Examining Types of Online Student Engagement and Their Contribution to Student Satisfaction and Perceived Learning in Online Graduate Courses

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Introduction

Online learning has grown exponentially due to its flexibility and rapid development of the Internet technology in the past decades. According to a recent report (Seaman, Allen, & Seaman, 2018) over six million students are taking at least one distance course, representing 31.6% of all students, and over three million students are taking exclusively distance courses, representing 14.9% of all students. However, retention rate and graduation rate in online programs have become a concern (B. Smith, 2010; Herbert, 2006; Heyman, 2010; James, Swan & Daston, 2016, Xu & Jaggars, 2014) and need further investigation. Online courses require high levels of self-regulation, motivation, time management and engagement from students in order to be successful in online learning (Azevedo, Cromley & Seibert, 2004; Yen & Liu, 2009). If students are fully engaged and actively involved in course learning activities and stay connected with other stakeholders in online learning, it is likely they will achieve the desired learning objectives, complete their courses, and finish their online programs. Therefore, it is critical to investigate which types of student engagement in online courses contribute to student satisfaction and their perceived learning.

The findings of this study revealed that some of the student engagement factors contribute positively to student satisfaction and perceived learning in online courses. The findings provided online faculty and instructional designers insights to consider incorporating different engagement factors when designing and revising their online courses.

Student Engagement in Online Courses

Student engagement has been defined in the literature as investment or commitment (Marks, 2000), participation (Kuh, Kinzie, Buckley, Bridges, & Hayek, 2007), or effortful involvement in learning (Pekrun & Linnenbrink-Garcia, 2012; Reschly & Christenson, 2012). Literature on student engagement has been focused on three aspects: behavioral engagement, emotional engagement, and cognitive engagement (Fredricks et al, 2004). Behavioral engagement refers to student participation in learning. In online courses, students actually complete certain online learning activities such as participating in discussions by responding to the original questions, peers' posts, and/or asking challenging questions about the topic being discussed. Emotional engagement refers to positive and negative reactions to professors, peers, academics, and schools (Lee & Smith, 1995; Stipek, 2002). In online courses, students are emotionally associated themselves toward learning. They may simply like the topics, the activities, the instructor, and the students who interact with them or deeply appreciate the knowledge and skills gained in the learning process. Cognitive engagement refers to student effort, to what extent students are engaged in their course work to master complex ideas and difficult skills (Fredricks, Blumenfeld, & Paris, 2004). In online courses, students utilize varied strategies and efforts in online learning activities. Strategic students use metacognitive strategies to plan, monitor, and evaluate their cognition when completing tasks (Pintrich & De Groot, 1990; Zimmerman, 1990). Students who are cognitively engaged use strategies associated with deep learning (Fredricks et al, 2004) such as reflective learning, live cases, group work, simulations etc. Reflective learning and live cases are among the most engaged learning activities that result in deep learning.

Social engagement has also been proposed in the literature. It refers to the social aspect in a student's collegiate experience (Knight, 2013). It is similar to the social presence as described in the three presence (Garrison, Anderson, & Archer, 2000) of online learning. In online courses, faculty can encourage students to participate in online forums such as "water cooler" or create "personal profiles" and share with the entire class to enhance social engagement. Social engagement in online learning can also be further enhanced through "virtual clubs" or "virtual events". All online students can choose to participate in campus events at a distance.

Recent studies also identified additional aspect relevant to online learning that is collaborative engagement. This aspect is relevant to "the development of different relationships and networks that support learning, including collaboration with peers, instructors, industry, and the educational institution" (Redmond, et al, 2018). In online courses, many learning activities such as collaborative projects, peer journaling etc. can be utilized to promote student collaboration. Tools like groups and Wikis in an LMS can be used to support these types of learning activities.

Instrument of Online Student Engagement

Students' engagement in online learning has been measured in many different ways, ranging from self-report survey to observational measures. Since among these methods, self-report method is a cost-efficient and flexible way to gather a large quantity of data efficiently (Fowler, 2013), it was used widely in measuring students' engagement in online context. Many instruments, such as surveys, questionnaires, or scales, have been established and used to assess the extent to which students engaged. For example, Dixson (2010) created the Online Student Engagement Scale to assess students' behavioral, emotional, and cognitive engagement in online learning; and Coates (2006) established the Student Engagement Questionnaire to measure students' engagement in aspect of behavior, emotion, and cognition.

