could be used in teaching and learning, such as website builders and video production tools. The creation of an online learning module was more complex to learn compared with basic applications of instructional technologies because it involved an integration of different skills and knowledge such as analysis, design, development, and implementation of an interactive module (an online lesson).

Instructions and activities in each badge were organized and “simplified” to provide necessary scaffoldings to the learning process. The specific layout of instructions in each badge encouraged students to use cognitive strategies to accomplish the learning task step-by-step. For example, Kate said, “[DBs] showed both what to do and how to do [instructional technology tools]. Likewise, Kevin said:

> [DBs] simplified [the learning task] because [each badge] gets all the details on everything you need to do. So you can review if you don't know [during the learning process] and then it gives you, like, examples and instructions. For example, the screen cast badge I was, like, “I have no idea how to do this!” And then [the instructions in each challenge] says look at all this and that. [DBs] just go step-by-step instructions and that's what I just kept referring back to.

DBs not only provided effective scaffoldings in instructions within each badge for a complex task like designing an interactive module (an online lesson), they also acted as stepping stones for learners to plan out learning ahead of time in order to to accomplish a big project. This helped students with both high and low SESR to better plan, monitor, and complete the more complex learning tasks. As an example, Lisa said:

> After I was told that we could use badges that we have done before to develop the interactive module, I was, like, oh perfect! I already did this and that and I could use them to build up my interactive module (…) that makes developing the interactive module much easier.

DBs also helped students to connect simple learning tasks with the complex ones in a course that was designed to encourage students to make good connections among different course components. For example, when Anna was working on the complex task of designing an interactive module (an online course), she reflected back on one of the simple learning tasks (application of video production tools) and improved it, based on what she learned while working on the complex learning task (designing an interactive module). She said:

> The video production badge corresponded to my interactive module. I feel like starting the interactive module helped me make that video. So after [doing a couple of challenges

in the interactive module badge] I knew exactly what I wanted to talk about in the video; [doing the interactive module badge] was very helpful for me [to complete the video production badge].

Theme 4: DBs and Feedback

The digital badge system used in this course had a circulatory feedback function, with which students could have multiple chances to get feedback on their work and resubmit multiple times within deadlines. When students submitted a challenge, their TA would get a submission email and he/she could go to the system to evaluate the student's work. If the work was acceptable, then the TA could accept it and the student would be notified by an email that the challenge had been accepted. If the work needed some improvement, the TA could deny this submission with feedback for improvement and then send it back to the student for correction and resubmission. Students with high SESR in this study had different perspectives than students with low SESR on the feedback given by their TAs through the badge system.

Feedback for checking basic requirements. Students with low SESR perceived the feedback given by their TAs as more of check-off reminders. They loved having their TAs check if their work had met the basic requirements, and having the opportunity to resubmit multiple times until their work could be accepted. For example, Kate said:

> I know most of the badges were developed in a way that you can always go back and resubmit. [My TA] always gave you feedback, especially when you first submit it, and then you can do what you have to fix. Like the first part of the interactive module [designing an interactive module], [My TA] said things like "you need to have citations!" And he would explain the requirements again just like refreshing something.

Similarly, Lisa said:

Whenever [my TA provided feedback to me], it would be like clarifying the deliverables that I don't do them exactly right. Or like I don't understand the deliverables and she repeated them again. (…) and if I don't do it right again she'll correct it again."

Feedback for improving understanding. Students with high SESR also liked their TAs to help them check their work; however, they wanted more detailed feedback on clarifying confusion and helping them understand why things should be done in certain ways. For example, Anna said:

Yeah, that's really helpful because some badges I was really confused on. And [my TA] gave me, like, a long paragraph on what I could fix and then if I had any questions on that I could always ask her and she would really help me with that".

Kevin was aware of the situation, especially when he completed the assignments without understanding exactly what he was doing. He wanted more feedback from his TA to confirm how he was doing with the learning task. For example, he said:

It's just, like, you do the homework and then the professor doesn't really make sure you understand it. [For] a lot of the badges I've done before, (…) I don't really know what I'm doing for them. I wanted just, like, the TA to come around [and explain] why you completed this badge or why you didn't get accepted for this badge.

