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Preservice Teachers' Technology Integration Attitude Change in a Course Implementing Digital Badges

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Preservice teachers' beliefs and attitudes impact the likelihood they will integrate technology in their future teaching. Consequently teacher preparation programs should provide courses designed to enhance preservice teachers' attitudes and beliefs towards technology use in the classroom. However, many programs instead focusing solely on technology skills and knowledge and are not designed to establish positive attitudes towards technology integration. It is therefore important for teacher education programs to integrate technology effectively in their own classes in to illustrate best practices. This study examines the beliefs and perceived attitudinal learning of preservice teachers in a technology integration course that utilized digital badges as a way to model effective technology integration. It also examines their perceptions of the instructional design of the course and the efficacy of digital badges as a learner-centered learning technology. Results showed that students by far perceived digital badges as the most beneficial aspect of the course to their attitudinal learning. In regards to their attitudinal learning, students perceived the highest growth in their cognitive learning and the lowest in their affective. Students perceived the lack of resources as the primary barrier to technology integration in their future classrooms.

INTRODUCTION

The beliefs and attitudes of preservice teachers impact and predict the likelihood that the they will integrate technology in their future teaching (Bai & Ertmer, 2008; Uslu & Buman, 2012). Furthermore, teachers' beliefs guide and direct their teaching and design decisions (Hew & Brush, 2007), which affects the usability of the technology and integration and impacts students' learning. Experts consequently argue that teacher preparation programs should provide effective courses designed to enhance preservice teachers' attitudes and beliefs (Bai & Ertmer, 2008; Hew & Brush, 2007) towards technology use in the classroom. However, many programs are not designed to influence attitudes or beliefs towards technology integration (Kay, 2006), instead focusing solely on technology skills and knowledge. Swain (2006) found that preservice teachers are not always well prepared to integrate technology effectively into their curriculum, and they can have difficulty translating their knowledge and beliefs regarding technology integration into effective practice (Rice, Johnson, Ezell, & Pierczynski-Ward, 2008). Therefore, recommendations in the literature call for teacher education programs to integrate technology effectively in their own classes in order to illustrate best practices for technology integration (Kelly, et al., 2004; Krueger et al., 2004; Rice, et al., 2008).

This study examines the beliefs and perceived attitudinal learning of preservice teachers in a technology integration course that utilized digital badges as a way to model effective technology integration with specific pedagogical goals in mind. It also examines the preservice teachers' perceptions of the instructional design of the course and the efficacy of digital badges as a learner-centered learning technology.

Teacher training and attitudinal learning

Given the recommendations that technology integration courses should focus on promoting positive attitudes and beliefs in order to encourage preservice teachers to transfer what they have learned and apply it to their future classrooms (Bai & Ertmer, 2008; Hew & Brush, 2007), it is important to understand how best to design instruction for attitudinal learning. However, many teacher education programs fail to target their students' attitudes and beliefs towards technology (Kay, 2006). Related to this is the fact that despite recognition of the critical importance of attitudinal learning (Gagne, Briggs, & Wager, 1992), research on instruction for attitudinal learning is limited (Enger & Lajimodiere, 2011).

Attitude is defined as a person's psychological evaluations of an object, person, or event (Gagne, et al., 1992; Thomas & Znaniecki, 1919; Zimbardo & Leippe, 1991). Attitudes are described as comprised of three components: cognitive, behavioral, and affective (Kamradt & Kamradt, 1999; Simonson, 1979; Zimbardo & Ebbesen, 1970). Cognitive components refer to the psychological evaluation of knowledge, information, and thoughts; behavioral components indicate the actions taking toward the object, person, or event; and affective describes the emotions and feelings the individual holds (Simonson, 1979; Simonson & Maushak, 1996; Kamradt & Kamradt, 1999). Attitudinal learning or change therefore seeks to alter an attitude's strength, such as from negative to slightly positive, or from slightly positive to very positive (Briñol & Petty, 2005).

While attitude change has been identified as a core objective in school (Gagne, et al., 1992), attitudinal learning outcomes have often been subjugated to sublevel objectives in favor of strictly cognitive measures, possibly because of confusion as to how best to measure attitude (Simonson & Maushak, 2001). For example, in a study which sought to positively impact student attitudes towards technology through teacher-training, an unvalidated, author-created survey was used to measure the impact of the training on teachers' attitudes and found a negative impact on teacher attitudes towards technology integration and no correlation between teacher attitudes and student attitudes (Gibson, et al., 2014). This was a surprising outcome given prior research identifying teacher beliefs as the most important factor in successful computer integration in the classroom (Inan & Lowther, 2010). Related to attitudes are beliefs, which represent "the perceived likelihood that an attribute is associated with an object" (Albarracín, et al., 2005, p. 4) and can therefore be more readily confirmed or rejected based on "objective criteria" (p. 5). Fluck and Dowden (2013) sought to design instruction to positively influence pre-service teacher beliefs by having them envision the use of technology through altering the design of sample existing curriculum and proposing the integration of specific technologies; they then measured student beliefs based on a scoring rubric. Farjon, Smits, and Voogt (20019) examined 398 pre-service teachers at a Dutch university and found that their attitudes and beliefs towards technology integration had the greatest influence on their technology integration. An example can further illustrate the relationship,between attitude and belief: the belief that modern schools expect teachers to effectively integrate technology could be confirmed through available data, while a positive attitude towards the use of technology in the classroom refers more to the level of favorable response towards technology integration. Both are key considerations in training preservice teachers to be prepared to effectively integrate technology in their future classrooms.