Although many instruments were created and used to measure students' engagement in online learning, students' engagement were measured in different aspects since these instruments were created according to different definitions of student engagement (Henrie, Halverson, & Graham, 2015). For example, Fredricks et al., (2004) set behavioral, cognitive, and emotional engagement as the indicators of the student engagement, while Handelsman, Briggs, Sullivan, and Towler (2005) constructed student engagement in skills engagement, emotional engagement, participation/interaction engagement, and performance engagement. Such examples highlight the unstructured construct of student engagement and the importance of providing well-defined construct.

The Study

This study attempted to validate the instrument to measure online engagement and determine whether relationships between types of online engagement and student satisfaction and student perceived learning exist and to what extent these online engagement factors contribute to student satisfaction and perceived learning.

A variety of measures have been used to measure student engagement in literature. Student self-reporting in online surveys is used for this study as it provides data on how students are engaged in online courses and their satisfaction toward online courses and their perceived learning. A questionnaire was sent to all students taking four online graduate Educational Technology courses taught by one of the investigators in Fall 2018 and Spring 2019 semester to collect data. Thirty-one responses were received from 36 students enrolled in those courses with a response rate of 86 percent. Many of the participants, 81% were female and 19% were male; 39% of them were master's and 61% were doctoral students. All respondents had online learning experience as 87% of them had taken over 4 online courses before.

Instrument Validation

Upon reviewing student engagement instruments available, an instrument with five Likert- scale was created. The Liket-scale questions sought online student engagement level of each engagement aspect, and their satisfaction and perceived learning. Five questions regarding participants' demographics were also included in the questionnaire.

Prior to instrument evaluation, SPSS was used to screen the data. Each of the participant was assigned an ID number. Through checking the responses to 24 items of the OSEQ, the response of the ID #10 to the item 15 and the response of the ID #22 to the item 17 were missing. Therefore, these responses were coded as a missing data, which was coded as blank spaces in the data file.

The OSEQ used in this study to measure online students' engagement contained 24 items (Items 1 -24), each with four response options: 1 = "Strongly Disagree", 2 = "Disagree", 3 = "Agree", and 4 = "Strongly Agree". The direction of the rating scale suggest that higher scores represented higher levels of engagement in online learning. To ensure instrumentation quality, a standard Rasch analysis utilizing the WINSTEPS computer program was employed to evaluate both item functioning and dimensionality of engagement in online learning. The instrument performance was examined from the perspective of separation, categorical functioning, dimensionality, item hierarchical order, fit statistics, which provided decisive information on the reliability and validity of the instrument used in this study.

The instrument demonstrated a Rasch reliability of .92, which is high. High item reliability indicates that the sample size is large enough for stable comparisons between items. Hight item reliability also suggests that the instrument represented a clear line of inquiry, in which some items were more difficult and some items were easier, and that the confident could be placed in the consistency of the inferences of person ability, if these same items were given to another sample with comparable ability levels, is warranted (Bond & Fox, 2015).

Separation is a measure of the spread of the estimates relative to their precision (Linacre, 2012a). The item separation value for the 24 items was 3.48, which was transformed into a strata index [Strata = (4G+1)/3; Wright & Masters, 1982] of 4.97 (rounded down to 4). This indicated that the four response categories were able to separate the participants endorsement of engagement into four statistically different groups. Good separation reflects small error, and the higher the separation is, the more confidence we can place in the replicability of item placement across other samples (Bond & Fox, 2015).

To evaluate the reliability statistics, the non-extreme person estimates were used because it is more conservative (Wright & Stone, 1979). There were three participants classified as extreme respondents. WINSTEPS summary statistics of the 28 measured non-extreme participants shows that the real-person reliability was .86 and the model-person reliability is .88, which is not large difference from the real-person reliability. The Rasch reliability was considered to be ‘good’ (Miller et al., 2003) among participants. The real-person estimates were used to interpret the data because these estimates are more conservative.

The Rasch person separation index is a reliability index determined on the basis of how many statistically different levels of engagement were distinguished by the items. The person separation of 2.49 transformed into a strata index [Strata = (4G +1)/3; Wright & Masters, 1982] of 3.65 (rounded down to 3). This indicates that three statistically different groups of participants on the OSEQ variable and it provides evidence that there is a quantifiable engagement measure.