Discussion and Implication

The purpose of this multiple case study was to explore students' experiences using digital badges to facilitate their goal-setting process throughout an undergraduate technology integration course. Results found in this study aligned with three functions of DBs proposed by Cucchiara et al., 2014: capturing (validate and trace learning progress), signaling (review and reflect on learning process), and motivating (award achievements). In addition, we also found that DBs were especially effective in facilitating students' goal-setting processes. These findings helped us draw implications for educators and practitioners who are interested in applying this innovative technology in their educational practices.

Capturing and Signaling Learning

Similar to what was proposed in previous studies about using DBs to validate and recognize learning (Bowen & Thomas, 2014; Devedžić & Jovanović, 2015), we also found that DBs could make learning visible to students who looked for gaps in learning or extended content areas to explore. Research on goal-setting showed that making a public statement of the achieved badges could increase goal commitment and thus improve effort devotion and persistence (Salancik, 1977). Some commercial digital badge platforms also encourage students to publish their badges on social websites like Facebook (Morrison & DiSalvo, 2014). However, we found that students did not want to publish the DBs on their social websites because they thought the work they had done to achieve the badges was not of high enough quality to be shown to the public, especially to potential employers. In other words, from the students' perspective, the completed badges with metadata did not add value to the presentation of their perceived level of competency.

Although demonstrating what skills had been accomplished has long been considered as an important benefit of using digital badges in education because the process of learning granular skills or knowledge could be recorded and presented to potential employers (e.g. Cheng et al., 2018; Jovanovic & Devedzic, 2014; Ostashewski & Reid, 2015), educators and practitioners should notice that students have concerns about letting employers see their whole learning processes. For badge design considerations, there could be two categories for digital badges, one for learning, and one for competency presentation. In this scenario, learners could be given options to choose what to show to different audiences.

Motivating Learning

Prior research found mixed or even conflicting results on the motivational effects of using DBs (Denny, 2013; Kwon et al., 2015; Stetson-Tiligadas, 2016). For example, researchers investigated the digital badges implemented in a computer science course and found that DBs overall did not have a significant effect on course results or student behavior, mainly because students were satisfied once the desired grade had been achieved (Haaranen, Ihantola, Hakulinen, & Korhonen, 2014). However, another group of researchers found that the number of badges a student earned was positively correlated with performance-avoidance-motivation (Abramovich et al., 2013). In our study, we found that using DBs had different motivational effects on students with different self-efficacy for self-regulated learning (SESR) levels. The motivational effect of using DBs as external rewards for students with higher SESR was not as strong as it was for students with lower SESR. In other words, students with low SESR felt more motivated than those with high SESR to learn after being rewarded a badge.

For educators and practitioners who are interested in applying DBs in their educational practices, it is important to design and use DBs in a way that fits the needs of students with different levels of self-efficacy for self-regulated learning. It is also important for them to know that the type of instructional DBs that are embedded with interactive learning activities could be more impactful on student motivation than DBs that are only embedded with basic competency metadata. More research is needed to investigate the relation between self-efficacy for self-regulated learning and the use of digital badges.

Facilitating the Goal-setting Process

In addition to the three basic functions of DBs on learning, we found four specific functions of DBs on facilitating goal-setting process: connecting multiple goals, affecting goal commitment, scaffolding complex tasks, and providing personalized feedback.

Connecting multiple goals. DBs could help students combine performance and learning goals together in a learning environment where both self-decided and assigned goals were present. Each badge not only provides students with a specific performance outcome to achieve, but it also assigns a learning goal, which each student could pursue at his/her own pace. Course-related goals were mixed with assigned goals and personal goals. On the one hand, the course was mandatory to take; on the other hand, the formation of course-related goals was also influenced by factors like satisfying degree requirements, building confidence, pursuing personal interests or long-term professional goals. In this course, the instructor and the TA in each lab were authority figures who provided the assigned goals. All four participants mentioned the help of their TAs who provided feedback in different stages of the course, helping them to be more committed to the course objectives.

