*Article*

# Individual Differences in Digital Badging: Do Learner Characteristics Matter?

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**Abstract**

Badge use has rapidly expanded in recent years and has benefited a variety of applications. However, a large portion of the research has applied a binary *useful* or *not useful* approach to badging. Few studies examine the characteristics of the user and the impact of those characteristics on the effectiveness of the badging system. This study takes preliminary steps toward that cause, examining the effectiveness of a badging system across two web-based university courses in relation to the individual differences of the learners. Individual differences are examined through the lens of Long–Dziuban reactive behavior types and traits. Results revealed differences in badge effectiveness that were dependent upon students' Long–Dziuban categorization. Student engagement, intrinsic motivation, reflective and integrative learning, and higher order learning were the constructs most dependent upon categorization. Additional results and their implications are discussed within.

**Keywords**

badging, digital badges, engagement, individual differences, learning, Long-Dziuban, motivation, reactive behavior

In response to the proliferation of distance learning and web-based academia, educators have sought complementary technologies. One such technology, digital badging, is accelerating to the forefront of pedagogical interest (Carey, 2012; Khaddage, Baker, & Knezek, 2012; Mehta, Hull, Young, & Stoller, 2013; Rosewell, 2012). Digital badging systems promise increased granularity of

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assessment (Abramovich, Schunn, & Higashi, 2013), elevated time on task (Blair, 2012), and more precise markers of academic success (Rosewell, 2012).

A digital badge can be considered a visual marker of achievement that is awarded in response to the completion of prespecified criteria and exists in a virtual space (Frederiksen, 2013). For the uninitiated, the digital badge can best be considered in relation to its forbearers. Like military ribbons and Boy and Girl Scout merit badges, digital badges represent what the earner has achieved.

Many of the benefits of digital badging systems are steadily gaining the attention of educators and online systems designers. Consequently, badging has undergone rapid implementation. For example, Mozilla (2014), creators of the Firefox web browser, have created the OpenBadges system, a nonproprietary interface that displays qualification-based badges issued by any organization that wishes to participate. Several universities have also begun incorporating badging systems, such as Purdue (2014) and UC-Davis (Stewart, 2013).

The large-scale adoption of such a technology necessitates the discovery of optimized methods of implementation. It is not enough to simply know that badges seem to improve pedagogy; a deep understanding of *how* they improve, *why* they improve, and *for whom* they improve facilitates the adoption of such a system in a useful way.

Badging has primarily been treated as a one-size-fits-all possibility—*Do badges globally improve motivation? Do badges globally alter performance?* The answers may be more complex than the questions. Perhaps it is the case that badges do improve motivation—sometimes, for some learners; but not always, for all learners. Research has begun examining the design aspects of badging systems, but, with some exceptions (Abramovich et al., 2013; Hakulinen & Auvinen, 2014), learner characteristics have largely been ignored. If the qualities of the learner impact the effectiveness of the system, implementation may require alteration, using badging systems for students who benefit most and omitting them where they discourage the desired results. This study seeks to advance the knowledge base on individual differences as they relate to badging systems, with a specific focus on reactive behavior types and traits (Long, 1975, 1985).

## Background

### *Badging Effectiveness*

The complete benefits of badges are still being established, but several studies have already revealed positive results. In one large-scale experiment, badges significantly increased student contributions and time on task (Denny, 2013). Blair (2012) tested the effects of badges on participants playing a video game and showed that well-designed achievements can improve motivation. Fitz-Walter et al. (2011) found that badges enhanced motivation in a cell-phone app meant to orient new students on campus. Additionally, Charleer, Klerkx, Santos, and

Duval (2013) showed that badges improved awareness of the requirements for successful completion of a human computer interaction course.

## Individual Differences

While badging systems are proving beneficial in many instances, initial research shows that different learners seem to have differing experiences when exposed to badging systems. Abramovich et al. (2013) found evidence that the amount and direction of student motivational changes, after the introduction of a badging system, differed in relation to student preability in math. Hakulinen and Auvinen (2014) discovered differences in motivation to obtain badges between students of different goal orientations. While badging was highly effective for some, it did not appear to exhibit universal appeal. Unfortunately, a shortage of research in this domain leaves questions about the prevalence of such differences as well as the size of their impacts.

## Reactive Behavior Types

Reactive behavior types and traits (Dziuban, Moskal, & Dziuban, 2000) present an interesting framework for the study of individual differences in an educational system. According to Long (1975, 1985), students tend to behave in accordance with one of the four reactive behavior types:

1. *Aggressive independent* (AI)—High in energy with little need for approval, they prefer to work alone and are frequently disorganized and impulsive. Direct with others, they prefer to solve situations in real time, not proactively.
2. *Passive independent* (PI) —Low in energy with little need for approval, they prefer not to participate and may act contrarily to their own best interests. Frequently underachieving, they may develop negative feelings toward personal academic ability.
3. *Aggressive dependent* (AD)—High in energy with high need for approval, they are motivated to participate and actively seek help outside of class. Though frequently high achievers, peer esteem increases stress instead of satisfaction.
4. *Passive dependent* (PD)—Low in energy with high need for approval, they are compliant and nonconfrontational. Gentle and caring, their need for approval causes disagreement and criticism to be interpreted as personal rejection.

These types may also be considered in terms of aggressive types versus passive types or independent types versus dependent types. Energy levels are denoted by aggressive (high) and passive (low), while need for approval is denoted by dependent (high) and independent (low).

Behavior type may be associated with zero to four supporting traits (Dziuban et al., 2000):

1. *Phobic*—Tend to fear negative outcomes, spending their energy in caution while taking care to consider every possible outcome. Highly analytical.
2. *Impulsive*—Unpredictable and often energetic. These students tend to perform *on a whim*, frequently engaging in tasks without careful consideration or prior experience.
3. *Obsessive compulsive*—Organized and methodical. These students tend to complete their tasks and be successful. While typically beneficial, their unspontaneous work ethic can be exhausting.
4. *Hysterical*—Creative, empathetic, and openly emotional. When feeling positive, their energy is contagious. However, they have an affinity for crisis, reacting in a strong negative manner if they perform poorly on a test or forget an assignment.

The Long–Dziuban (LD) Survey Instrument (Dziuban & Dziuban, 1998) is a validated (Long, 1985) and reliable (Cioffi, 1995) instrument used to assess these types and traits. As a short two question self-report instrument, its utility partially lies in its simplicity. The first question asks the reader to read four short descriptions and mark the one that they most identify with, thereby indicating his or her type. The second question asks the reader to read four more short descriptions and mark as many as he or she identifies with, thereby indicating his or her traits. If Long's types are influential in the effectiveness of badges, the simplicity of this instrument will prove useful in efficiently deciding whether or not to use badges with specific groups of students.