Rating scale functioning also contribute to instrument performance. If the rating scales function well, the step values should be arranged distinctively and monotonically. The summary of measured steps shows that step calibrations for Categories 1, 2, 3, and 4 progressed from the base line to -2.17, to -.52, and to 2.69. That means that the step difficulty between the response 1 (i.e., Strongly Disagree) and the response 2 (i.e., Disagree) is 2.17 logits, the step difficulty between the response 2 and the response 3 (i.e., Agree) is 1.65 logits (2.17-.52 = 1.65 logits), and the step difficulty between the response 3 and the response 4 (i.e., strongly agree) is 3.21 logits (2.69 – (-.52) = 3.21 logits). Therefore, the step threshold increase met the recommended guideline of being above 1.4 logits meaning that respondents reliably distinguished between the rating scale categories. In addition, the average measure ranged between -3.39 logits to 3.81 logits, which increased with the category value. Overall, these findings suggest that the rating scale used on the instrument was functional for students. The step values were arranged monotonically along the linear measure and the scales were functioning reasonably well. However, the number of participants selecting category 1 was only 1% leaving almost a break, which may threaten the usefulness of this category. In addition, the probability curve shows that the peak of Category 2 was not distinctive enough.

The difficulty difference in category “4” (Strongly Agree) between the easiest item and the most difficulty item was about three logits, and the difficulty difference between the steps of each item was not equal. The difference in step difficulty between “3” (Agree) and “4” (Strongly Agree) was more than five logits, while the difference in step difficulty between "2" (Disagree) and "3" (Agree) is about two logits. Thus, qualitatively, the raw score 4 of Item 1 (Explore online course site) was not equal to the raw score 4 of Item 18 (Build learning community to create sense of belongs), and category values were not intervals, because $(4-3) \neq (3 - 2)$.

Item Fit Statistics show that the measured infit mean square values (MNSQ) fell within the range of .60 and 1.4 suggested as acceptable for Likert-type rating scales and the measured outfit MNSQ values fell within the range of .60 and 1.4 also suggested as acceptable for Likert-type rating scales (Bond & Fox, 2015). In addition, another statistic -Z-Standardized score (ZSTD) fell within the range of -2 and +2 also suggested as acceptable with a sample size of between 30 and 300 (Linacre, 2012a). Moreover, the point-measure correlation (PT-MEASURE) must be positive and larger than .3 were suggested as acceptable (Linacre, 2012a) because negative or ‘nearly zero’ values of PT-MEASURE correlations is the signal that items are problematic and are not consistent with the construct. Looking at the four indicators (Infit mean square, Outfit, mean square, Infit ZSTD, and Outfit ZSTD) and the point-measure correlation, item 1 (Infit MNSQ = 2.54 > 1.4, and Infit ZSTD = 3.5 > 2), item 3 (Infit MNSQ = 2.23 > 1.4, and Infit ZSTD = 2.9 > 2), item 4 (Infit MNSQ = 2.10 > 1.4, and Infit ZSTD = 2.5 < 2), item 2 (Infit MNSQ = 2.07 > 1.4 and Infit ZSTD = 2.4 > 2), item 23 (Infit ZSTD = -2.0), and item 22 (Infit ZSTD = -2.1 < -2.0) were detected as misfitting items and needed to be further investigated.

According to Bond and Fox (2007), when the MNSQ >1.4 or ZSTD > 2, it suggested that there is more variation than modeled; when the MNSQ < 0.7 or ZSTD < -2, there is less variation than modeled. So by looking at the item 1, 3, 4 and 2 closely, these items' ZSTD is larger than 2, so these items are underfitting (i.e., the response pattern is too haphazard and the response to this item is too deterministic), which may degrade the quality of the ensuring measures. In addition, both item 22 and item 23's ZSTD is less than or equal to -2, therefore, item 22 (I will take a similar online course again) and item 23 ("I have achieved the stated learning objectives for this course") are overfitting (i.e., the response pattern is too determined and the responses to these items are too erratic), which might mislead us into concluding that the quality of our measures is better than it really is. Although item 1, 2, 3, 4, 22 and 23 are misfitting according to the ZSTD, by investigating these items' meaning, they are consistent with the theory. Therefore, these items were retained.

To examine the dimensionality of the instrument used in this study, a Rasch Principle Components analysis of Residuals were conducted. The purpose of this analysis is not to construct variables, but to explain variance. The Rasch dimension explained 46.4% of the variance in the data. The explained variance is low (the cutoff value is 60%). So, there is something else that influences the responses. Therefore, the analysis of the residuals was checked to find out if it is a random noise or systematic influencing. The largest secondary dimension, "the first contrast in the residuals" explained 13.6% (larger than 10%) of the variance, and the strength of the first contrast was 6.1 eigenvalues, indicating that there was some unexplained variance.