According to Keller (2009), learners are more motivated when they perceive the learning goals are relevant to their personal goals for present or future. In this study, we found that students with high SESR could make better connections to their long-term personal goals than those with low SESR. From the comparison of course-related goals between the two pairs of students, we also found that students with high SESR formulated more of a learning goal that focused on the development of their ability or the mastery of new skills. Students with low SESR, on the other hand, formulated more of a performance goal that focused on seeking positive evaluation of their ability and avoiding negative ones (Elliott & Dweck, 1988). Research found that learning goals had a positive impact on learning in terms of strategy formulation, mastery-oriented response to obstacles, and sustained performance (Bryan & Locke, 1967; Reader & Dollinger, 1982).

Affecting goal commitment. The simple use of DBs did not increase goal commitment. Because learners recognized the importance of DBs as assignments that were closely related to grade points, they felt more committed to completing the learning tasks. Prior research arrived at similar conclusions (Haaranen et al., 2014; Reid, Paster, & Abramovich, 2015). In addition, we also found that DBs with interactive activities could trigger intrinsic motivation to devote more time and effort on learning tasks. Using DBs as pure external rewards was more motivating to students with lower SESR than those with high SESR. Future research needs to more accurately measure students' goal commitment under the impact of using DBs and investigate the reasons behind the differences identified.

Scaffolding complex tasks. Each DB could serve as a sub-goal or stepping stone in the learning process (Cheng et al., 2018). This function was especially salient when a package of DBs consisted of a number of knowledge/skills-related simple and complex learning tasks. With this package of DBs, students could design their own learning paths, choose alternative approaches to complete the tasks, and identify personalized learning trajectories. Specifically, they could choose to use simple tasks as scaffolds to develop skills and knowledge until accomplishing the complex task, or they could improve comprehension of the simple tasks by connecting to advanced skills or knowledge acquired when completing the complex tasks. In either way, DBs helped students to make better connections among different learning components.

Providing personalized feedback. Prior research found that DBs could provide both summative and formative feedback (Besser, 2016; Fanfarelli & McDaniel, 2017). For example, Besser (2016) found that digital badge systems could provide students with prompt personalized feedback. Similarly, in this study, we found that the circulatory feedback system adopted by DBs that were used for pedagogical purposes could be used to provide more personalized and prompt feedback to students, especially students with different SESR. This is particularly important because we found that students with low and high SESR had different needs for feedback. Those with low SESR wanted more outcome-based feedback, in other words, feedback that could help them satisfy the task requirements. In contrast, those with high SESR wanted more comprehension-based feedback, in other words, feedback that explained why things should be done in certain ways. Future research may explore how to personalize feedback in DBs to satisfy the needs of different groups of students.

For educators and practitioners who are interested in applying DBs to facilitate student goal-setting and help them with self-regulated learning skills, here are four tips generated from this study:

1. Design pedagogical or system strategies that can help learners, especially those with low SESR to connect their learning objectives to multiple goals in life, to optimize the effects of using DBs on learner motivation.
2. Incorporate interactive activities in the instructions within each badge to trigger learners' intrinsic motivation to devote more time and effort to learning tasks.
3. Try to encourage learners to review all available DBs at the beginning and personalize learning paths according to their individual needs.
4. Customize feedback to students with different levels of SESR.

Conclusion

Digital badges have been used for a variety of purposes, such as representing accomplishments (Bowen & Thomas, 2014; Erickson, 2015), motivating learner participation and interaction (Chou & He, 2017; Stetson-Tiligadas, 2016), professional development (Diamond & Gonzalez, 2014; Wallis & Martinez, 2013), gamification (Haaranen et al., 2014; Hakulinen & Auvinen, 2014), and teaching (Fanfarelli & McDaniel, 2017; Newby et al., 2016). This study focused on exploring the application of DBs as goal-setting facilitators. Findings from this study confirmed the predictions made by previous research that DBs could be a useful tool to facilitate goal-setting processes (Cheng et al., 2018; Gamrat et al., 2014; McDaniel & Fanfarelli, 2016; Randall et al., 2013). This study contributed further by examining how students use this technology to facilitate different parts of their goal-setting processes including identifying goals, improving goal commitment, controlling task complexity, and receiving feedback. In addition, the study found students with different levels of self-efficacy for self-regulated learning skills use this tool differently in their goal-setting processes.