Existing research supports the instrument's ability to differentiate between varying levels of student performance. For example, reactive behavior types and traits of students, as assigned by the survey instrument, have been influential in academic achievement in mathematics (Cioffi, 1995; Junkins, 2000), real estate examination performance (Combs, 2004), and student-desired instructor feedback methodology in dance education (Salapa, 2000). This study will focus on the interaction between these reactive behavior types and traits and a digital badging system in university-level courses.

## Research Questions

The primary research question inquires whether or not individual differences exist on the effectiveness of a digital distance learning badging system with regard to reactive behavior types and traits. If so, more specific research questions include:

1. How does aggressiveness impact badging effectiveness?
2. How does dependence impact badging effectiveness?

3. How does reactive behavior type impact badging effectiveness?
4. How do LD traits impact badging effectiveness?
5. To what extent and in which direction does number of badges earned correlate with the various dimensions of badging effectiveness?

For this study, effectiveness is defined along several dimensions, including engagement, intrinsic motivation, and the seven dimensions measured by the National Survey for Student Engagement (NSSE): collaborative learning, reflective and integrative learning, student faculty interaction, higher order learning, effective teaching practices, learning strategies, and student satisfaction.

## Method

### *Participants*

Participants in this study included 44 students (24 male and 20 female) from the University of Central Florida (UCF). All participants were over the age of 18 and currently enrolled in one of the four web-based courses, two Web Design sections, and two Graphic Design sections. All course sections had the same instructor and were offered as electives for students in UCF's School of Visual Arts and Design.

In total, 89 students consented to participation in this study. However, all surveys were provided online. Several participants elected to not complete any of the surveys or did not complete the entire set of surveys. Only complete data sets were retained, totaling 44 participants. No discernable patterns of differences were observed in the available data between complete and incomplete data sets. Participants were not offered any incentives or penalties for participating in the study.

### *Course Structure*

Both courses were completely web based with an equal emphasis on quizzes and exams and project-based assignments. The courses were structured to improve ability in web and graphic design while preparing students for the Adobe Certified Expert exams in either Dreamweaver or Photoshop. For Web Design, the course consisted of complementary projects in Dreamweaver that built into a complete website by the end of the semester. In Graphic Design, participants completed a series of projects in Photoshop, including digital image editing, video editing, and various aspects of design.

### *Badging System*

Two of the sections, one for each course, included a badging system. ˆOriginally, the badging system contained a total of 22 badges (18 were present in Graphic Design, 19 in Web Design). Four badges were never awarded. Top Gun, So Close, and Third Wheel would have been awarded for the top three scores on each project. However, a

clear top three never emerged as multiple participants consistently occupied the top three positions. Flawless victory would have been awarded for receiving a perfect score on all quizzes, a feat which was not accomplished by any participants. ^Thus, a total of 18 badges remained (14 in Graphic Design, 15 in Web Design; see Table 1).

Badges were introduced by the "Let's Play a Game" badge, which was awarded to all students on the first day of class. Subtext accompanying the badge indicated that many other badges were obtainable, but that students would not be told how to unlock them. In accordance with Blair (2012), aside from one introductory badge, all badges were skill based, requiring the demonstration of advanced ability or exceptional effort to obtain the badges. While some were awarded for achieving a perfect score, others were given for reasons such as performing well and submitting an assignment early, demonstrating exceptional creativity, or helping another student on the discussion board. Examples of badge designs are included in Figure 1.

Participants could view their earned badges at any time by clicking a link labeled "Achievements" on the course website. Badges of other students were not visible. Badges not yet acquired were not shown or mentioned anywhere on the site. Clicking an earned badge revealed a description of the badge, the completion criterion, and a larger image of the badge.

## Materials

To measure reactive behavior type and associated traits, the Long–Dziuban Survey Instrument was used. This measure asks participants to read four short descriptions and select the one that best matches them, thereby indicating their reactive behavior type. Next, they read a description of four traits and select any number of traits that they feel describes them.

A modified version of the NSSE (2014) was used to assess collaborative learning, reflective and integrative learning, student faculty interaction, higher order learning, effective teaching practices, learning strategies, and student satisfaction. Modifications were made to better suit the structure of the course, removing responses that were irrelevant (e.g., asking whether student gave a presentation in the course. This was not an option for this web-based course).

Other measures included the Interest/Enjoyment Subscale of the Intrinsic Motivation Inventory (Ryan, 1982) to measure intrinsic motivation and the Engagement Measure (Charlton & Danforth, 2005; Jennett et al., 2008) to measure engagement. Final grade and number of badges earned were also recorded.

## Procedure

All participants proceeded through their respective course as any student would. Measures were disseminated online 3 weeks before the end of the semester to facilitate higher completion rates.

**Table 1.** Badges and Associated Criteria.

| Badge name | Criteria | Course |
|---|---|---|
| Let's play a game | Automatically awarded on first day of class | Both courses |
| High score | Score 100% on a project | Both courses |
| Do or do not. There is no try | Score 100% on a quiz or exam | Both courses |
| Preemptive strike | Finish an exam at least 2 days before its due date and score a 90% or higher | Both courses |
| All your basics are belong to us | Score 90% or higher on all of the first three quizzes | Both courses |
| YOU SHALL NOT PASS! | Score 90% or higher on all quizzes | Both courses |
| You. . . complete me | Finish final project before the last day it is due and score a 90% or better | Both courses |
| Above the call of duty | Exceptional effort on a project (as perceived by instructor) | Both courses |
| Happy Little Trees | Exceptional creativity on a project (as perceived by instructor) | Both courses |
| Dr. Phil | Provide high-quality constructive feedback on the discussion board (as perceived by instructor) | Both courses |
| Overachiever | Effectively demonstrate an advanced concept not covered by the curriculum | Both courses |
| Well planned | Initial site skeleton is an accurate representation of final published site | Web design only |
| Optimized prime | Site loads quickly with no errors on a mobile device | Web design only |
| I have a dream | First assignment site mockup demonstrates exceptional detail | Web design only |
| One site to rule them all | No site errors on any of the five tested browsers | Web design only |
| Too easy | Used more than the required number of images in assignment 7's composition | Graphic design only |
| Don't ever change | Used adjustment layers in a project | Graphic design only |
| I shall call him squishy | Named all layers within a project that included three or more layers | Graphic design only |

Students in badged courses were awarded badges both automatically and by the instructor, depending on the type of badge. Badges that were based on concrete criteria for a single project or exam were awarded automatically (e.g., received a 100% on an exam). Subjective badges were always awarded by the instructor (e.g., demonstrated exceptional creativity on a project).