Studies examining preservice teacher attitudes regarding technology have tended to focus more on taking a snap shot of existing attitude towards technology in general (Teo, Milutinović, & Zhou, 2016) or computer-assisted (Baturay, Gökçearslan, & Ke, 2017) or computer supported education (Celik & Yesilyurt, 2012) rather than measuring the impact of instruction on these attitudes over time and in response to specific instructional interventions or modeled learning technologies. As with research on attitudinal instruction in general, instructional strategies for effectively promoting attitudinal learning need further exploration (Daruwalla & Darcy, 2005; Simonson, 1979; Simonson & Maushak, 1996).

Initial recommendations (Mueller, et al, 2017) prescribe instructional strategies that target each of the three attitudinal components. Presenting new information is a common and effective instructional strategy targeting the cognitive component to establish a mind prepared for attitudinal learning (Bodenhausen & Gawroknski, 2013; Sinatra, Kardash, Taasoobshirazi, & Lombardi, 2012). Kamradt and Kamradt (1999) and Simonson (1979) proposed learning experiences that provoke emotion to target affective attitudinal learning. Along these lines, when learners are situated in an authentic situation, they have an opportunity to be motivated to develop empathy toward the targeted attitude (Ascione, 1992; McGill and Beaty, 2001; Turner, 1992). Instructional strategies for behavioral attitudinal learning include having learners perform a behavior in line with the targeted attitude (Kamradt & Kamradt, 1999). Another strategy for behavioral attitude change involves providing the opportunity for learners to practice the targeted attitude through role-playing (Bednar and Levie 1993; Smith and Ragan 1999). Modeling the effective use of technology in the classroom can be a way for students to experience and use technology integrated to support learning, thus applying desired behaviors. In this study, digital badges played an important role in introducing learner-centered technology integration approaches to preservice teacher students as a way to shape their attitudes and beliefs regarding effective teaching and learning.

Digital badges as a learning technology

As previously mentioned, in addition to positively impacting preservice teacher beliefs and attitudes towards technology integration, it is also recommended that teacher training courses model the effective use of technology (Kelly, et al., 2004; Krueger et al., 2004; Rice, et al., 2008). A recent technology that is being integrated into educational settings is digital badges (Gibson, Ostashewski, Flintoff, Grant & Knight, 2015; Abramovich, Schunn, and Higashi, 2013), which are now also being implemented into pre-service teacher technology integration courses (Newby, Wright, Besser, & Beese, 2016).

In this study, the technology integration course integrated digital badges as a core component of the coursework. Digital badges have been defined as "a graphic representation of a skill or competency that is displayed and accessed online, is earned through specific criteria, and links to "evidence" or portfolio data that can be reviewed by stakeholders" (Lesser, 2016, p. 44). With origins in the achievement awards of digital games, the online reputation sytems of ecommerce, as well as traditional physical recognitions such as ribbons and medals, digital badges can be used to motivate learners to work on materials and complete activities, provide recognition and accreditation of learners' status, to serve as evidence of achievement, and confirm the knowledge and ability of learners through peer and expert feedback on the artifacts serving as evidence (Gibson, et al., 2015).

Digital badges are emerging in academic settings as both private and open digital badge systems. Accredible, Blackboard's Open Badges, and systems at the University of California-Davis and Purdue University offer examples of private badging systems, while Mozilla's Badges Backpack is an example of the open source badging system (Gibson et al., 2015; Fain, 2014; Newby, Wright, Besser, & Beese, 2016).

Abramovich, Schunn, and Higashi, (2013) found that digital badges can positively affect learners' motivations, and different badge types may influence learners' motivation in varied ways. They also found that digital badges direct learners toward knowledge and skills acquisition. Hence, digital badges can be used to "provide both direct and indirect evidence of knowledge, knowledge-in-use, skill mastery and levels of attainment" (Gibson et al., 2015, p. 408).

Reported impacts on learning and motivation have been limited (Hulton, Hew & Tan, 2018) and mixed. A mixed-method study of higher education students' perception of the potential benefits of adopting a specific badging platform was conducted through student focus groups with 30 students completing questionnaires and participating in group discussions; the results indicated that students recognized the value if badge tasks were specific and meaningful, but there was limited indication of extrinsic motivation from badges themselves and no actual implementation and assessment of badges was conducted (Coleman, 2018). In an experimental study of 120 elementary students in eight ESL classrooms in Hong Kong, Homer, Hew, and Tan (2018) found that the use of digital badges and points significantly improved student learning for some but not all classes; although, students had a positive view of the badges, and teachers believed that they promoted on task and positive student behaviors. Likewise, Biles, Plass, and Homer (2018) implemented an educational game on geometry and utilized a pre and post test on geometry and several surveys and scales on situational interest and goal orientation with 77 middle school students in the US who played either a version of the game utilizing digital badges or a version that did not. They found that the use of badges, including performance-oriented and mastery-oriented badges increased learning performance only for those students with high situational interest.

This study examines the perspectives of pre-service teachers in a course that applied learner-centered technologies, primarily digital badges, to promote positive attitudes towards classroom technology integration.

METHODS

Research Questions

The following three research questions directed the study:

1. What were pre-service teachers' perceptions of their attitudinal learning and beliefs towards technology integration throughout the course?

2. Given their importance in the instructional design as both a model of technology integration and of specific pedagogical practices, were digital badges perceived by pre-service teachers as the most impactful instructional component to their attitudinal learning?

3. Given the course's integration of digital badges as a means to model technology integration, how did pre-service teachers perceive the value of using digital badges for learning?