There were limitations in this study. Although we included multiple cases and different perspectives in the study, semi-interview data was the only source of information, which might decrease the credibility of study. Also, the participants in this study represent a small sample of learners in one tertiary-level context, and thus a generalization of the research findings to a large population is restricted. However, this exploratory case study provided insights for future research to investigate 1) the relationship between the use of DBs and self-regulated learning, possible mediators include but are not restricted to gender, motivation level, and learning styles; and 2) the relationship between the use of DBs and actual learning performance. In addition, this study also provided practical implications for educators who are interested in applying digital badges in a higher education context and practitioners who want to implement this technology in similar learning environments. Future research is necessary to explore the relation of using digital badges with goal-setting from different methodological perspectives, using varying data sources, to provide a holistic picture. Future research could also explore how to implement goal-setting strategies into the design of a digital badge-supported learning environment. Finally, it is also worthwhile to explore other types of technologies, in addition to digital badges, that could support learners' goal-setting.

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Appendix A

Self-Efficacy for Self-Regulated Learning Subscale of Multidimensional Scales of

Perceived Self-Efficacy (MSPSE)

Items
Based on your experiences in 270, how well can you:
1. Finish homework assignments by deadlines?
2. Study when there are other interesting things to do?
3. Concentrate on school subjects?
4. Take class notes of class instruction?
5. Use the library to get information for class assignments?
6. Plan your schoolwork?
7. Organize your schoolwork?
8. Remember information presented in class and textbooks?
9. Arrange a place to study without distractions?
10. Motivate yourself to do schoolwork?
11. Participate in class discussion?

Appendix B

Semi-Structured Interview Questions

Interview Items:

1. What do you want to do in the future (professional, personal, or otherwise)?
2. What did you want to get out of this course? What were your goals? At this point, have you made any changes to your initial goals?
3. Did you know exactly what you are going to do in this course at the beginning of the semester, for example the course activities, assignment requirements, and different components of the course content? How did you figure that out? Were you confused at any point?
4. How much did your personal goals for the course match the course objectives? Explain the similarities and differences.
5. What were your initial impressions of the digital badges?
6. Have the use of badges helped you clarify the things you need to do in this course? Explain how badges had helped you understand the specific goals you need to accomplish.
7. Does the use of badges have any effect on helping you work on and be persistent with the requirements of this course? If yes, please give an example.
8. How many badges have you successfully achieved so far?
9. Did you miss or not obtain any badge? Do you remember what problems you had with that missed badge?
10. What do you feel is the difference between completing a badge and completing a traditional assignment?
11. Has the feedback given by your TA clarified what you need to do to accomplish that badge? If yes, please give an example.
12. What was your decision-making process when you were selecting which group badge to do?
13. How did you feel when a challenge had been accepted? Did it make you more confident in accomplishing other goals?
14. Did the challenges in the badge provide scaffolds or step by step guidance that helped you achieve the skill or knowledge? If yes, please give an example.
15. How did you feel when you achieved a badge? Did it make you more confident in accomplishing other goals?
16. After achieving a badge, have you thought about how those awarded badges could be used in the rest of the semester or in the future?
17. When you were doing the interactive module badge, did you ever reflect back on the badges you had done before? To what extent did the previous badges help you accomplish this interactive module badge?
18. Have you been involved in any type of conversation with your friends about badges? What were those conversations about (comparing badges...)? Give an example.
19. What are you going to do with the collected badges? Would you post them to social networking websites, like Facebook or LinkedIn? Why or why not?
20. Do you consider badges as stepping stones to help you achieve your goals? Give an example.

CHAPTER 5. DISCUSSION AND IMPLICATIONS

The purpose of this dissertation is to explore the use of ODBs in improving learning performance and facilitating learners' goal-setting processes in a higher education context. It consisted of three related research studies that served two overarching research goals: first, to find empirical evidence for the impact of using ODBs on improving learning performance and skill acquisition perceptions; and second, to explore learners' experiences of using ODBs in facilitating their goal-setting processes. This chapter includes a summary of each of the three studies, in which the author compares the findings with previous literature, discusses the relationships among the three studies, and explains how they serve the overarching research goals. Implications of this dissertation for different stakeholders, including teachers, instructional designers, and learners are also included. The last part of this chapter includes the limitations of each study and the opportunities for future research in this area.