From the item-person map shows that the mean of measure of the student engagement rested about 2.5 logits above that of the items, suggesting that the items were easy to agree with. The higher end of the distribution of students higher than the highest levels of items. This indicates that there are a group of students who are much more engaged than this instrument can measure with these items. Thus, more items that can measure the higher levels of engagement as needed, in order for students' engagement to be measured more accurately. The difference in difficulty between the easiest item and the most difficulty item was about five logits (between -2.2 logits to 3 logits). The easiest item to say 'Strongly Agree' was located at the bottom of the item hierarchy, and it was item 2 ("I participate in online activities (online discussions, online chat etc.) according to the course schedule."), 4 ("I log onto to the course and view course materials on a regular basis according to the schedule."), and 9 ("I review my coursework for mistakes to improve it before submitting to the course site."). The most difficult item to say 'Strongly Agree' was located at the top of item hierarchy, and it was 18 ("I build or join learning communities to create a sense of belonging."). Reviewing course material and completing course work were easy for participants to endorse, while creating sense of belongs was relatively hard for this group to endorse. In addition, there were 4 students located on the top of the item hierarchy with engagements measures near 6 logits. This indicated that these students were likely to endorse all the items in this questionnaire.

Data Analysis and Results

Following the psychometric analyses of the data (i.e., the Rasch rating scale analysis), WINSTEPS person measures and category measures (logits) were used in place of standard raw scores for hypothesis testing to avoid methodological flaws associated with the use of raw scores. Person measures and category measures were intervals generated from the interactions of student endorsability, item difficulty, and step difficulty, and varied with item to item.

Since the spearman's correlation calculates a coefficient, which is a measure of the strength and direction of the association/relationship between two continuous or ordinal variables, in this study, this test was used to assess potential relationships between the five types of student engagement and student satisfaction and perceived learning in online courses, given the variables (i.e., behavioral engagement, emotional engagement, cognitive engagement, collaborative engagement, social engagement, student satisfaction, and perceived learning) are continuous. Figure 1 presents the statistics and level of significance illustrating nonparametric correlations between the variables.

In this study thirty-one participants were recruited. Preliminary analysis showed the relationship to be monotonic, as assessed by visual inspection of a scatterplot. There was no statistically significant correlation between behavioral engagement and students' satisfaction, $r_{(s)} = .301$, $p = .099 > .05$. However, there was a statistically significant, moderate positive correlation between behavioral engagement and students' perceived learning, $r_{(s)} = .542$, $p = .002 < .05$.

Nonparametric Correlations

Correlations

			Behavioral_Engag	Emotional_Engag	Cognitive_Engag	Collaborative_Engag	Social_Engag	Satisfaction	Perceived_Learning
Spearman's rho	Behavioral_Engag	Correlation Coefficient	1.000	.158	.180	.140	.303	.301	.542**
		Sig. (2-tailed)	.	.396	.333	.452	.097	.099	.002
		N	31	31	31	31	31	31	31
	Emotional_Engag	Correlation Coefficient	.158	1.000	.505**	.476**	.214	.733**	.756**
		Sig. (2-tailed)	.396	.	.004	.007	.248	.000	.000
		N	31	31	31	31	31	31	31
	Cognitive_Engag	Correlation Coefficient	.180	.505**	1.000	.489**	.365*	.306	.427*
		Sig. (2-tailed)	.333	.004	.	.005	.044	.094	.017
		N	31	31	31	31	31	31	31
	Collaborative_Engag	Correlation Coefficient	.140	.476**	.489**	1.000	.620**	.486**	.428*
		Sig. (2-tailed)	.452	.007	.005	.	.000	.006	.016
		N	31	31	31	31	31	31	31
	Social_Engag	Correlation Coefficient	.303	.214	.365*	.620**	1.000	.338	.258
		Sig. (2-tailed)	.097	.248	.044	.000	.	.063	.161
		N	31	31	31	31	31	31	31
	Satisfaction	Correlation Coefficient	.301	.733**	.306	.486**	.338	1.000	.773**
		Sig. (2-tailed)	.099	.000	.094	.006	.063	.	.000
		N	31	31	31	31	31	31	31
	Perceived_Learning	Correlation Coefficient	.542**	.756**	.427*	.428*	.258	.773**	1.000
		Sig. (2-tailed)	.002	.000	.017	.016	.161	.000	.
		N	31	31	31	31	31	31	31

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 1

This test was also run to assess the relationship between emotional engagement and students' satisfaction and perceived learning. Preliminary analysis also showed the relationship to be monotonic, as assessed by visual inspection of a scatterplot. There was a statistically significant, strong positive correlation between emotional engagement and students' satisfaction, $r_{(s)} = .733$, $p < .001$. Furthermore, there was a statistically significant, strong positive correlation between emotional engagement and students' perceived learning, $r_{(s)} = .759$, $p < .001$.

