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The Impact of Badges on Course Participation and Interaction

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Abstract—Badges have long been used to encourage users in achieving specific goals in video or computer games. Recent studies have shown that badges can be effective to incentivize learners to complete specific tasks in online learning environments. This study examined the impact of a badge system on class participation and interaction for both online and face-to-face classes in a graduate program. Badges were issued for students who contributed to quality class discussion and peer project comments in two different types of courses. Results of student online postings in different types of online classes with and without a badge system implemented were analyzed. The findings indicate that badges can enhance student interaction in traditional online courses where activities mainly consist of reading, writing, reflecting and commenting.

Keywords—*badges; online learning; interaction, online participation, gamification*

I. Introduction

A new movement of digital badges for lifelong learning is on the rise. Many higher education leaders, practitioners, educators, and researchers have plunged into the development of various badge systems to engage and enhance student learning (ACCLAIM, 2013; Educause, 2012). Digital badges are defined as "an assessment and credentialing mechanism that is housed and managed online. Badges are designed to be visible and validate learning in both formal and informal settings, and hold the potential to help transform where and how learning is valued" (MacArthur Foundation, 2015). Badges are often seen on display in online learning management systems, mobile apps, social media, and a variety of digital networks. Educational institutes and organizations such as museums, Massive Open Online Courses (MOOCs), K-12 schools, and universities/colleges are adapting the use of badges for a variety of purposes. The proponents of the badge systems emphasize that badges allow learners to choose the best learning paths to complement their goals and interests, earn credits for skills acquired, share their accomplishments for new employment, and manage their learning credentials (ACCLAIM, 2013). Badge system seen by the supporters as a mean to facilitate students to meet criteria associated with instructional goals and to improve achievements bringing forth their passion for learning. The opponents of the badge systems are concerned that the use of badges would decrease student's intrinsic motivation and focus only on winning badges (OpenBadge, 2012). Recent badge studies have shown a strong association between student participation and high achievement (Anderson, Huttenlocher, Kleinberg, & Leskovec, 2013; Sullivan, 2013). However, most of these studies have focused on large-scale courses with an automatic badge-issuing system, such as the MOOCs (Anderson, et al., 2013; Sullivan, 2013). Little is known of the role and impact of badge systems in higher education graduate programs, which are different from the MOOCs in not only their smaller class size but also their class dynamics. Little also is known of whether and to what extent the efficacy of badges vary by course delivery format, student demographics, and type of student involvement. In order to address this gap, this pilot study will examine the impact of a badge system on student participation and interaction in both online and face-to-face graduate courses.

2. Literature Review

Class participation and interaction is a well-known pedagogy measurement associated with better learning outcomes. Student engagement, broadly defined, has become increasingly important in higher education (Handelsman, Briggs, Sullivan, & Towler, 2005). Studies have found that in-class participation is important with Millennial students who demand more interaction from their classroom

experience (Allred & Swenson, 2006; Howe & Strauss, 2000). Therefore, student engagement has become a significant part of higher education assessment in an increasing number of universities (Kuh, 2001). On the other hand, studies have also found that students in online courses can often feel isolated and overwhelmed due to the lack of face-to-face communication with their instructor and peer students. "Without a feeling of community, people are on their own [and] likely to be anxious, defensive and unwilling to take the risks involved in learning" (Wegerif, 1998, p. 48). Therefore, with the growth of distance learning, one of the major challenges is in how to create a genuine learning community atmosphere which fosters critical thinking, desired learning outcomes and student satisfaction by well-structured information flow, learning support, and group collaborations (Dede, 1996; Wellman, 1999).

Up to now, the most widely used approach to enhance interactivity in online courses is the adoption of asynchronous discussion forums. With the proliferation of social networks, many learning management systems have incorporated interfaces similar to social media to motivate student interaction. Badges are often embedded in the system to allow instructors to "steer" students to certain online activities. A recent study on badges from Stanford University has provided evidence on the positive role of badges. Anderson, Huttenlocher, Kleinberg, and Leskovec (2013) found increased course participation in three badge-integrated MOOCs that had an enrollment size around 120,000. The research team developed an algorithm to award students badges when their online behaviors reached a certain level of cumulative contribution, such as answering a question, asking two questions, or voting on three answers, and so forth. The researchers concluded badges a great way to incentivize learners based on the finding that the number of frequent voters and heavy readers in MOOCs with a badge system is five times more than that in MOOCs without a badge system.

Studies in the literature also suggest that the efficacy of a badge system depends on many factors and badges could trigger desirable behaviors if used by specific learners for specific purposes (Denny, 2013). The study of badges is emergent and most acknowledge that more research of the mechanisms and context is needed. In particular, more research are needed to better the understanding of the role and impact of badge systems in classes which are different from the MOOCs in enrollment, embedded activities, and dynamics. More research also is needed to explore the impact of badges within a range of contexts, such as organization settings, technical infrastructure, learner demographics and characteristics, purposes of tools, and the relevance of badges in encouraging desirable behaviors.