Summary of Findings

In Chapter Two, we found a positive impact of using ODBs on improving both learning performance and perceptions of skill acquisition. This finding was essential because previous studies had not yet seen the effectiveness of using ODBs on improving learning performance by the time this study was conducted. Results from this study have thus contributed to the current understanding of the use of ODBs in education. In addition to the understanding that the application of ODBs could be useful in promoting motivation (O'Connor & McQuigge, 2013; Stetson-Tiligadas, 2016), supporting professional development in teacher education (Diamond & Gonzalez, 2014; Gamrat et al., 2014), and self-regulated learning (Cucchiara et al., 2014), this research study further indicated that the use of ODBs could be used to improve learning performance. Specifically, it could not only help pre-service teachers gain more positive perceptions on learning instructional technologies but more importantly, it could push them to achieve better performance in learning instructional technologies. This chapter provided a foundation for other sections of this dissertation.

Chapter Three included a conceptual discussion on why ODBs could be useful in improving academic learning performance from the perspective of goal-setting. Although the relation of goal-setting and the use of ODBs has been recognized by previous researchers (Frederiksen, 2013; McDaniel & Fanfarelli, 2016), this chapter expanded the conversation by digging into the roles of using ODBs in facilitating students' goal-setting processes. Based on the goal-setting theoretical framework, the study in this chapter included a review of both the anecdotal and academic discussions on the relationship of ODBs and goal-setting. We found there is a potential of using ODBs as a goal-setting facilitating tool because it may help moderate goal effects on learning by being used to enhance goal commitment, control task complexity, and provide feedback. We also discussed how to optimize the impact of using ODBs on goal effects by defining tiers of ODBs, selecting the appropriate type of ODBs for different learning purposes, and using ODBs at various stages of learning. This chapter served as a bridge between Chapters Two and Four. Specifically, in Chapter Two, we found that under a higher education context, the use of ODBs could help students perform better in learning. Extending the conversation, Chapter Three further discussed the potentials of expanding the impact of ODBs as a useful instructional technology from the lens of goal-setting. The focused literature review and conceptual discussion in this chapter prepared the ground for the next chapter, which was a qualitative case study exploring learners' experiences of using ODBs to facilitate their goal-setting processes in a specific higher education classroom context.

Chapter Four explored how students used ODBs to facilitate their goal-setting processes through a qualitative case study. The purpose of this study was to investigate students' experiences in using ODBs to facilitate their goal-setting processes in an undergraduate instructional technology course. Results from this study were consistent with three functions of ODBs proposed in another case study about digital badges and self-regulated learning (Cucchiara et al., 2014): capturing (validate and trace learning progress), signaling (review and reflect on learning process), and motivating (award achievements). We also found that ODBs were effective in facilitating the student's goal-setting processes. Specifically, we found four respective functions of ODBs on facilitating goal-setting processes: first, ODBs can help bridge students' performance goals and learning goals. Working with ODBs gives students specific performance outcomes to achieve. Some students perceive an ODB as a learning goal to acquire a specific knowledge or skill at his/her own pace. Second, ODBs with interactive activities can trigger intrinsic motivation, making learners devote more time and effort on learning task. Third, each ODB serves as a sub-goal or stepping stone in the learning progress, with which students can design their learning paths, choose alternative approaches to complete the tasks, and identify personalized learning trajectories. Lastly, an open digital badges system designed for pedagogical or instructional purposes typically has a circulatory feedback system that provides more personalized and prompt feedback for students.

Implications for Teachers and Instructional Designers

Based on the findings from the three studies in this dissertation, ODBs could be a useful tool for teachers and instructional designers in higher education. It was found in this dissertation that educator and instructional designers can integrate the use of ODBs into the design and facilitation of instructions to help learners improve learning performance and support learners' goal-setting processes. Following are some lessons learned on how to effectively incorporate the use of ODBs in the design and facilitation of instructions within the context of higher education. Teachers and instructional designers who are interested in using ODBs may use the following guidelines for references.