**Figure 1.** Badge examples.

Students in nonbadged courses proceeded through the course ordinarily, with the exception of completing the measures at the end of the semester. No badges were awarded in these courses.

Completion of study materials was optional. No benefits were offered to students who participated. Students who did not participate did not experience any punishment and still received badges if they were in the badged courses.

### *Data Analysis*

T-tests and correlation analyses were conducted with alpha defined at .05. For correlations, a large effect is considered at $r > .50$, medium at $r > .30$. Effects below .30 were considered negligible and are not reported. T-tests were used for all significance testing.

## Results

During data collection, only a small number of participants classified themselves as not phobic in nonbadge courses ($n = 4$), AI in either course type ($n_{\text{badges}} = 2$, $n_{\text{noBadges}} = 2$), or PI in nonbadge courses ($n = 4$). To reduce the potential for confounds, analyses that examined these groups were not conducted. However, AI and PI participants were included when examining independent types in general. The total participant breakdown can be seen in Tables 2 and 3.

Minimum and maximum observed and possible values for each construct are listed in Table 4. Note that lower values are more desirable than higher values for NSSE items (collaborative learning, reflective and integrative learning, student faculty interaction, higher order learning, effective teaching practices, learning strategies, and student satisfaction). A higher score for these items represents a lower score on the construct. Also note that Pearson's $r$ values have been converted for easier interpretation so that a positive value reflects a positive relationship with the construct. No other conversions have occurred.

**Table 2.** Participant Breakdown by Long Type.

| | AI | PI | AD | PD | Total |
|---|---|---|---|---|---|
| Badged | 2 | 4 | 10 | 5 | 21 |
| Nonbadged | 2 | 6 | 9 | 6 | 23 |
| Total | 4 | 10 | 19 | 11 | 44 |

*Note.* AI = aggressive independent; PI = passive independent; AD = aggressive dependent; PD = passive dependent.

**Table 3.** Participant Breakdown by Long Trait.

| | Phobic | Obsessive compulsive | Impulsive | Hysteric | None |
|---|---|---|---|---|---|
| Badged | 13 | 14 | 5 | 6 | 3 |
| Nonbadged | 19 | 14 | 5 | 10 | 0 |
| Total | 32 | 28 | 10 | 16 | 3 |

**Table 4.** Minimum and Maximum Values by Construct.

| | Minimum observed | Maximum observed | Absolute minimum | Absolute maximum | Mean | *SD* |
|---|---|---|---|---|---|---|
| Final grade | 63.90 | 98.20 | 0 | 100 | 86.35 | 8.77 |
| Intrinsic motivation | 10 | 47 | 7 | 49 | 37.30 | 9.31 |
| Engagement | 30 | 60 | 12 | 60 | 47.59 | 8.03 |
| Collaborative learning | 4 | 12 | 3 | 12 | 10.02 | 2.33 |
| R&I learning | 3 | 9 | 3 | 12 | 5.66 | 1.77 |
| Student faculty interaction | 7 | 16 | 4 | 16 | 13.95 | 2.39 |
| Higher order learning | 4 | 18 | 4 | 20 | 9.80 | 3.59 |
| Effective teaching practices | 5 | 17 | 5 | 25 | 9.93 | 3.45 |
| Learning strategies | 2 | 8 | 2 | 8 | 4.18 | 1.76 |
| Student satisfaction | 2 | 7 | 2 | 8 | 3.75 | 1.50 |

*Note.* *SD* = standard deviation; R&I = reflective and integrative.

## *Research Question 1 Results—Aggressive Versus Passive Types*

In badge courses, aggressive types scored significantly better than passive types in intrinsic motivation, $t(19) = -2.90$; $p = .01$, engagement, $t(19) = -2.95$; $p = .01$, reflective and integrative learning, $t(19) = 2.43$; $p = .03$, and higher order learning, $t(19) = 4.03$; $p < .01$ (see Tables 5–7).

**Table 5.** Means and *SD*s for Aggressive and Passive Types in Badge Courses.

| | $M_{aggressive}$ | $SD_{aggressive}$ | $M_{passive}$ | $SD_{passive}$ |
|---|---|---|---|---|
| Final grade | 86.24 | 6.81 | 85.04 | 13.03 |
| Intrinsic motivation | 41.58 | 4.60 | 32.00 | 10.24 |
| Engagement | 51.00 | 5.69 | 42.22 | 7.97 |
| Collaborative learning | 9.75 | 2.56 | 11.11 | 0.78 |
| R&I learning | 5.08 | 1.83 | 7.00 | 1.73 |
| Student faculty Interaction | 12.67 | 3.09 | 14.00 | 2.96 |
| Higher order learning | 7.92 | 2.75 | 12.44 | 2.24 |
| Effective teaching practices | 9.42 | 3.48 | 11.11 | 2.85 |
| Learning strategies | 3.92 | 1.73 | 5.11 | 1.05 |
| Student satisfaction | 3.17 | 1.19 | 4.22 | 1.39 |

*Note.* *SD* = standard deviation; R&I = reflective and integrative.

**Table 6.** Means and *SD*s for Aggressive and Passive Types in Nonbadged Courses.

| | $M_{aggressive}$ | $SD_{aggressive}$ | $M_{passive}$ | $SD_{passive}$ |
|---|---|---|---|---|
| Final grade | 87.16 | 7.45 | 86.71 | 8.83 |
| Intrinsic motivation | 38.82 | 8.09 | 35.58 | 11.56 |
| Engagement | 50.00 | 6.56 | 46.00 | 9.47 |
| Collaborative learning | 9.55 | 2.16 | 9.92 | 2.94 |
| R&I learning | 5.00 | 1.10 | 5.83 | 1.80 |
| Student faculty interaction | 14.64 | 1.43 | 14.58 | 1.38 |
| Higher order learning | 8.36 | 3.14 | 11.00 | 4.13 |
| Effective teaching practices | 9.36 | 3.93 | 10.08 | 3.55 |
| Learning strategies | 3.45 | 1.51 | 4.42 | 2.19 |
| Student satisfaction | 3.55 | 1.44 | 4.17 | 1.80 |

*Note.* *SD* = standard deviation; R&I = reflective and integrative.

## *Research Question 2 Results—Independent Versus Dependent Types*

Dependent types had significantly higher student faculty interaction, $t(28) = 2.06$; $p = .05$, in badge courses than nonbadge courses. In nonbadge courses, independent types had significantly lower engagement than dependent types, $t(21) = 3.55$; $p < .01$ (see Tables 8–10).