Secondly, improvement is also needed in operationalization of badges and the scope data collected for analysis. So far, most research was implemented based on automatic badge issuing systems and collected predominantly student perception data (Deterding, 2012; Haaranen, Ihantola, Hakulinen, & Korhonen, 2014). Socially and psychological, badges are more likely to be effective when they are symbolically significant. In other words, to truly engage learners and bring forth meaningful student participation and interactions, badges should be embedded as an integral part of learning activities and systematically aligned with course objectives. Automatic badge issuing systems tend to issue students badges based on whether a learner has tasks and the amount of tasks completed. Such a system has limitations in taking into proper account of the quality of work accomplished and the extent to which the completed tasks align with course objectives. Recognizing such a limitation, some studies had adopted student self-report questionnaires to determine the student engagement level. However, this approach is limited in perspective and may be susceptible to a strong positive response bias toward giving a higher self-evaluation of the level of engagement in order to gain a better course grade.

Lastly, there are different types and natures of student involvements, however most studies did not distinguish them. Therefore, it remains unclear if badges have differentiated effects on different types of courses and nature of student engagement. Research findings along this line, can better inform the incorporation and design of badges into course activities, which target at encouraging specific types of student participation and interaction.

3. Research Design

This study utilized student online postings to examine the impact of badges on student participation and interaction in both online and face-to-face courses.

3.1. Background

This study consists of five graduate courses with a total of 77 graduate students (20 males and 57 females) over the span of one year. Two courses were titled "Principles of Educational Research" (hereafter research course) and three courses were titled "Use of Technology for Effective Instruction" (hereafter technology course). These graduate courses were offered every semester to graduate students at the School of Education at a mid-size comprehensive private university in Midwestern USA. The majority of the students are pre-service and in-service educators or school administrators. The courses with the same titles have the same learning modules, assignments, and assessment. The students used Blackboard, a course management system, to retrieve course content. They also used Edmodo, a Facebook-like social and learning management system, to post course assignments and provide peer feedback on assignments. The badge system was incorporated into the courses via Edmodo in Fall 2014 for the following purposes: (1) encouraging student online participation, (2) providing a progress report on their participation, (3) acknowledging student submission of various assignments throughout the course, and (4) motivating student contributions to peer project comments. In order to ensure that badges acknowledge and symbolically resonate the level and quality of student participation and involvement, the instructor systematically and timely reviewed students' assignment submissions, contribution to topic-related discussions, feedbacks to peer projects and assignments and issued badges on Edmodo only to quality posts. Badges received were counted toward course participation grade or 20% of the total grade. Students could receive up to 20 badges for completing assignments and contribution to peer comments. The badges also kept the students informed on their course participation. The students could check their badges number any time to keep track of their online contributions. One of the researchers was also the course instructor. The frequency of online posting was used as an indicator for course participation and peer comments an indicator for student interaction.

3.2. Research Questions

In order to explore the impact of badges on student participation and interaction, this study compares courses with and without badge systems as well as online vs. face-to-face courses. Three indicators were used in the comparison. Original postings refer to on-time assignment postings or initiations of discussions which could advance learning experiences on class-related topics. Comments/replies refer to feedback on peer projects or replies to class-topic related discussions. Total postings denote the combination of original postings and comments/replies. The project focused on the following research question: *What is the impact of a badge system on student participation and interaction in both online and face-to-face courses?*

Specifically, we tested the following null hypotheses:

1. There is no statistically significant difference in the mean numbers of total postings, original postings, and comments/replies by whether there was a badge system implemented.
2. There is no statistically significant difference in the mean numbers of original postings and comments/replies between technology and research courses.
3. There is no statistically significant difference in the mean numbers of original postings and comments/replies between online and face-to-face technology courses with a badge system.

4. Data Analysis And Discussion

For hypotheses 1 and 2, we hold the delivery format constant by excluding the face-to-face course and analyzed only students enrolled in online courses. Table 1 shows results of the two-way ANOVA with interaction of the mean total number postings made by students enrolled in online courses by badge system, gender, and course type. The test for homogeneity of variance was not significant, Levene F $(7, 56)= 0.823$, $p = 0.573$, indicating that this assumption underlying the application of the two-way ANOVA was met. The results indicate a significant main effect for badge system ($F(1, 59) = 26.63$, $p <0.001$) and a significant main effect for course type ($F(1, 59) = 81.21$, $p <0.001$) on the number of original postings plus comments and replies of students enrolled in online courses. After controlling gender and course type, students in courses with a badge system contributed more posts than those in courses without a badge system (19.3 vs. 15.0). After controlling badges and gender, students enrolled in online technology classes were found to make more posts than those enrolled in online research