Deciding How You Want to Integrate ODBs in Your Course

The distinctive features of ODBs can be used in different ways. To decide whether including ODBs in your course design is the correct choice, the first critical task is to consider how you define learning and what learning outcomes you expect to take place. There are various educational affordances of digital badges, which can be used differently (Gibson et al., 2015). Depending on the different course objectives and how you define learning, you can use ODBs as a single motivational element in your course to award students for participation or collaboration, provide a knowledge/skill practice platform, offer alternative credentials, or deliver learning content and instructional materials. The different ways of using ODBs depends on the varied nature of instruction and learning objectives that you want to target on teaching. Although ODBs can be used within different learning frameworks, most of the existing ODB systems are aligned with a competency-based or a mastery-based instructional approach (Besser, 2016; Diamond & Gonzalez, 2014). Under that framework, an ODB represents the "mastery" of skill or knowledge, which shows the owner’s capability of doing or of knowing something. With the support of the ODB system, instructors can provide clearly defined objectives, guidelines, tutorials, feedback, and evaluation criteria. Learners, for their part, can try multiple attempts to accomplish the tasks in a badge and get rounds of feedback until they master the skill or knowledge.

Teachers or instructional designers who are considering the possibility of using ODBs in their course may benefit from asking these rhetorical questions before integrating ODBs in the instruction:

1) What are my course objectives and sub-objectives?
2) Can I categorize the course objectives and sub-objectives into competencies?
3) What kinds of roles do I want ODBs to play in my course?
4) How can the use of ODBs help with achieving my course objectives?
5) How do I make the criteria by which my learners are evaluated measurable?
6) How many resources and what budget can be spent on supporting mastery-based feedback?

Prepare Students for a Goal-Oriented Learning Experience

Working with ODBs requires learners to have a comparably high level of self-regulation and goal-setting capability. Being intentional on setting learning goals is not an intuitive task for learners, especially in a traditional higher education environment in which the performance evaluation is mostly based upon letter grades and seating time.

Interacting with ODBs with a goal in mind is just like reading with leading questions. Exposing students to a large pool of ODBs might be overwhelming at first sight. Thus, it is critical to help learners set goals and plan for their individual learning paths. Before jumping into a pool of ODBs, it is also important to help learners think through questions like: “What do I want to achieve in this course?” and “How can I achieve it with achieving badges?” In addition, it is necessary to remind your learners that gaining more badges is not always the best strategy; what really matters is how you can take advantage of these badges as pathways to achieve your personal learning goals. Here are some tips for teachers and instructional designers to leverage the role that ODBs can play in helping students become more goal-oriented in improving their learning:

1) Emphasize the important role of goal-setting in this course. Make sure the students understand that it is their responsibility to set learning goals and monitor the goal achievement process throughout the course.
2) Introduce the purpose of using ODBs in this course and explain how the use of this tool relates to the course objectives and their personal learning goals.
3) Go through the function and content of each badge. Also, provide students with detailed information on the materials and requirements in each ODB.
4) Design instructional activities that can help students with their decision-making process in selecting ODBs that are connected to their personal learning goals, with consideration of the benefits and challenges of accomplishing each.
5) Encourage learners to set challenging and specific learning goals. Difficult and specific learning goals can challenge learners to make greater achievement.
6) Strategically provide students with opportunities to adjust learning goals at different stages of learning.
7) Emphasize the importance of monitoring the progress of achieving goals and the commitment to the goals.
8) Encourage students to connect their learning goals set in this course to other personal goals, which help them see the greater value of accomplishing the learning goals in this course.