Description of site and participants

Participants included 145 pre-service teachers enrolled in a required 3-credit Introduction to Educational Technology and Computing course in a large, public Midwestern United States university in fall 2017. The course's main goal was to provide preservice teachers with the fundamentals of instructional design, media, computers and classroom technologies that will help to better integrate technology into teaching. The course syllabus described the course objective as "Given a wide variety of learning situations and challenges, you will strategically select and utilize effective digital tools to access, identify, and evaluate relevant information in order to creatively design, produce, and share effective learning solutions." The course was designed to provide challenges and experiences for the students to facilitate their assessment and evaluation of designing and producing educational solutions that incorporate technology. Students had a weekly one-hour lecture in class led by a full professor and a two-hour lab meeting in smaller classes of approximately 20 students that were led by doctoral students. The graded activities included case solutions based on both face-to-face and online small group discussions, exams, and digital badge-based instructional projects.

The course required the use of digital badges (via the University's digital badges platform) that presented instructional projects that the preservice teachers were required to complete in order to successfully pass the course. The projects included researching and evaluating potential technologies for integration in the K-12 classroom. The digital badges presented these projects (presented and housed specific instructions, resources, and evaluation criteria) and were also used to assess the projects (students would submit their work to the badge as an attachment where it would be evaluated and the badge awarded if criteria for success were met, or feedback given on what improvements were needed if the submission feel short of meeting criteria). The course therefore integrated technology, including a course management system where several online small group discussions took place, resources were shared, and grades were posted, as well as the digital badges platform which was the primary tool for presenting and assessing course projects. By integrating technology, the course was modeling the target behavior: the integration of technology for teaching and learning, and in this particular case, project-based and mastery-oriented pedagogy, a key aspect given recommendations to not only modeling effective technology integration in these courses (Garcia & Rose, 2007; Groth, Dunlap & Kidd, 2007) but also integration focusing on desired pedagogical approaches and the reasoning behind those choices (Bai & Ertmer, 2008; Uerz, Volman, & Kral, 2018).

The majority of the course students were female (77.9%), white (86.9%), aged 16-20 years (88.3%), and studying to be elementary (48.3%) or secondary (41.4%) teachers. On a scale from 1 to 4 (with 1 being extremely low and 4 being extremely high), students' pre-course ratings of perceived prior knowledge regarding technology integration averaged 2.74. The researchers did not teach nor design the course, (although the course was offered within the same program) but were granted access for research purposes by the instructor who confirmed the course and its design's intent to positively impact student attitudes towards technology integration for teaching and learning.

Procedures and Data sources

The study used three online Qualtrics surveys to obtain participants' perceptions of their experiences during their enrollment in the course. The three surveys were conducted at three different times during the 16-week semester (weeks 5, 10, 15). Participants were informed that their participation was entirely voluntary and that they had the choice to withdraw their participation at any time. Researchers sought and obtained Institutional Review Board (IRB) approval prior to conducting the research.

Of the 182 students enrolled, 145 completed all of the surveys: 1) a validated survey measuring students' perceptions of attitudinal learning gains (Watson, et al., 2018) in order to address research questions one and two, and 2) an author-created survey measuring students' perceptions of benefits of digital badges in order to examine research question three, and 3) a validated survey (Brush et al., 2008) evaluating preservice teachers attitudes and beliefs towards technology integration, which also addressed research question one.

Instruments

Three sets of surveys were used in this study, including 1) Attitudinal Learning, 2) Digital Badges for Learning, and 3) Technology Integration for Learning (See Appendix A).

The *Attitudinal Learning Inventory (ALI)* (Watson, et al., 2018) was used to measure preservice teachers' perception on their attitudinal learning. This instrument was developed based on cognitive dissonance theory (Festinger, 1962), and its development relied on the three recognized components of attitudinal learning: cognitive, affective, and behavioral (Daruwalla & Darcy, 2005; Kamradt & Kamradt, 1999, Mueller, et al, 2017), as well as learning associated with social activities. This survey asked 14 questions on a 5-point Likert scale (1=strongly disagree, 5=strongly agree) regarding students' perceived learning gains on cognitive, affective, behavioral, and social learning. This survey also asked the learning activity in the course that the students felt was most impactful to their attitudinal learning.

The *Digital Badges for Learning survey* was used to survey preservice teachers' perception of their use of digital badges in the course. The survey was developed by the authors for this study and mostly focused on general satisfaction, effectiveness in supporting motivation, and learning with digital badges. The survey included 8 items to measure students' understanding about the value of digital badges and their confidence of the use of digital badges on a 5-point scale. Finally, items on participant demographic, level of prior knowledge, and most impactful instructional activities in the course were included.

The *Technology Integration for Learning (TIL) survey* was used to measure preservice teachers' perceptions toward technology integration. A survey created by Brush, Glazewski, and Hew (2008), was utilized which asked preservice teachers to report their perceptions of technology beliefs (12 items). A Likert scale was used for this survey. The responses for the technology beliefs items ranged from "1 (*strongly disagree*) to 4 (*strongly agree*)" (Brush, et al., 2008, p. 118-120).

Data Analysis

The authors first examined students' perceptions of impactful learning activities in the course during weeks 5, 10, and 15. As this survey question allowed multiple responses and the respondents were asked to choose 'yes' or 'no' for each option of the learning activities, we used Cochran's Q test and post hoc McNemar tests to determine whether the changes in the perceptions were significant over time. Secondly, we performed a series of two-way repeated measures ANOVAs to examine students' perceived attitudinal learning gains by grade levels and time periods. To compare students' perceptions of benefit of digital badges and technology integration in classroom, we divided the students into two different groups by using the mean scores of students' perceived attitudinal learning gain. In terms of students' grade, we divided them into the two groups: 'high and average group' and 'lower group', because the majority of the students received a grade of A in this course (see Table 1). The high and average group included those who received a grade of A, while the lower group included the rest of the students who received other grades. Then, using the two different sets of the participants, we performed a series of independent t-tests. All of the quantitative analysis was performed using SPSS version 22.0 for Windows.