**Table 7.** *p* Values for Research Question 1: Aggressive and Passive Types.

| | Aggressive vs. passive badge courses | Aggressive vs. passive nonbadge courses | Aggressive badges vs. no badges | Passive badges vs. no badges |
|---|---|---|---|---|
| Final grade | 0.79 | 0.90 | 0.76 | 0.73 |
| Intrinsic motivation | **0.01 | 0.45 | 0.32 | 0.47 |
| Engagement | **0.01 | 0.26 | 0.70 | 0.35 |
| Collaborative learning | 0.14 | 0.74 | 0.84 | 0.25 |
| R&I learning | **0.03 | 0.20 | 0.90 | 0.15 |
| Student faculty interaction | 0.33 | 0.93 | 0.07 | 0.55 |
| Higher order learning | **<0.001 | 0.10 | 0.72 | 0.36 |
| Effective teaching practices | 0.25 | 0.65 | 0.97 | 0.49 |
| Learning strategies | 0.08 | 0.24 | 0.50 | 0.39 |
| Student satisfaction | 0.07 | 0.37 | 0.50 | 0.94 |

*Note.* R&I = reflective and integrative.
**Significant ($p < .05$).

**Table 8.** Means and *SD*s for Independent and Dependent Types in Badged Courses.

| | $M_{independent}$ | $SD_{independent}$ | $M_{dependent}$ | $SD_{dependent}$ |
|---|---|---|---|---|
| Final grade | 84.38 | 11.72 | 82.27 | 9.16 |
| Intrinsic motivation | 38.50 | 8.02 | 37.07 | 9.31 |
| Engagement | 48.67 | 8.76 | 46.67 | 7.84 |
| Collaborative learning | 10.67 | 1.03 | 10.20 | 2.40 |
| R&I learning | 5.33 | 1.63 | 6.13 | 3.13 |
| Student faculty interaction | 13.17 | 3.82 | 13.27 | 2.82 |
| Higher order learning | 9.50 | 4.68 | 10.00 | 2.90 |
| Effective teaching practices | 8.83 | 4.17 | 10.67 | 2.82 |
| Learning strategies | 4.50 | 1.64 | 4.40 | 1.60 |
| Student satisfaction | 3.33 | 1.21 | 3.73 | 1.44 |

*Note.* *SD* = standard deviation; R&I = reflective and integrative.

## *Research Question 3 Results—Individual Types*

*AD and PD Types.* PD types had significantly lower reflective and integrative learning in badge courses than nonbadge courses, $t(9) = -3.00$; $p = .02$.

**Table 9.** Means and *SD*s for Independent and Dependent Types in Nonbadged Courses.

| | $M_{independent}$ | $SD_{independent}$ | $M_{dependent}$ | $SD_{dependent}$ |
|---|---|---|---|---|
| Final grade | 85.59 | 9.37 | 87.64 | 7.46 |
| Intrinsic motivation | 32.13 | 9.27 | 39.80 | 9.54 |
| Engagement | 41.13 | 6.92 | 51.53 | 6.59 |
| Collaborative learning | 10.63 | 2.13 | 9.27 | 2.69 |
| R&I learning | 5.75 | 2.19 | 5.27 | 1.10 |
| Student faculty interaction | 14.00 | 1.20 | 14.93 | 1.39 |
| Higher order learning | 10.75 | 5.04 | 9.20 | 3.12 |
| Effective teaching practices | 9.88 | 3.40 | 9.67 | 3.92 |
| Learning strategies | 4.38 | 2.39 | 3.37 | 1.67 |
| Student satisfaction | 4.75 | 1.58 | 3.40 | 1.50 |

*Note*. *SD* = standard deviation; R&I = reflective and integrative.

**Table 10.** *p* Values for Research Question 2: Independent and Dependent Types.

| | Independent vs. dependent badge courses | Independent vs. dependent nonbadge courses | Badges vs. no badges independent | Badges vs. no badges dependent |
|---|---|---|---|---|
| Final grade | 0.70 | 0.57 | 0.83 | 0.66 |
| Intrinsic motivation | 0.75 | 0.08 | 0.20 | 0.43 |
| Engagement | 0.62 | **<0.001 | 0.10 | 0.08 |
| Collaborative learning | 0.65 | 0.23 | 0.33 | 0.32 |
| R&I learning | 0.42 | 0.48 | **0.02 | 0.17 |
| Student faculty interaction | 0.95 | 0.12 | 0.55 | **0.05 |
| Higher order learning | 0.77 | 0.37 | 0.15 | 0.47 |
| Effective teaching practices | 0.25 | 0.90 | 0.35 | 0.43 |
| Learning strategies | 0.90 | 0.46 | 0.53 | 0.27 |
| Student satisfaction | 0.40 | 0.06 | 0.53 | 0.54 |

*Note*. R&I = reflective and integrative.
**Significant ($p < .05$).

In badge courses, AD types had significantly higher intrinsic motivation, $t(13) = 2.31$; $p = .04$, engagement, $t(13) = 2.60$; $p = .02$, reflective and integrative learning, $t(13) = -3.01$; $p = .01$, and higher order learning, $t(13) = -3.13$; $p = .01$, than PDs (see Tables 11–13).

**Table 11.** Means and *SD*s for AD and PD Types in Badged Courses.

| | $M_{AD}$ | $SD_{AD}$ | $M_{PD}$ | $SD_{PD}$ |
|---|---|---|---|---|
| Final grade | 85.74 | 7.22 | 87.32 | 13.19 |
| Intrinsic motivation | 40.50 | 4.25 | 30.20 | 13.20 |
| Engagement | 49.80 | 5.45 | 40.40 | 8.62 |
| Collaborative learning | 9.70 | 2.79 | 11.20 | 0.84 |
| R&I learning | 5.20 | 1.87 | 8.00 | 1.23 |
| Student faculty interaction | 12.60 | 3.10 | 14.60 | 1.67 |
| Higher order learning | 8.70 | 2.26 | 12.60 | 2.30 |
| Effective teaching practices | 10.30 | 3.09 | 11.40 | 2.30 |
| Learning strategies | 4.10 | 1.79 | 5.00 | 1.00 |
| Student satisfaction | 3.40 | 1.17 | 4.40 | 1.82 |

*Note.* *SD* = standard deviation; AD = aggressive dependent; PD = passive dependent; R&I = reflective and integrative.