Using ODBs with Technological Pedagogical Content Knowledge

Teachers and instructional designers also need technological pedagogical content knowledge (TPACK) to ensure effective integration of ODBs in designing learning. TPACK is widely recognized as a theoretical framework for understanding teacher knowledge required for effective technology integration among educational researchers (Harris, Mishra, & Koehler, 2014). It is also useful and applicable to the integration of ODBs in higher education classrooms. According to TPACK, it is important for teachers and instructional designers to have three core domains of knowledge: technological knowledge, pedagogical knowledge, and content knowledge. These three domains of knowledge interact with and build on each other. To ensure the effective integration of ODBs in a higher education classroom, we are merging the three domains of knowledge to create meaningful learning experiences. Teachers need to have the technical knowledge of ODBs, such as how do ODBs work, how to create and edit a badge, and how do students interact with the badge. It is also important for teachers to be knowledgeable about the subject that they teach. They must know what they are going to teach and how the nature of knowledge is different from other content areas. And more importantly, teachers need to decide whether ODBs are a good technological fit to serve as a learning platform for this subject content. In addition, teachers also need to know how to teach, manage, assess, and develop the content within an ODB system. With these considerations, teachers who have the technological pedagogical content knowledge are more likely to effectively integrate ODBs in their teaching.

An Essential Guide for Learners in Badge-Support Learning Environments

The use of ODBs can help make learning content more grounded in personal experiences and allow learning experiences to be differentiated for individual learners with individualized goals. Based upon the results of the three studies in this dissertation, learners can benefit from working with ODBs in different ways, such as becoming more intentional on setting goals, more persistent and committed to achieving the goals, and more motivated to improve learning. ODBs could also be used to provide scaffolding and personalized feedback to learners. If you are learners who have a chance to work with badges in courses, training programs, or other informal and formal learning contexts, here are three general guidelines to help you take advantage of using this tool to support your learning.

Guideline #1 Identifying and communicating goals to locate learning

Learning with ODBs is different from traditional ways of taking a course or attending a workshop. Each badge represents a knowledge or skill package that you need to accomplish. Before getting started, it is essential to have an idea of the learning options you have. Try to explore answers to questions like: What kinds of ODBs are available? Do I have options to choose which badges I want to gain? How much time can I spend on accomplishing the ODBs that I intend to pursue?

The selection of badges depends on your goals and learning objectives. It will be very frustrating if the knowledge or skill that you want to accomplish is not within the scope of instruction in this learning environment. By evaluating the types and content of each ODB, you can get a fair understanding of the mission and scope of the learning in a given course. It also helps to set your personal goals and distinguish them from the course objectives. Further, you may want to connect your personal learning goals with your long-term professional goals. In this way, you will feel much more motivated in learning because you can see the long-term value and benefits. Finally, you can also use the ODBs provided in this learning environment as a guiding map to explore interests, detect the scope of learning, and monitor the progress of your goal achievement beyond the individual classroom.

Guideline #2 Adjusting Learning Pathways

Often a learner recognizes a lack of interest in a program or course but is prevented by the system from making any change (Christensen, Horn & Johnson, 2011). Learning with ODBs means learning with adjustable goals and interests. Many learners start with extrinsic goals and it takes time to find their intrinsic goals. Instead of tracking time spent on structured courses, the modularity or even atomicity of skills and knowledge in each ODB can represent nuanced progress in learning. As long as it is within the scope of learning in a specific context, it is possible to try different ODBs to adjust learning pathways that fit the achievement progress of your personal goals.

Guideline #3 Sharing ODBs to Enhance Goal Commitment

When goals are made more public than private, learners have greater commitment to their goals, especially difficult goals (Salancik, 1977). Most ODB systems are supported by an open infrastructure that allows learners to carry and display badges online (Peer 2 Peer University et al., 2011). For example, Khan Academy encourages learners to publish their badges on Facebook (Khan Academy, 2012).Try to make your gained badges public if the ODB system you work with has a publish function. It grants recognition for every learning milestone, making you feel more satisfied and confident in continuing to set new and challenging goals.

Limitations and Future Research

There are limitations across the three studies included in this dissertation. First, the instructional digital badge is the primary type of ODB included in all three studies with limited consideration of other kinds of ODBs. Most of the data were collected in an undergraduate introduction to educational technology course in which instructional digital badges were designed and implemented. Future studies are needed to see if other types of ODBs, such as those that are created just for credentialing purposes, have the same effects on learning performance and goal-setting. Secondly, our participants in the three studies were all pre-service teachers. Future studies could focus on another group of audiences and investigate how they perceive the use of ODBs in the learning and goal-setting processes.