Table 1
Frequencies of Students' Final Course Grade

Grade	n	%	Group
A	95	65.5	High and Average
A-	20	13.8	Lower
B	13	9.0	
B-	4	2.8	
B+	6	4.1	
C	2	1.4	
C-	1	.7	
C+	3	2.1	
D	1	.7	
Total	145	100.0	

RESULTS

Descriptive statistics

In order to check if the data met the normality assumption, the means, standard deviations, skewness and kurtosis for all the measured variables were analysed together. The means ranged from 3.12 to 4.25, and the standard deviations from 0.57 to 0.89 (See Table 1). The absolute values of the skewness ranged from 0.02 to 1.07, while the absolute values of the kurtosis ranged from 0.04 to 2.40, all of which did not exceed the absolute value of 3.0, indicating the normal distribution of the data (Ghasemi & Zahediasl, 2012).

Table 2
Means, standard deviations and correlation coefficients (n = 145)

Variables		Min	Max	Mean	SD	Skewness		Kurtosis	
Week 5	Cognitive Learning	1.00	5.00	4.08	0.74	-1.13	0.20	2.72	0.40
	Affective Learning	1.33	5.00	3.37	0.85	-0.18	0.20	-0.37	0.40
	Behavioral Learning	1.75	5.00	3.26	0.77	0.19	0.20	-0.63	0.40
	Social Learning	2.00	5.00	3.50	0.67	-0.02	0.20	-0.13	0.40
Week 10	Cognitive Learning	1.33	5.00	4.14	0.78	-0.95	0.20	1.21	0.40
	Affective Learning	1.00	5.00	3.12	0.86	-0.18	0.20	-0.39	0.40
	Behavioral Learning	1.00	5.00	3.38	0.82	0.04	0.20	-0.19	0.40
	Social Learning	1.25	5.00	3.44	0.75	-0.16	0.20	0.04	0.40
Week 15	Cognitive Learning	1.00	5.00	4.17	0.89	-1.63	0.20	2.40	0.40
	Affective Learning	1.00	5.00	3.33	0.84	-0.43	0.20	-0.37	0.40
	Behavioral Learning	1.00	5.00	3.55	0.86	-0.42	0.20	-0.05	0.40
	Social Learning	1.00	5.00	3.52	0.83	-0.53	0.20	0.25	0.40
Benefits of Digital Badge		1.50	6.00	4.25	0.78	-1.07	0.20	2.09	0.40
Benefits of Technology Integration		2.25	4.92	3.78	0.57	-0.25	0.20	-0.52	0.40

Changes in Students' Perceptions of Learning

Impactful Learning Activity. To examine the change in students' perceptions of impactful learning activities over the three time periods (weeks 5, 10, 15), Cochran's Q Tests were performed. The results indicated a significant effect for time in students' perceptions of reading/resources, Q (2) = 8.667, $p < .01$; digital badges project, Q (2) = 7.690, $p < .05$; and lectures/videos, Q (2) = 14.747, $p < .001$.

Table 3

Students' Perceptions of Most Impactful Learning Activity over Time

Learning Activity	Week 5 # students & (%)	Week 10 # students & (%)	Week 15 # students & (%)	Cochran's Q Test	Post hoc McNemar Test
Readings/Resources	15 (10.3)	5 (3.4)	6 (4.1)	*p* = .013*	W5-W10 (*p* = .006)* W10-W15 (p = 1.000) W15-W5 (p = .064)
Case Discussions	28 (19.3)	29 (20.0)	31 (21.4)	*p* = .874	N/A
Quizzes/Exams	5 (3.4)	6 (4.1)	9 (6.2)	*p* = .504	N/A
Digital Badges	111 (76.6)	128 (88.3)	117 (80.7)	*p* = .021*	W5-W10 (*p* = .017)* W10-W15 (p = .019)* W15-W5 (p = .488)
Lectures/Videos	36 (24.8)	47 (32.4)	20 (13.8)	*p* = .001*	W5-W10 (p = .200) W10-W15 (*p* = .000)* W15-W5 (*p* = .034) *

Note: Numbers in parenthesis are percentage. *Values are significant by using Cochran's Q test ($p < .05$)

Overall, students perceived the digital badges project as the most impactful learning activity in the course, while they perceived quizzes/exams as the least impactful. Although they valued readings/resources in the beginning, this perception significantly reduced from the midway of the semester (post hoc: week 5 versus week 10, p = .006). Students appreciated the value of lectures/videos until the mid-semester; however, this perception significantly disappeared toward the end of the semester (post hoc: week 10 versus week 15, p = .000, week 5 versus week 15, p = .034). Students put a high premium on digital badges project in this course, particularly around the midterm (post hoc: week 5 versus week 10, p = .017; week 10 versus week 15, p = .019).

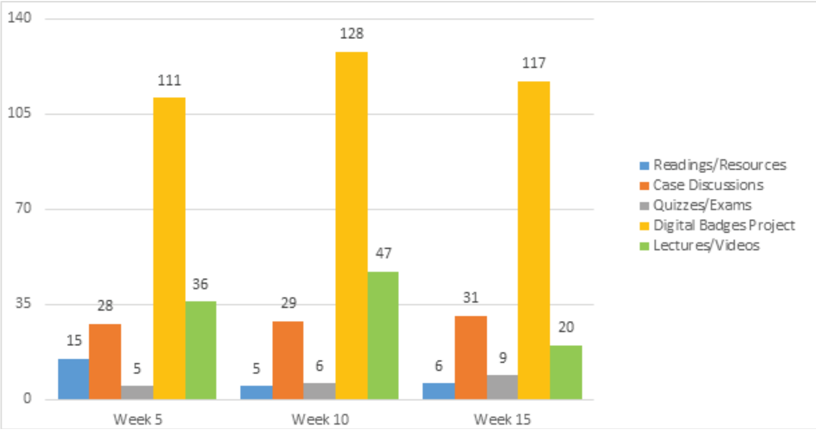

Figure X. Frequencies of students' choice of impactful learning activity.