**Table 12.** Means and *SD*s for AD and PD Types in Nonbadged Courses.

| | $M_{AD}$ | $SD_{AD}$ | $M_{PD}$ | $SD_{PD}$ |
|---|---|---|---|---|
| Final grade | 86.63 | 8.20 | 89.15 | 6.60 |
| Intrinsic motivation | 41.56 | 5.81 | 37.17 | 13.67 |
| Engagement | 52.22 | 4.79 | 50.50 | 9.09 |
| Collaborative learning | 9.11 | 2.15 | 9.50 | 3.56 |
| R&I learning | 4.89 | 0.93 | 5.83 | 1.17 |
| Student faculty interaction | 14.78 | 1.48 | 15.17 | 1.33 |
| Higher order learning | 8.78 | 3.11 | 9.83 | 3.31 |
| Effective teaching practices | 9.78 | 4.27 | 9.50 | 3.73 |
| Learning strategies | 3.33 | 1.32 | 4.33 | 2.07 |
| Student satisfaction | 3.22 | 1.30 | 3.67 | 1.86 |

*Note.* *SD* = standard deviation; AD = aggressive dependent; PD = passive dependent; R&I = reflective and integrative.

## *Research Question 4 Results—Individual Traits*

*Phobic.* In badge courses, nonphobic participants scored significantly better on reflective and integrative learning, $t(19) = -2.99$; $p = .01$, and higher order learning, $t(19) = -3.19$; $p = .01$, than phobic participants (see Tables 14 and 15).

**Table 13.** *p* Values for Research Question 3: Individual Types—AD and PD.

| | AD vs. PD badge courses | AD vs. PD non-badge courses | Badges vs. no badges AD | Badges vs. no badges PD |
|---|---|---|---|---|
| Final grade | 0.77 | 0.54 | 0.80 | 0.77 |
| Intrinsic motivation | **0.04 | 0.40 | 0.66 | 0.42 |
| Engagement | **0.02 | 0.64 | 0.32 | 0.09 |
| Collaborative learning | 0.27 | 0.80 | 0.62 | 0.33 |
| R&I learning | **0.01 | 0.11 | 0.66 | **0.02 |
| Student faculty interaction | 0.21 | 0.61 | 0.07 | 0.55 |
| Higher order learning | **0.01 | 0.54 | 0.95 | 0.15 |
| Effective teaching practices | 0.5 | 0.90 | 0.76 | 0.35 |
| Learning strategies | 0.32 | 0.27 | 0.31 | 0.53 |
| Student satisfaction | 0.22 | 0.59 | 0.76 | 0.53 |

*Note*. AD = aggressive dependent; PD = passive dependent; R&I = reflective and integrative.
**Significant ($p < .05$).

**Table 14.** Means and *SD*s for Phobic and Nonphobic Traits in Badged Courses.

| | $M_{phobic}$ | $SD_{phobic}$ | $M_{nonphobic}$ | $SD_{nonphobic}$ |
|---|---|---|---|---|
| Final grade | 85.28 | 11.65 | 86.45 | 5.85 |
| Intrinsic motivation | 35.69 | 10.18 | 40.38 | 5.24 |
| Engagement | 44.85 | 8.75 | 51.13 | 4.55 |
| Collaborative learning | 10.23 | 2.35 | 10.50 | 1.69 |
| R&I learning | 6.77 | 1.69 | 4.50 | 1.69 |
| Student faculty interaction | 14.00 | 2.92 | 12.00 | 2.98 |
| Higher order learning | 11.38 | 2.60 | 7.38 | 3.11 |
| Effective teaching practices | 10.23 | 2.56 | 10.00 | 4.38 |
| Learning strategies | 4.77 | 1.59 | 3.88 | 1.46 |
| Student satisfaction | 3.92 | 1.50 | 3.13 | 0.99 |

*Note*. *SD* = standard deviation; R&I = reflective and integrative.

*Obsessive compulsive.* No significant results were observed for obsessive compulsive participants (see Tables 16–18).

*Impulsive.* Impulsive participants had significantly lower learning strategies, $t(8) = -2.80$; $p = .02$, in badge courses than nonbadge courses. Nonimpulsive

**Table 15.** *p* Values for Research Question 4: Individual Traits—Phobic and Not Phobic.

| | Phobic vs. not phobic badge courses | Phobic vs. not phobic nonbadge courses | Badges vs. no badges phobic | Badges vs. no badges not phobic |
|---|---|---|---|---|
| Final grade | 0.80 | — | 0.71 | — |
| Intrinsic motivation | 0.25 | — | 0.81 | — |
| Engagement | 0.08 | — | 0.46 | — |
| Collaborative learning | 0.78 | — | 0.56 | — |
| R&I learning | **0.01 | — | 0.06 | — |
| Student faculty interaction | 0.15 | — | 0.34 | — |
| Higher order learning | **0.01 | — | 0.32 | — |
| Effective teaching practices | 0.88 | — | 0.91 | — |
| Learning strategies | 0.21 | — | 0.17 | — |
| Student satisfaction | 0.20 | — | 0.83 | — |

*Note.* R&I = reflective and integrative.
**Significant ($p < .05$).

**Table 16.** Means and *SD*s for Obsessive Compulsive and Nonobsessive Compulsive Traits in Badged Courses.

| | $M_{OC}$ | $SD_{OC}$ | $M_{non\text{-}OC}$ | $SD_{non\text{-}OC}$ |
|---|---|---|---|---|
| Final grade | 85.46 | 8.13 | 86.26 | 13.00 |
| Intrinsic motivation | 39.00 | 7.21 | 34.43 | 11.33 |
| Engagement | 47.50 | 7.52 | 46.71 | 9.32 |
| Collaborative learning | 10.36 | 2.31 | 10.29 | 1.70 |
| R&I learning | 5.86 | 1.79 | 6.00 | 2.52 |
| Student faculty interaction | 13.29 | 2.87 | 13.14 | 3.58 |
| Higher order learning | 9.86 | 3.26 | 9.86 | 3.89 |
| Effective teaching practices | 9.64 | 2.90 | 11.14 | 3.93 |
| Learning strategies | 4.36 | 1.69 | 4.57 | 1.40 |
| Student satisfaction | 3.57 | 1.16 | 3.71 | 1.80 |

*Note.* *SD* = standard deviation; R&I = reflective and integrative.

participants had significantly higher student faculty interaction, $t(32) = 2.33$; $p = .03$, in badge courses than nonbadge courses. In badge courses, nonimpulsive participants scored significantly better than impulsive participants in intrinsic motivation, $t(19) = 2.11$; $p = .05$, engagement, $t(19) = 3.35$; $p < .01$, reflective and