classes (20.9 vs. 13.5 posts). Because the interaction term of badges and course type in Table 1 are statistically significant ((F1, 59) = 18.53, p <0.001), it is necessary to examine the simple main effects. Analysis of the simple main effects (Table 1.1) shows that badges did not have a statistically significant effect for online technology courses (F(1,60) = 0.04, p =0.5290) but did have a statistically significant effect for online research courses (F(1,60) = 54.35, p <0.001) on increasing the total number of original postings, comments and replies. Students in online research classes with a badge system made an average of 17.4 postings, which were 7.9 more postings than the average of those in online research classes without a badge system. It suggests that a badge system seems to have an effect on enhancing the student's participation in online research classes.

Table 1: Results of the ANOVA with interaction of the total posts by badge system, gender and pedagogical orientation

Source	Sum of Squares	df	Mean square	F	
Corrected model	1545.99	4	386.50	37.51	
Badge system	274.42	1	274.42	26.63	***
Gender	0.59	1	0.59	0.06	
Course type	836.84	1	836.84	81.21	***
Badge system * Course type	190.94	1	190.94	18.53	***
Error	607.95	59	10.30		

Levene F(7,56)= 0.823, p=0.573; R-square = .718; ** p< 0.01; ***p<0.001

Table 1-1: Simple main effects of badges and course type on the number of total posts

Variable	Category	Mean (N)	Mean Differences	SE
Main Effects				
Badge system	Yes	19.34 (33)	4.30 ***	0.579
	No	15.05 (31)		0.667
Gender	Male	17.30 (17)	0.22	0.794
	Female	17.08 (47)		0.477
Course type	Technology	20.90 (28)	7.42 ***	0.666
	Research	13.48 (36)		0.573
Simple Main Effects				
Technology Course* Badge	Yes	21.24 (17)	0.78	0.772
Technology Courses*Badge	No	20.46 (11)		0.960
Research Course*Badge	Yes	17.38 (16)	7.88 ***	0.796
Research Course*Badge	No	9.50 (20)		0.712

Course type		Sum of Squares	df	Mean square	F	
Technology	contrast	4.07	1	4.07	0.40	
	error	608.54	60	10.14		
Research	contrast	551.25	1	551.25	54.35	***
	error	608.54	60	10.14		

** p< 0.01; ***p<0.001

Table 2: Results of the ANOVA with interaction of the number of original posts by badge system, gender and course type

Source	Sum of Squares	df	Mean square	F	
Corrected model	486.54	4	121.63	33.92	
Badge system	3.23	1	3.23	0.90	
Gender	0.21	1	0.21	0.06	
Course type	452.99	1	452.99	126.32	***
Badge system * Course type	3.72	1	3.72	1.04	
Error	211.57	59	3.59		

Levene F(7,56)= 1.022, p=0.426; R-square = 0.697; ** p< 0.01; ***p<0.001

Table 2-1: Main effects of course type on the total number of original postings of students enrolled in online courses

Variable: Course type	Mean (N)	Mean Difference	S.E.
Technology	10.40 (28)	5.46***	0.393
Research	4.94 (36)		0.338

F(1,66) = 112.34 and p<0.001: ** p<0.01; *** p<0.001

In order to better understand the dynamics between badges and student involvement, we further decomposed student engagement (i.e., total number of postings) into "active participation" (measured by the number of original postings) and "interaction" (measured by the number of comments and replies). Table 2 and Table 3 show the results of ANOVA of original postings and comments/replies respectively.

Table 2 shows the results of a two-way ANOVA on student participation via original postings. There is a significantly difference in original postings between the different types of courses (p<0.001). After controlling gender, badges, and the interaction term of badges, students enrolled in online technology classes were found to make more original posts than those enrolled in online research classes (10.40 vs. 4.94 posts) as shown in Table 2.1. Badges, gender, and the interaction term of badge system, on the other hand, did not have a statistically significant effect on the number of original posts.