Attitudinal Learning Gains. To investigate whether there is a change in students' perceptions of attitudinal learning gains over time and whether there is a difference in those perceptions by grade levels, two-way repeated measures ANOVAs were conducted. Overall, students most highly perceived cognitive learning gains in the course, while the least perceived component was affective learning.

Table 4

Descriptive Statistics for Attitudinal Learning by Grade and Time

Dependent Variable	Group	N	Week 5		Week 10		Week 15	
			M	SD	M	SD	M	SD
Cognitive Learning	High and Average	95	4.14	0.60	4.18	0.74	4.33	0.70
	Lower	50	3.97	0.96	4.05	0.86	3.88	1.11
	Total	*145*	*4.08*	*0.74*	*4.14*	*0.78*	*4.17*	*0.89*
Affective Learning	High and Average	95	3.39	0.75	3.23	0.85	3.48	0.91
	Lower	50	3.33	1.02	2.92	1.12	3.03	1.20
	Total	*145*	*3.37*	*0.85*	*3.12*	*0.96*	*3.33*	*1.04*

Dependent Variable	Group	N	Week 5		Week 10		Week 15	
			M	SD	M	SD	M	SD
Behavioral Learning	High and Average	95	3.27	0.78	3.45	0.83	3.60	0.81
	Lower	50	3.24	0.74	3.25	0.78	3.45	0.93
	Total	*145*	*3.26*	*0.77*	*3.38*	*0.82*	*3.55*	*0.86*
Social Learning	High and Average	95	3.52	0.68	3.53	0.73	3.62	0.75
	Lower	50	3.45	0.66	3.28	0.75	3.32	0.93
	Total	*145*	*3.50*	*0.67*	*3.44*	*0.75*	*3.52*	*0.83*

Table 5 shows the interaction effect between time and grade, which illustrates that the two different sets of participants (high and average achievers versus lower achievers) perceived cognitive learning gains over time.

Table 5
Two-way Repeated Measures ANOVA Results

Dependent Variable	Source	*df*	*F*	*p*
Cognitive Learning	Grade	1	4.275	.040*
	Time	2	.738	.480
	Time x Grade	2	3.271	.041*
Affective Learning	Grade	1	3.431	.066
	Time	2	11.732	.000**
	Time x Grade	2	3.815	.024*
Behavioral Learning	Grade	1	1.312	.254
	Time	2	6.889	.001**
	Time x Grade	2	.680	.508
Social Learning	Grade	1	4.056	.046*
	Time	2	1.200	.304
	Time x Grade	2	1.470	.233

*$p < .05$, ** $p < .01$

The significant time x grade interaction occurred because the lower achiever group showed a decrease in their perception of cognitive learning gains between Week 10 and 15, while the high and average achiever group showed an increased during the same period (p = .041). Overall, the high and average achiever group were more likely to perceive a higher level of cognitive learning gains than the lower achiever group (p = .040).

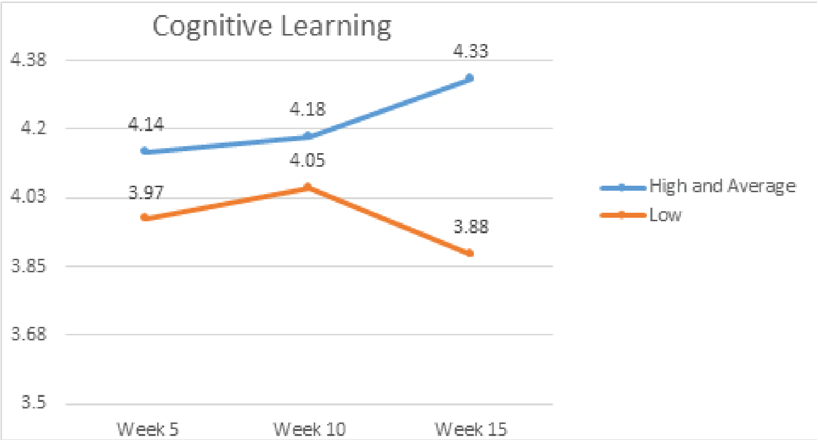

Figure 1. Changes in students' perceptions of cognitive learning gains by grade and time.

In terms of affective learning, there was no significant difference between the two groups, while the main effect of time was found (p = .000). As shown in Figure X, the two groups indicated the same change pattern over time; however, the lower group showed a larger drop than the high and average group between week 5 and 10 (p = .024).

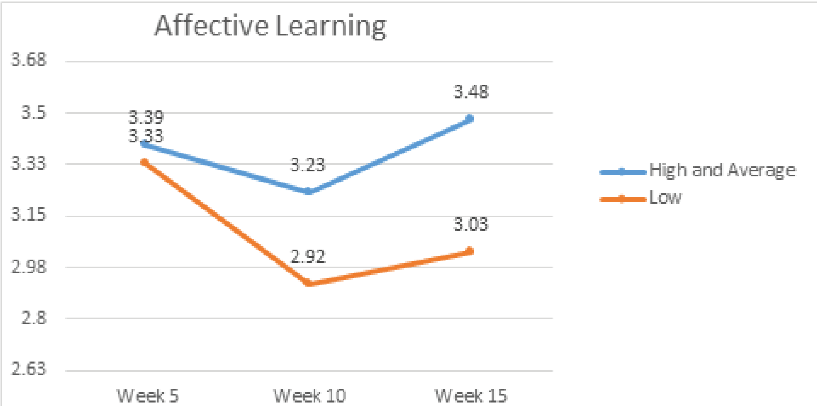

Figure 2. Changes in students' perceptions of affective learning gains by grade and time.