**Table 17.** Means and *SD*s for Obsessive Compulsive and Nonobsessive Compulsive Traits in Nonbadged Courses.

| | $M_{OC}$ | $SD_{OC}$ | $M_{non\text{-}OC}$ | $SD_{non\text{-}OC}$ |
|---|---|---|---|---|
| Final grade | 86.19 | 7.77 | 88.08 | 8.74 |
| Intrinsic motivation | 34.50 | 11.54 | 41.22 | 5.04 |
| Engagement | 45.43 | 8.54 | 51.78 | 6.52 |
| Collaborative learning | 9.50 | 2.71 | 10.11 | 2.37 |
| R&I learning | 5.43 | 1.70 | 5.44 | 1.33 |
| Student faculty interaction | 14.64 | 1.45 | 14.56 | 1.33 |
| Higher order learning | 10.14 | 4.40 | 9.11 | 2.93 |
| Effective teaching practices | 10.57 | 3.76 | 8.44 | 3.32 |
| Learning strategies | 4.29 | 2.27 | 3.44 | 1.13 |
| Student satisfaction | 4.00 | 1.75 | 3.67 | 1.50 |

*Note*. *SD* = standard deviation; R&I = reflective and integrative.

**Table 18.** *p* Values for Research Question 4: Individual Traits—Obsessive Compulsive and Not Obsessive Compulsive.

| | Obsessive compulsive vs. not obsessive compulsive badge courses | Obsessive compulsive vs. not obsessive compulsive nonbadge courses | Badges vs. no badges obsessive compulsive | Badges vs. no badges not obsessive compulsive |
|---|---|---|---|---|
| Final grade | 0.87 | 0.59 | 0.81 | 0.74 |
| Intrinsic motivation | 0.27 | 0.12 | 0.23 | 0.13 |
| Engagement | 0.83 | 0.07 | 0.50 | 0.22 |
| Collaborative learning | 0.94 | 0.59 | 0.38 | 0.87 |
| R&I learning | 0.88 | 0.98 | 0.52 | 0.58 |
| Student faculty interaction | 0.92 | 0.89 | 0.13 | 0.29 |
| Higher order learning | 1.00 | 0.54 | 0.85 | 0.67 |
| Effective teaching practices | 0.33 | 0.18 | 0.47 | 0.16 |
| Learning strategies | 0.78 | 0.32 | 0.93 | 0.10 |
| Student satisfaction | 0.83 | 0.64 | 0.45 | 0.96 |

*Note*. R&I = reflective and integrative.
**Significant ($p < .05$).

**Table 19.** Means and *SD*s for Impulsive and Nonimpulsive Traits in Badged Courses.

| | $M_{imp}$ | $SD_{imp}$ | $M_{nonImp}$ | $SD_{nonImp}$ |
|---|---|---|---|---|
| Final grade | 85.98 | 11.28 | 85.65 | 9.54 |
| Intrinsic motivation | 30.80 | 12.19 | 39.56 | 6.61 |
| Engagement | 38.80 | 7.79 | 49.87 | 6.05 |
| Collaborative learning | 10.00 | 3.39 | 10.44 | 1.63 |
| R&I learning | 7.40 | 1.52 | 5.44 | 1.93 |
| Student faculty interaction | 14.20 | 3.49 | 12.94 | 2.93 |
| Higher order learning | 11.60 | 2.51 | 9.31 | 3.50 |
| Effective teaching practices | 10.80 | 1.64 | 9.94 | 3.64 |
| Learning strategies | 6.00 | 1.23 | 3.94 | 1.34 |
| Student satisfaction | 4.60 | 1.95 | 3.31 | 1.01 |

*Note.* *SD* = standard deviation; R&I = reflective and integrative.

**Table 20.** Means and *SD*s for Impulsive and Nonimpulsive Traits in Nonbadged Courses.

| | $M_{imp}$ | $SD_{imp}$ | $M_{nonImp}$ | $SD_{nonImp}$ |
|---|---|---|---|---|
| Final grade | 82.74 | 6.18 | 88.09 | 8.23 |
| Intrinsic motivation | 35.20 | 9.12 | 37.67 | 10.36 |
| Engagement | 43.40 | 6.19 | 49.17 | 8.49 |
| Collaborative learning | 10.60 | 2.61 | 9.50 | 2.55 |
| R&I learning | 6.20 | 2.28 | 5.22 | 1.26 |
| Student faculty interaction | 14.20 | 1.64 | 14.72 | 1.32 |
| Higher order learning | 9.80 | 4.82 | 9.72 | 3.71 |
| Effective teaching practices | 8.00 | 2.55 | 10.22 | 3.84 |
| Learning strategies | 3.40 | 1.67 | 4.11 | 2.00 |
| Student satisfaction | 4.60 | 1.95 | 3.67 | 1.53 |

*Note.* *SD* = standard deviation; R&I = reflective and integrative.

integrative learning, $t(19) = -2.07$; $p = .05$, and learning strategies, $t(19) = -3.06$; $p = .01$ (see Tables 19–21).

*Hysteric.* No significant results were observed for hysteric participants (see Tables 22–24).

**Table 21.** *p* Values for Research Question 4: Individual Traits—Impulsive and Not Impulsive.

| | Impulsive vs. not impulsive badge courses | Impulsive vs. not impulsive nonbadge courses | Badges vs. no badges impulsive | Badges vs. no badges not impulsive |
|---|---|---|---|---|
| Final grade | 0.95 | 0.19 | 0.56 | 0.43 |
| Intrinsic motivation | **0.05 | 0.64 | 0.54 | 0.54 |
| Engagement | **<0.001 | 0.17 | 0.33 | 0.78 |
| Collaborative learning | 0.69 | 0.41 | 0.76 | 0.22 |
| R&I learning | **0.05 | 0.21 | 0.36 | 0.70 |
| Student faculty interaction | 0.43 | 0.47 | 1.00 | **0.03 |
| Higher order learning | 0.19 | 0.97 | 0.48 | 0.74 |
| Effective teaching practices | 0.62 | 0.24 | 0.07 | 0.83 |
| Learning strategies | **0.01 | 0.48 | **0.02 | 0.77 |
| Student satisfaction | 0.06 | 0.27 | 1.00 | 0.44 |

*Note*. R&I = reflective and integrative.
**Significant ($p < .05$).