Table 3: Results of the two-way ANOVA with interaction of the number of comments/replie badge system, gender and course type

Source	Sum of Squares	df	Mean square	F	
Corrected model	483.76	4	120.94	13.57	
Badge system	159.09	1	159.09	17.84	***
Gender	24.23	1	24.23	2.72	
Course type	89.01	1	89.01	9.98	**
Badge system * Course type	103.50	1	103.50	11.61	***
Error	526.00	59	8.92		

Levene F(7,56)= 1.661, p=0.138; R-square = .479; ** p< 0.01; ***p<0.001

Table 3-1: Simple main effects of badges by course type on the number of comments and replies

Variable			Category	Mean (N)	Mean Differences	SE
Main Effects						
Gender			Male	10.28 (17)	1.41	0.739
			Female	8.87 (47)		0.444
Badge system			Yes	11.21 (33)	3.27 ***	0.579
			No	7.94 (31)		0.667
Course type			Technology	10.78 (28)	2.42 **	0.666
			Research	8.36 (36)		0.573
Simple Main Effects						
Technology Course* Badge			Yes	11.12 (17)	0.67	0.772
Technology Courses*Badge			No	10.45 (11)		0.960
Research Course*Badge			Yes	11.30 (16)	5.88 ***	0.796
Research Course*Badge			No	5.42 (20)		0.712
Course type	Sum of Squares		df	Mean square	F	
Technology	contrast	2.93	1	2.93	0.33	
	error	525.99	59	8.92		
Research	contrast	300.32	1	300.32	33.69 ***	
	error	525.99	59	8.92		

** p< 0.01; ***p<0.001

Table 3 shows the results of a two-way ANOVA on student interaction, i.e., comments and replies to each other. Badge system, course types, and their interaction term all had a statistically significant effect on the mean number of comments/replies. Table 3.I presents analysis of the main effects and simple main effects. It shows that course type had a statistically significant effect on student comments/replies. After controlling gender, badges, and their interaction term, students enrolled in online technology classes were found to contribute more comments/replies than those enrolled in online research classes (10.8 vs. 8.4 posts). The paired comparison of students in online technology classes with a badge system and those in online technology classes without a badge system shows badges did not have an effect on enhancing the student's participation in online technology classes. Paired comparison of students in online research classes, on the other hand, indicates that students in classes with a badge system made an average of 11.3 comments/replies which almost doubled the amount made by those in classes without a badge system (5.2 posts). It suggests that badges seem to have an effect on enhancing the student interaction in online research classes.

For hypothesis 4, we examine if course delivery format, i.e., online vs. face-to-face, matters for classes with a badge system. Because there was no face-to-face research course section offered by the same instructor of the online research courses, only data on the three technology courses were examined. The T-test results show that the delivery format did not have a statistically significant effect on the original postings or comments/replies (Table 4).

To sum up, in a graduate program setting, badges did not have a uniformed effect on student involvements. This study found the effect of badges did not vary by gender but did vary by course type and type of student involvements. Badges were found to be more effective in online research courses and particularly in enhancing student interactions. Secondly, there was no significant difference between the online and face-to-face courses in number of original posts or that of

comments/replies. At least on technology courses, course delivery format did not affect the effect of badges on either student participation or interaction. Students were equally active in the both online and face-to-face technology courses.

The differentiated effects of badges by course type in this study may have to do with pedagogical orientation of the two courses. Although both types of courses required students to post their assignments, technology courses emphasized strongly on activity such as project-based learning and student-generated content. The instruction activities for the research courses were mainly reading, writing, reflecting, and commenting (RWRC). The results of this study seem to suggest that badges might be more effective for RWRC type of courses. The instructional activities for the technology courses have contributed to active interaction with or without badges. Therefore the effect of badges were not obvious in technology courses.

Table 4: Mean differences in number of original posts and comments/replies by delivery type among students enrolled in technology courses with a badge system

	Delivery Type	N	Mean	Std. Deviation	t-test	Mean Differences	SE
Total postings	*Online*	17	21.2	3.15	-0.41	-0.38	0.93
	Face-to-face	13	21.6	1.26			
Original postings	*Online*	17	10.4	1.70	-1.24	-0.59	0.47
	Face-to-face	13	11.0	0.00			
Comments/replies	*Online*	17	10.8	1.67	0.38	0.21	0.56
	Face-to-face	13	10.6	1.26			

** p< 0.01; ***p<0.001

5. Conclusion

This research has contributed to the literature on badges by comparing the effects of badges by online course type, two different delivery formats, and student demographics in a graduate education program setting. Instead of being issued automatically based on quantitative attributes, badges in this study were awarded only if the student engagement was assessed by the instructor to be of quality. This study found that the effect of implementing a badge system on student participation and interaction in online courses vary greatly by the type of courses and the type of student participation. A badge system could work well for online courses that consist mainly reading, writing, reflecting and commenting (RWRC) types of activities. The research findings confirmed previous research (Anderson et. al, 2013; Haaranen et. al, 2014) on the role of badges to increase learner participation in either large courses or smaller graduate courses. Badges appear less critical in courses that are already highly interactive by pedagogical orientation. Badges are still emerging and require further research. The limitations of the study are the small sample size and a lack of student perspectives. It would be helpful to include more classes in the data collection to achieve a better representation. Student perceptions may help explain how and why badges contribute or hinder their learning outcomes. Future research could also include qualitative data such as student and teacher interviews to provide a fuller picture.

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