Figure 3 illustrates that there was neither the time x grade interaction effect, nor the time main effect of grade, but the two groups showed a gradual increase in their perceptions of behavioral learning gains over time (p = .001).

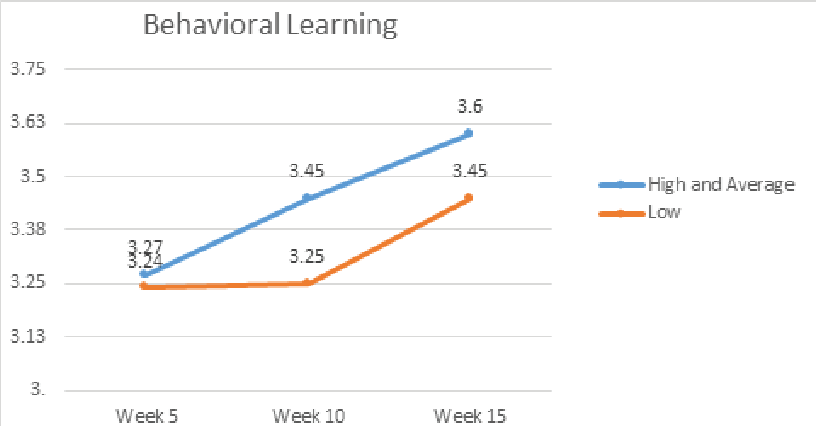

Figure 3. Changes in students' perceptions of behavioral learning gains by grade and time.

Lastly, the high and average group showed a gradual increase in their perceptions of social learning gains over time, while the lower group showed a decrease between week 5 and 10 and a slight increase between week 10 and 15 (p = .046).

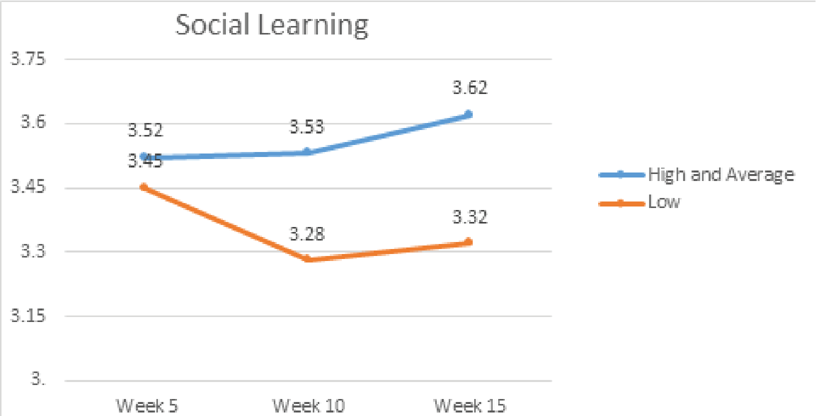

Figure 4. Changes in students' perceptions of social learning gains by grade and time.

Differences in Students' Perceptions by Grade and Attitudinal Learning

Benefits of Digital Badges. An independent t-test revealed that the high and average achiever group valued the benefits of digital badges more than the low achiever group (p = .002).

Table 6

Difference in Students' Perceptions of Benefits of Digital Badges by Grade

Dependent Variable	Group	n	Mean	SD	t	p	η^2
Digital Badges	High and Average	95	4.33	0.76	3.106	.002**	0.063
	Lower	50	3.82	1.24			

*$p < .05$, **$p < .01$

We also divided the participants into the upper 30% and lower 30% groups by the levels of their perceived attitudinal learning gains and performed independent t-tests to examine differences in students' perceptions of the benefits of digital badges. The results indicated significant differences in affective learning and social learning between the two groups. In both constructs, the upper 30% group highly perceived the benefits of digital badges project (affective learning: p = .001; social learning, p = .001) than the lower 30% group.

Table 7

Differences in the Benefits of Digital Badges by Attitudinal Learning Levels

Group		n	Mean	SD	t	p	η^2
Cognitive Learning	Lower 30%	44	4.03	.98	-1.589	.116	.028
	Upper 30%	45	4.33	.80			
Affective Learning	Lower 30%	44	3.95	.91	-2.242	.001*	.055
	Upper 30%	45	4.35	.61			
Behavioral Learning	Lower 30%	44	3.85	.88	-1.223	.225	.017
	Upper 30%	45	4.15	.89			
Social Learning	Lower 30%	44	3.60	.76	-3.484	.001*	.122
	Upper 30%	45	4.39	.62			
Total		89	4.16	.98			

*$p < .05$

Benefits of Technology Integration in Classroom. Similarly, we conducted an independent t-test to compare the perceptions between the high and average group and the lower group. There was no significant difference between the grade groups (p = .655).

Table 8
Difference in Students' Perceptions of Benefits of Technology Integration by Grade

Dependent Variable	Group	n	Mean	SD	*t*	*p*	
Technology Integration	High and Average	95	3.78	0.58	-0.448	0.655	0.001
	Lower	50	3.82	0.45			

We also examined whether there is a significant difference in students' beliefs regarding the benefits of technology integration in classroom between the lower 30% and upper 30% group of the attitudinal learning gains. In all of the four attitudinal learning components, the upper 30% group significantly highly perceived the benefits of technology integration in classroom in comparison to those in the lower 30% group.