**Table 22.** Means and *SD*s for Hysteric and Nonhysteric Traits in Badged Courses.

| | $M_{hyst}$ | $SD_{hyst}$ | $M_{nonHyst}$ | $SD_{nonHyst}$ |
|---|---|---|---|---|
| Final grade | 84.23 | 7.83 | 86.33 | 10.52 |
| Intrinsic motivation | 35.33 | 8.57 | 38.33 | 9.01 |
| Engagement | 43.83 | 7.31 | 48.60 | 8.00 |
| Collaborative learning | 11.50 | 0.84 | 9.87 | 2.26 |
| R&I learning | 5.67 | 2.16 | 6.00 | 2.00 |
| Student faculty interaction | 14.00 | 1.67 | 12.93 | 3.43 |
| Higher order learning | 9.83 | 3.06 | 9.87 | 3.60 |
| Effective teaching practices | 10.83 | 2.71 | 9.87 | 3.50 |
| Learning strategies | 4.50 | 1.87 | 4.40 | 1.50 |
| Student satisfaction | 3.83 | 0.75 | 3.53 | 1.55 |

*Note*. *SD* = standard deviation; R&I = reflective and integrative.

## *Research Question 5—Correlations*

The correlations between all variables and number of badges earned are listed in Tables 25 and 26.

**Table 23.** Means and *SD*s for Hysteric and Nonhysteric Traits in Nonbadged Courses.

| | $M_{hyst}$ | $SD_{hyst}$ | $M_{nonHyst}$ | $SD_{nonHyst}$ |
|---|---|---|---|---|
| Final grade | 87.07 | 8.68 | 86.82 | 7.83 |
| Intrinsic motivation | 40.90 | 5.38 | 34.23 | 11.80 |
| Engagement | 49.60 | 7.38 | 46.62 | 8.98 |
| Collaborative learning | 9.30 | 3.13 | 10.08 | 2.06 |
| R&I learning | 5.40 | 1.35 | 5.46 | 1.71 |
| Student faculty interaction | 14.10 | 1.37 | 15.00 | 1.29 |
| Higher order learning | 9.80 | 3.52 | 9.69 | 4.23 |
| Effective teaching practices | 8.70 | 2.95 | 10.54 | 4.08 |
| Learning strategies | 3.20 | 1.23 | 4.54 | 2.18 |
| Student satisfaction | 3.80 | 1.55 | 3.92 | 1.75 |

*Note.* *SD* = standard deviation; R&I = reflective and integrative.

**Table 24.** *p* Values for Research Question 4: Individual Traits—Hysteric and Not Hysteric.

| | Hysteric vs. not hysteric badge courses | Hysteric vs. not hysteric nonbadge courses | Badges vs. no badges hysteric | Badges vs. no badges not hysteric |
|---|---|---|---|---|
| Final grade | 0.67 | 0.94 | 0.52 | 0.89 |
| Intrinsic motivation | 0.49 | 0.11 | 0.13 | 0.31 |
| Engagement | 0.22 | 0.40 | 0.15 | 0.54 |
| Collaborative learning | 0.11 | 0.48 | 0.12 | 0.80 |
| R&I learning | 0.74 | 0.93 | 0.76 | 0.46 |
| Student faculty interaction | 0.48 | 0.12 | 0.90 | 0.05 |
| Higher order learning | 0.98 | 0.95 | 0.99 | 0.91 |
| Effective teaching practices | 0.55 | 0.24 | 0.17 | 0.64 |
| Learning strategies | 0.90 | 0.10 | 0.11 | 0.85 |
| Student satisfaction | 0.66 | 0.86 | 0.96 | 0.54 |

*Note.* R&I = reflective and integrative.

## Discussion

### *Research Question 1 Discussion—Aggressive Versus Passive Types*

Several differences were observed between aggressive and passive participants. First, aggressive participants consistently performed better in badged courses

**Table 25.** Aggressiveness and Dependence Correlations.

| | AD | PD | Independent | Dependent | Aggressive | Passive |
|---|---|---|---|---|---|---|
| Student satisfaction | −.301 | −.905 | −.305 | **−.557 | −.253 | **−.685 |
| Learning strategies | −.173 | −.339 | −.758 | −.197 | −.265 | −.429 |
| Effective teaching practices | .113 | −.125 | −.387 | .035 | .06 | −.14 |
| Higher order learning | .236 | **−.979 | −.128 | −.174 | .134 | −.364 |
| student faculty interaction | .177 | .122 | −.471 | .136 | −.047 | .136 |
| Reflective and integrative learning | .037 | −.484 | **−.904 | −.091 | −.136 | −.211 |
| Collaborative learning | −.037 | .385 | **−.983 | .015 | −.108 | .022 |
| Engagement | −.076 | .321 | .464 | .104 | −.007 | .233 |
| Intrinsic motivation | −.272 | .442 | .546 | .156 | −.182 | .407 |
| Final grade | **.723 | .861 | .506 | **.778 | **.724 | **.725 |

*Note*. AD = aggressive dependent; PD = passive dependent.
**Significant ($p < .05$).

than passive participants, achieving significantly better scores in higher order learning, reflective and integrative learning, engagement, and intrinsic motivation. Additionally, aggressive participants had significantly better student faculty interaction in badge courses than nonbadge courses. One may consider the possibility that passive participants did not have adequate drive to actively engage in the hunt for badges. If this were the case, it would be expected that passive participants would have received fewer badges than aggressive participants, which was not the case. Instead, the difference may be a reaction to other positive feedback received in response to additional work put in by aggressive participants (e.g., grades, instructor praise, etc.), with badges playing only a supplementary role. Further research should be conducted to gain a better grasp on the underlying causes for the observed effects.

## *Research Question 2 Discussion—Independent Versus Dependent Types*

Significant differences were sparse between independent and dependent participants. Dependent participants showed significantly higher engagement, but no other significant differences were observed between the two types.

Differences were also minimal between badge and nonbadge participants within each type. Dependent participants had significantly higher student faculty interaction in badged courses than nonbadged courses, while independent participants showed no significant differences between the two course types.

The defining characteristic of dependents is that they require more approval than independents. Badges may seem like a great means of providing this

**Table 26.** Trait Correlations.

| | Phobic | Not phobic | Obsessive compulsive | Not obsessive compulsive | Impulsive | Not impulsive | Hysteric | Not hysteric |
|---|---|---|---|---|---|---|---|---|
| Student satisfaction | **−0.61 | −0.349 | −0.182 | −0.827 | −0.682 | −0.39 | −0.354 | −0.511 |
| Learning strategies | −0.252 | −0.629 | −0.339 | −0.427 | −0.562 | −0.311 | −0.299 | −0.355 |
| Effective teaching practices | −0.162 | 0.041 | −0.044 | −0.18 | 0.177 | −0.097 | 0.137 | −0.094 |
| Higher order learning | −0.302 | −0.179 | 0.299 | −0.752 | −0.682 | 0.031 | 0.357 | −0.306 |
| Student faculty interaction | −0.17 | 0.061 | 0.002 | −0.097 | −0.105 | 0.001 | 0.334 | −0.097 |
| Reflective and integrative learning | −0.174 | −0.605 | −0.053 | −0.433 | −0.232 | −0.216 | 0.012 | −0.325 |
| Collaborative learning | 0.11 | −0.64 | −0.057 | −0.264 | −0.023 | −0.216 | −0.095 | −0.09 |
| Engagement | 0.297 | 0.083 | 0.122 | 0.282 | 0.41 | 0.049 | 0.499 | 0.032 |
| Intrinsic motivation | 0.338 | 0.066 | 0.128 | 0.47 | 0.444 | 0.048 | 0.416 | 0.138 |
| Final grade | **0.728 | **0.758 | **0.655 | **0.754 | **0.99 | **0.558 | 0.788 | **0.672 |