In addition, this test was run to assess the relationship between cognitive engagement and students' satisfaction, and perceived learning. Preliminary analysis showed the relationship to be monotonic, as assessed by visual inspection of a scatterplot. There was no statistically significant correlation between cognitive engagement and students' satisfaction, $r_{(s)} = .306$, $p = .094 > .05$. However, there was a statistically significant, moderate positive correlation between cognitive engagement and students' perceived learning, $r_{(s)} = .427$, $p = .017 < .05$.

The Spearman's rank-order correlation was run to assess the relationship between collaborative engagement and students' satisfaction, and perceived learning. Preliminary analysis showed the relationship to be monotonic, as assessed by visual inspection of a scatterplot. There was a statistically significant, moderate positive correlation between collaborative engagement and students' satisfaction, $r_{(s)} = .486$, $p = .006 < .05$. Furthermore, there was a statistically significant, moderate positive correlation between collaborate engagement and students' perceived learning, $r_{(s)} = .428$, $p = .016 < .05$.

The test was also run to assess the relationship between social engagement and students' satisfaction, and perceived learning. Preliminary analysis showed the relationship to be monotonic, as assessed by visual inspection of a scatterplot. There was no statistically significant correlation between social engagement and students' satisfaction, $r_{(s)} = .338$, $p = .063 > .05$. There was no statistically significant correlation between social engagement and students' perceived learning either, $r_{(s)} = .258$, $p = .161 > .05$.

Discussion, Limitation, and Future Studies

As discussed in the instrument validation section, the instrument demonstrated a Rasch reliability of .92, which is quite high. The item fit statistics within the range of 0.6 and 1.4 indicated these items were acceptable for

Likert-type rating scales. However, some of the items with misfit score of 1.58 and 1.39 need to be revised. When further examining the items for cognitive engagement, some of those items actually resemble the theme of behavioral engagement. New items to better measure cognitive engagement need to be added. For example, "I integrate ideas from multiple sources when completing course assignments" "I justify my decisions with educational framework when completing course assignments" "I monitor my learning progress when completing my course work" and "I reflect on the course work I completed" need to be added to further investigate the cognitive dimension of student engagement.

Figure 2 illustrate the relationships between each of the engagement factors and student satisfaction and perceived learning.

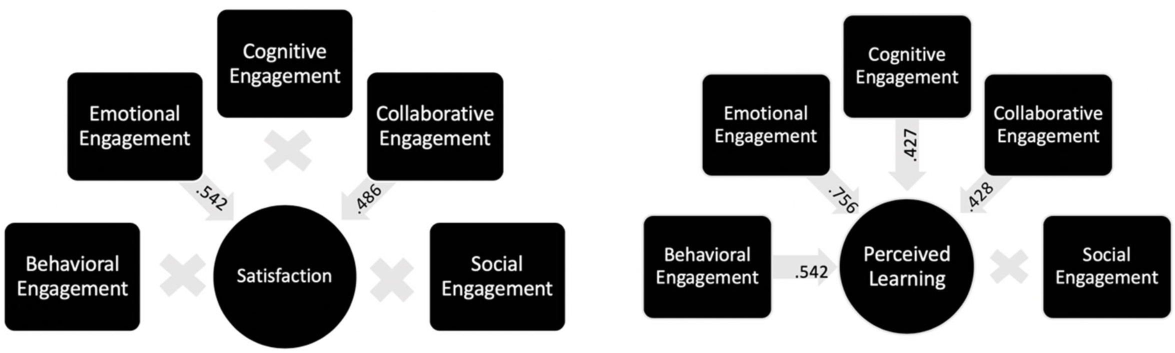

Figure 2

Limitations of this study include small sample size and some items in the instrument do not quite measure a specific type of engagement. We will add more items to measure each type of engagement, and revise the items for the cognitive dimension and administer the survey to more online courses for analysis.

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