Table 9
Differences in the Benefits of Technology Integration by Attitudinal Learning Levels

Group		n	Mean	SD	*t*	*p*	
Cognitive Learning	Lower 30%	44	3.68	.38	-3.063	.003*	.097
	Upper 30%	45	4.00	.44			
Affective Learning	Lower 30%	44	3.71	.42	-3.089	.003*	.099
	Upper 30%	45	4.00	.45			
Behavioral Learning	Lower 30%	44	3.65	.68	-2.928	.005*	.090
	Upper 30%	45	4.01	.44			
Social Learning	Lower 30%	44	3.75	.42	-2.662	.009*	.075
	Upper 30%	45	4.00	.46			
Total		89	89	3.80			.54

*$p < .01$

DISCUSSION

The results of this study indicate a number of valuable insights. There were significant changes to students' perceptions of the instructional components that were most impactful to their attitudinal learning. While there were changes over time, ultimately, the overall perception of the items was somewhat consistently ranked throughout the course. Digital badges were overwhelmingly ranked as the most impactful instructional component throughout the course, while quizzes and exams and readings/resources were consistently ranked as the least impactful; although, there were variations over time, with all three categories rising and falling. Case discussions, on the other hand, showed continued, if slight, growth in perception of their impact throughout the course. Lecture videos were initially ranked fairly high, they were perceived as the second most important activity in mid-course, before falling substantially to a distant third at the conclusion of the course. These findings indicated the potential for digital badges to serve as an effective pedagogical use of technology in pre-service technology integration courses.

While the perceptions of value did significantly change over time, digital badges were consistently ranked highly throughout the course. Case discussions consistently gained value throughout the course until they were ranked as the second most valuable. These types of activities perhaps indicate a growing level of students' self-efficacy in regards to their ability to effectively integrate technology, as they came to rely less on lectures and readings and perceived more value in activities requiring synthesis and critical thinking. Self-efficacy describes a person's judgment of her ability to perform actions in order to realize a goal (Bandura, 1977). Self-efficacy is one type of belief and refers to an individual's judgment of his or her capability to perform actions to realize specific goals (Bandura, 1977). It is has been shown to influence academic motivation such as through effort, persistence, and emotional response (Zimmerman, 2000), and students with higher self-efficacy may have greater confidence and therefore better manage their learning environments by using such strategies as self-regulated learning (Komarraju & Nadler, 2013). One aspect of digital badges that can be valuable for promoting increased self-efficacy is how they are awarded as certification of learner accomplishment, while allowing both for resubmissions in the case of inadequate performances and formative feedback to support student learning while also supporting goal setting (Cheng, et al., 2018).

Students reported that they perceived the highest learning gains in cognitive areas, with the lowest gains in affective areas. Overall, all components did increase over the duration of the course with week 15 scores reported higher in all four components than they were reported in week 5, as should be expected with more exposure to instruction relevant to attitudinal learning. There were reported differences between students earning high and average grades than those receiving lower grades, with the lower group reporting a reduced perception of cognitive gains over the last 5 weeks while the higher and average groups reported increased gains.

There were also differences in the perception of the benefits of digital badges between the high and average group and the lower grade group of students. The results suggest that students who were assessed at higher levels of learning reported higher levels of attitudinal learning in regards to digital badges, the primary example of technology integration in the course. Essentially, the use of badges in the course was modeling the desired attitude, an important strategy for promoting attitudinal learning (Mueller, et al, 2017) and positive attitudes towards technology integration in the classroom specifically (Tondeur, et al., 2012), while also modeling particular pedagogical approaches given the project-based and mastery-oriented way the badges were utilized. This reinforces prior literature on the importance of modeling both technology integration in such courses (Garcia & Rose, 2007; Groth, et al., 2007) as well as desired pedagogical approaches with technology integration (Bai & Ertmer, 2008; Uerz, et al., 2018).

When examining students who perceived the highest and the lowest learning gains, we also saw significant differences in their perceptions of affective and social learning in regards to their attitudes towards digital badges. This could perhaps indicate a relationship between the affective and social components, as they showed larger differences between the groups than the other components. It is possible that this indicates weaknesses in the incorporation of affective and social learning strategies in the instructional design around attitudes towards the integration of digital badges. While further examination of these types of results in other instructional contexts is needed in order to fully make this claim, it does indicate some of the potential benefit of the ALI instrument in identifying strengths and weaknesses in specific instructional strategies and design approaches for attitudinal learning, an important implication for the continued use and ongoing development of this instrument.

When examining student attitudes towards the benefits of integrating technology in the classroom, essentially the target attitude of the instruction, there were no significant differences between the higher and average achievers and the lower achievers, and the respondents reported positive attitudes towards technology integration, averaging between agreeing and strongly agreeing with the benefits. This indicates that regardless of how students were assessed to have performed in the course, they reported attitudinal learning gains. This is somewhat problematic in that we would expect to see higher learning gains for those who were assessed to have performed better in the course, as we did in regards to attitudes towards the integration of digital badges. This indicates that there was alignment between student performance assessment and their attitudes towards digital badge integration, a sub-component but highlighted aspect of attitude towards technology integration but not the broader targeted attitude. Badge projects did make up 160 of the 330 total possible points in the course, with four exams making up 120 of the remaining points and the remaining 50 points being comprised of four case analyses. With badges the primary form of assessment, this could indicate that the project, student performance aspect of the badge assessments were effective in representing accurate evaluation of student attitudes towards badges, but taken together, the full set of assessments, including cognitive exams and case analysis discussions were less effective in accurately representing student attitudinal learning gains. Alternatively, it could simply be that student performance was more representative of issues such as effective self-regulation skills, which can increase the likelihood of effective performance and success in higher education (Zimmerman & Schunk, 2008) but nevertheless do differ from learning; although, this was not a targeted aspect of this research and therefore further examination would be necessary to analyze such a claim.