There are also limitations specifically in the Chapter Two study. First, the two groups were taught by different teaching assistants who might give different feedback on the assignments. The difference in learning performance and technology perception between the two groups could be a result of varying feedback rather than the use of ODBs. This might have an impact on the validity of results. Future studies should try to control confounding factors. Second, there was a disconnection between the theoretical framework and the other parts of the study design. Future studies should be more thoughtful about the applicability of a theoretical framework in a study and ensure greater alignment between research questions, theoretical framework, literature review, results, and discussion.

There are also limitations specifically in the Chapter Four study. Although we collected data from different cases, the only source of data was interview data, which restricted data triangulation (Schwandt & Gates, 2018). Future studies could incorporate various sources of data to increase the validity and reliability of the results. Also, results and implications were generated based on only four cases. Future studies could include a large sample size to further verify the results and provide a fuller picture of our understanding concerning the use of ODBs in learning. Additionally, when investigating the role of ODBs in facilitating learners' goal-setting processes, I approached the process of goal-setting from the perspective of industrial/organizational psychology. The study of goal constructs expands across different areas, such as cognitive, personality and motivational domains; within each domain, there are also multiple perspectives that focus on different aspects of a goal, such as latent, phenomenological, and external observer perspectives (Austin & Vancouver, 1996). Exploring from a different psychological perspective might generate different results and implications. In future studies, we can approach from these different perspectives of goals to explore effective ways of using technologies to support learners' goal-setting and goal-attainment.

Besides future studies that could address these specific limitations, there are other valuable related areas to explore regarding the use of technology to improve learning performance and support learner goal-setting. Based on the previous literature and the three studies in this dissertation, I propose the following four directions for related future research that may expand the breadth and depth of our understanding of the use of ODBs in education from the perspective of goal-setting:

1. Further investigate the reasons behind why the use of ODBs could improve learning performance by exploring some goal-related moderating and mediating factors between the use of ODBs and learning performance, such as feedback, task complexity goal commitment, and decision-making.
2. Investigate the impact of using ODBs on learners' goal-setting and learning performance in other contexts, such as vocational education and informal learning environment.

3. Explore the relation between students' self-efficacy for self-regulated learning and the use of ODBs in education.
4. Explore new measurement instruments of goal-setting skills and strategies. Goal-setting is often considered as a phrase in self-regulation (Pintrich, 2000; Zimmerman, Bandura, & Martinez-pons, 1992). While there are some measurements on self-regulation (Pintrich, 2000), scarce measurement instruments have been designed specifically for assessing goal-setting skills and strategies. Future research could look for novel methods for evaluating students' goal-setting strategies in both traditional and online learning environments.

Conclusion

The purpose of this dissertation is to explore the potential use of ODBs as learning tools to help improve students' learning performance and support their goal-setting processes. Three consecutive studies were conducted to explore the impact of using ODBs on learning performance and to investigate learners' experiences of using ODBs in their goal-setting processes. It was found that the use of ODBs has a positive impact on learners' perceptions of learning new technologies and learning performance. From the perspective of goal-setting, the use of ODBs could positively impact learning performance because it moderates goal effects on learning by enhancing goal commitment, controlling task complexity, and facilitating feedback provision. Additionally, learners' self-efficacy for self-regulated learning influences the approaches they use with ODBs in supporting their goal-setting processes.

This dissertation focused on one type of innovative technology – open digital badges – to explore how to integrate it in teaching and learning effectively. However, with the ubiquitous technology support found in the 21st century -- such as virtual reality, adaptive technologies, machine learning, just to name a few -- learners nowadays have a wide array of options in their toolbox to support their learning, and teachers have many technologies to enhance individual learning experiences. With lessons learned in this dissertation, it is fair to conclude that technologies that can provide the following affordances give better promises for improving learning: 1) support the provision of prompt and personalized feedback; 2) afford learner control and adjustment over task complexity; 3) support interactive instructional activities; and 4) facilitate the connection to a larger learning community.

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