**Significant ($p < .05$).

approval, but they did not appear to adequately serve this role in this study. If badged courses increased perception of approval, dependents would likely have shown improved satisfaction in badge courses, probably accompanied by engagement. While dependents did show significantly higher engagement than independents, the effect was not seen between badge and nonbadge courses within the dependent group. It may be proposed that while receiving a badge was likely viewed as a positive event which conveyed approval, submitting an assignment and not receiving a badge for it could have been perceived as the opposite. Instead of being perceived as the mere absence of approval, it may have delivered the message that the assignment submission was insufficient to be awarded a badge (approval), thus discouraging dependent students. Further, student faculty interaction was significantly higher in badge courses, which may have been a result of student attempts to resolve this inner conflict by gaining counsel from the professor. Future research should reexamine these groups with a badge system that has skill-based badges available for all assignments to see if the consistent potential for approval improves dependent outcomes. If increasing the number and consistency of badges increases outcomes for dependent students, these modifications are expected to have widespread beneficial effects.

### *Research Question 3 Discussion—Individual Types*

Dependents in this study were further categorized into ADs and PDs. ADs consistently outperformed PDs in badged courses, scoring significantly better in intrinsic motivation, engagement, reflective and integrative learning, and higher order learning, while no significant differences between types were observed in nonbadged courses.

PDs performed significantly worse in badge courses than nonbadge courses for engagement and reflective and integrative learning. ADs suffered no similar ill effects. ˆGiven these results, it seems as though the positive effects described for all dependents, in Research Question 2, were primarily applied to PDs. While both ADs and PDs have a high need for approval, it seems likely that the higher energy levels from ADs resulted in higher performance, resulting in greater levels of positive feedback. PDs may not have had that experience and were unable to counteract the effects of not receiving badges for all assignments. Deeper insight into the effects observed for these two groups would be acquired through conducting research on badging systems that provide the opportunity to earn badges along regular intervals.

### *Research Question 4 Discussion—Individual Traits*

Obsessive compulsive and hysteric participants revealed no significant results. However, impulsive and phobic participants did show differences in comparison to their counterparts and the presence or nonpresence of badges.

While there were no significant differences between impulsive and nonimpulsive participants in nonbadged courses, nonimpulsive participants showed improved scores in three dimensions in badged courses, including intrinsic motivation, engagement, and learning strategies. Additionally, nonimpulsive participants scored significantly better on student faculty interaction in badged courses than nonbadged courses, and impulsive students performed significantly worse in learning strategies in badged courses than nonbadged courses. While badges seem to have several clear benefits to nonimpulsive participants over impulsive participants, the cause is uncertain. Future studies should examine the underlying mechanisms for these results.

While there was an insufficient number of phobic participants to run analyses in nonbadged courses, differences were found between phobic and nonphobic participants in badged courses, with nonphobics performing significantly better in higher order learning and, most interestingly, reflective and integrative learning. This is particularly interesting because phobics are defined by their analytic tendencies and careful considerations of possible outcomes. Despite this, phobics in badged courses performed less reflective and integrative learning than nonphobics. Looking deeper, the difference between reflective and integrative learning in phobics in nonbadged courses and badged courses approached significance at $p = .06$. Badging may have had a negative impact on this type of learning for phobics, but the reason remains unclear. Larger scale studies should be conducted to more deeply examine the impact of badging systems on phobics and their counterparts.

### *Research Question 5 Discussion—Correlations*

Several relationships were observed, but a few, in particular, are highly remarkable. Student satisfaction showed a significant large positive relationship with number of badges earned, showing an increase in satisfaction as participants earned more badges. This evidence extends the theory posited earlier in this article, that dependents may have seen the absence of badges as proof of insufficiency, not merely the absence of approval. This support provides further testament to the need for future research examining the effects of badging technologies with more badges available along consistent intervals on dependent type learners. Additionally, independents showed medium or better positive relationships for number of badges earned with nearly all of the tested variables. Thus, it is unlikely that a negative effect would be seen for independents if more badges were included.

It was also proposed that the increased energy levels of AD participants may have resulted in better quality work and thus higher levels of approval than their lower energy PD counterparts, protecting them from the negative effects on perception of approval from not receiving badges. The correlational data for PDs seem to fit, showing medium or better positive

relationships between number of badges earned with final grade, intrinsic motivation, engagement, collaborative learning, reflective and integrative learning, higher order learning, learning strategies, and student satisfaction. As number of badges earned increased, so did these factors. Future research should undergo further examination of approval as a potential mediating factor.

## Conclusion

While the majority of badge research has been conducted without regard for individual differences, the findings from this study are indicative of the importance of these factors. This study adds to the short but growing list of evidence for the existence of individual differences in the way students are affected by badges while providing specific points of focus for future research.

In particular, PD learners warrant increased attention. They did not benefit to the same level as AD or independent learners. In response to the observed data, it is proposed that dependent learners will benefit from badging systems that offer badges more frequently, during regular intervals, to provide a more consistent source of potential approval. While this type of design is not expected to negatively impact non-PD learners, they should also be included in future experimentation to ensure negative effects are not introduced.

Impulsiveness and phobia were also impactful in this study, with badging showing reduced scores on several dimensions for impulsive and phobic participants over their counterparts. If a large percentage of learners for a specific course come from a population that is expected to have a high proportion of impulsiveness or phobia, a badging system may be undesirable. Future research should examine the underlying factors for this effect to see if it can be mitigated through careful design.

As badge prevalence continues to escalate, increasing importance will be placed on the knowledge of how students of varying characteristics react to various badging system designs. If optimization of a badging system is desirable—and it is—badge studies should begin identifying the best implementation methodologies for learners of varying characteristics. Given the differences observed in this study, the Long–Dziuban instrument may be an effective starting point. Future research should take care to examine a range of learning styles and learner characteristics, including and beyond those mentioned here.

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