When examining technology integration beliefs between those reporting higher and lowers levels of attitudinal learning gains, there were reported significant differences between the groups, with the higher group reporting more positive attitudes, including across all four attitudinal components. This is a valuable result as it shows alignment between the two different instruments, the ALI and the TIL, helping to demonstrate the validity of both. Furthermore, it also highlights the interconnectedness of the attitudinal learning components that the ALI utilizes to examine attitudinal learning. This supports past recommendation in the literature to design instruction that simultaneously targets affective, cognitive, and behavioral components (Kamradt & Kamradt, 1999; Mueller, et al., 2017), while also indicating the importance of social learning in attitude change, which has also been recommended (Watson, Loizzo, et al., 2016; Watson, Watson, et al., 2017).

CONCLUSION

This study examined preservice teachers' perceptions of attitudinal learning, technology integration, and digital badges over time during a course on technology integration. The course utilized lectures, case-based studies, technology projects driven by the use of digital badges, and quizzes/exams. Results indicated perceptions of attitudinal learning gains, particularly in cognitive areas, but less so with affective components. When considering a list of course activities, students overwhelmingly perceived digital badges and their use to present instruction and assess and provide feedback on individual project work as the most impactful course instructional activity. These findings pose several significant implications, including the efficacy of digital badges as a learning technology for supporting attitudinal learning, specifically within the context of technology integration. Furthermore, it indicates that when digital badges are utilized to support project-based and mastery-oriented pedagogical practices, they can serve as effective modeling of technology integration generally and these pedagogical practices specifically, which are highlighted as important aspects of effectively teaching technology integration in the literature. Other implications are further confirmation of the effectiveness of the ALI scale at measuring perceived attitudinal learning, including across time and by the efficacy of instructional practices for specific components of attitude. The interconnectedness of these attitudinal components were also one again confirmed, and the ALI and TIL were further validated by reflecting the relationship between student beliefs and attitudes regarding technology integration.

This particular case also presents an interesting look at how a technology integration course for pre-service teachers utilized digital badges to support a project-based and mastery-oriented approach to pedagogy, an interesting approach to the uses of digital badges. An important consideration when considering such an important is the supported functionality of a given digital badge platform. In this case, the university has developed its own platform that supported such an approach. Practitioners considering similar approaches would be well advised to examine the functionality of the digital badge platforms available to them when considering the potential usage of digital badges in their own technology integration courses.

The study does have several limitations to consider. Firstly, this study does examine a specific course, and while insights its instructional design can provide insights for the instructional design of similar courses, as a single case, its results cannot be generalized. Additionally, the results of this study relied on students' self-reported perceptions, and while this is a common approach for research on both attitudinal learning in general (Bohner & Dickel, 2011) and preservice teacher beliefs on technology integration (Brush, et al., 2008), the results could be further strengthened through the incorporation of qualitative data as well as longitudinal research on the integration of technology by these students once they become practicing teachers. Additionally, the potential impact of student self-regulation was raised as were questions regarding potential disconnects between project-based aspects of the course and more traditional assessments such as quizzes. Neither of these aspects were conclusively examined in this study and both deserve further attention in future studies.

Despite these limitations, this study does provide valuable insights into the efficacy of a course implementing best practices by modeling the effective integration of learner centered technology, and in particular, digital badges, while targeting the attitudes and beliefs of future teachers. In doing so, it addresses the need for more research on technology integration courses targeting attitudes and beliefs, the instructional design of attitudinal learning, and the efficacy of digital badges for learning. The study is also valuable in illustrating the effectiveness of both the ALI instrument (Watson, et al., 2018) and the TIL survey (Brush, et al., 2008), which demonstrated consistent results. Future studies should examine additional instructional design cases, including those that incorporate strategies targeting more affective learning outcomes, as well as integrating qualitative data approaches and longitudinal follow-up studies tracking actual technology integration practices by students who go on to become inservice teachers.

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APPENDIX A

Survey Items
• **Demographics** 1. What is your age? 2. What is your gender? 3. What is your ethnicity? 4. What is your subject area? 5. What will be your certification level? 6. Are you an international student? 7. Is this a mandatory course for you? 8. The most impactful aspect of the course was: • **Attitudinal Learning Items** (Watson & Watson, 2016) • ***Cognitive Learning*** 9. The course provided me with new information. 10. The course made me more knowledgeable. 11. I learned new information from the course • ***Affective Learning*** 12. I feel excitement about the topic. 13. I feel eager to learn more about the topic. 14. I feel passionate about the topic. • ***Behavioral Learning*** 15. My behaviors changed as a result of this course. 16. I did something new related to the topic as a result of this course 17. I made changes to my behavior as a result of this course 18. I do things differently now as a result of this course • ***Social Learning*** 19. I talk to others about this topic 20. I educate others about this topic 21. I am confident discussing this topic with others 22. I connect with other people regarding this topic • **Digital Badges Items** 23. In general, I believe that digital badges are effective leaner-centered technology. 24. Using digital badges in this course was motivational. 25. After taking this course, I feel more confident with integrating digital badges into my own teaching. 26. If the opportunity present itself, I intend to integrate digital badges into my own teaching. 27. I believe that digital badges make learning objectives clearer to learners. 28. I believe that digital badges are time consuming tool to be effective. 29. I believe that the digital badges that I earned in this course will be recognized by others as valuable credentials of my learning. 30. Using digital badges in this course was a positive experience for me. • **Technology Integration Beliefs Items** (Brush et al., 2008) 31. Support the use of technology in the classroom. 32. Knowledge about technology will improve my teaching. 33. A variety of technologies are important for student learning. 34. Technology facilitates the use of a wide variety of instructional strategies designed to maximize learning. 35. Technology helps teachers do things with their classes that they would not be able to do without it. 36. Incorporating technology into instruction helps students learn. 37. Student motivation increases when technology is integrated into the curriculum.