Associations between Learner Interaction and Achievement in an Online Course: A Longitudinal Study[1]

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Abstract

This study analyzed student interaction in an online graduate-level research methods course for students majoring in agricultural education and related disciplines. The study involved 117 students and data were collected over 5 years. Overall there were 54 comparisons between groups of students who earned grades of B+ or lower and groups who earned grades of A- or A. In 45 of these comparisons, the average number of interactions for the A- or A groups exceeded the average number of interactions for the B+ or lower groups. In every comparison, the A- or A groups had a higher mean for number of sessions, total time in minutes, discussions read, and content files viewed than the B+ or lower groups. Pearson correlations were used to describe the associations between interactions and students' final percentage grade. Number of sessions, total time in minutes, discussions read, and content files viewed were positively correlated with achievement in each of the 5 years studied. Effect sizes for specific interactions varied significantly by year.

Introduction

Online learning has exceeded the overall growth rate for higher education for more than a decade (Allen and Seaman, 2014). According to Allen and Seaman, 7.1 million students took at least one online course in 2013. Draves and Coates (2007) predicted that in this century half of all education will be online. Online learning offers many advantages over traditional classroom instruction (Draves, 2002). One advantage is that course management systems automatically collect data on the extent to which students interact with course materials, the instructor and other students. An opportunity exists to mine this data for clues on how to enhance teaching and learning online.

This study was framed by Kearsley and Shneiderman's (1998) engagement theory. *"The fundamental idea underlying engagement theory is that students must be meaningfully engaged in learning activities through interaction with others and worthwhile tasks"* (para. 1). This theory is especially applicable to online learning. It emphasizes student collaboration and authentic projects. The theory provides for interaction with content and places special emphasis on human interaction. Students identify class projects to capitalize on their intrinsic motivation for learning.

Engagement theory emphasizes interaction, and interaction is widely believed to be important in online learning. Different forms of interaction are routinely included on lists of best practices for teaching online. One nationally recognized example is the Quality Matters rubric, which includes eight standards for online courses. The fifth standard is "Course Activities and Learner Interaction" (Maryland Online, 2014, para. 5). Moore (1989) operationalized interaction to include three types: learner–content, learner–instructor, and learner–learner. Learner–content interaction involves students' interaction with course materials and related concepts and ideas (Swan, 2003) and "is a defining characteristic of education" (Moore, 1989, p. 2). Learner–instructor interaction involves any of the ways the instructor communicates with students to facilitate learning (Swan, 2003). Learner–learner interaction may include formal communications such as debates, discussions, and peer review as well as informal communications (Swan, 2003). Swan argued that each type of interaction supports learning and that the three types are interconnected. Swan presented a Venn diagram that placed learning at the intersection of learner–content, learner–instructor, and learner–learner interaction.

Studies involving online courses have shown that some measures of interaction correlate positively with grades. For example, Pratt-Phillips (2011) discovered a positive relationship between student grades in an equine science course and number of online sessions, files viewed, and time online. Syler et al. (2006) concluded

[1]This article is a product of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project No. 3713 and sponsored by Hatch Act and State of Iowa funds.

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that use of web-based course tools significantly impacted freshman and sophomore students' performance in a computer information systems class. Wang and Newlin (2000) reported significant positive correlations between student grades and home-page hits, posts read, and posts written in a web-based psychology course.

Attending class and devoting time to learning are important measures of overall engagement and make learner–content, learner–instructor, and learner–learner interaction possible. Studies (Devadoss and Foltz, 1996; Marburger, 2006; Romer, 1993) in economics have demonstrated a strong, positive relationship between class attendance and academic achievement. Research from the 1970s demonstrated that time on task was positively associated with learner achievement (Stallings, 1980). Resnick (2007) confirmed the link between time and learning but also pointed to the importance of using time in a manner that most effectively promotes learning. Though much of the research on class attendance and time on task were not done in the context of online learning, there are online equivalents. Students attend online classes by signing into a course management system. These systems can track how often students log in, where they go within the course, and how long they remain online. Pratt-Phillips's (2011) study offers support for the impact of attendance and time in an online setting.

Prior studies suggest that overall engagement and interaction have a positive influence on learning. However, the scope of this work is not sufficient to make generalizations across a variety of students and subject areas. As a result, Roberts et al.'s (2005) recommendation that research be conducted to determine how much interaction is taking place and how much is needed remains relevant.

Purpose

The purpose of this study was to analyze student interaction in an online graduate-level research methods course. The study had two objectives:

1. Describe student interaction by grade group and year.
2. Describe associations between specific interactions and final percentage grade by year.

Methods

This study was deemed exempt by the Iowa State University Institutional Review Board.

The population was 117 graduate students enrolled in an online research methods course taught over a 5-year period from 2008 to 2012. This timeframe was selected because it was the most recent 5-year period during which the course management system generated data that were comparable over time. The course was taught once each year during the spring semester. The population included 51 males and 66 females. Most students majored in agricultural education (n=71), followed by professional agriculture (n=36), undeclared (n=7), horticulture (n=2), and seed technology and business (n=1). To address the first research objective, students' final percentage grades in the course were used to form two groups. The first group consisted of 59 students who earned grades of B+ or lower. The second group consisted of 58 students who earned grades of A- or A. Table 1 shows the number of students in each grade group by year.

Although updates were made to the course over time, the overall instructional design remained consistent. The following description is based on the course as delivered in the spring of 2012 and is a fair representation of how the course was conducted in each of the 5 years covered by this study. Web-based tools used in this course included course content, assessments, calendar, discussions, e-mail, syllabus, roster, and "my grades." Lessons included a list of objectives and a list of activities to support learning. These activities incorporated reference to the appropriate chapters in the required textbook, links to related materials and assignments, and audio presentations of content with accompanying slides. There were 18 discussion areas including one each for general discussion, students only, anonymous course feedback, and midterm course evaluation. The remaining 14 discussion areas were used to facilitate submission of and feedback on assignments. Evaluative feedback on assignments was posted by the instructor and by students as public threaded discussions. Students were encouraged to use e-mail within the course management system for all course-related communications except messages to everyone in the course. In such circumstances, students were encouraged to use the discussion tool. The calendar was used to remind students of important deadlines and provided links to assignments, weekly lessons, assessments and discussion areas.

Student grades were based on an interview of a professor in their discipline (5%), human subjects in research training (5%), application exercises (15%), proctored examinations (50%), and a research proposal

Table 1. Sample Sizes by Grade Group and Year

	Grade group		
Year	B+ or lower	A- or A	Total
2008	15	13	28
2009	14	10	24
2010	12	9	21
2011	10	14	24
2012	8	12	20
All	59	58	117

Table 2. Specific Interactions and Types of Interaction Tracked for this Study

	Type of interaction		
Interaction	Learner–Content	Learner–Instructor	Learner–Learner
Number of sessions	X	X	X
Total time in minutes	X	X	X
Discussions posted	X	X	X
Discussions read	X	X	X
E-mail messages sent		X	X
E-mail messages read		X	X
Content folders viewed	X		
Content files viewed	X		
Calendar views			

(25%). The number of interactions recorded by the course management system was not factored into the course grade.

The instructional design for the course was consistent with Kearsley and Shneiderman's (1998) engagement theory. Assignments were flexible so students could determine for themselves the context for application of course concepts. Students also frequently interacted with each other and the instructor. This was especially true for the research proposal assignment.

Data for this study were limited to what was collected by the course management system in the normal delivery of the research methods course. WebCT Vista/ Blackboard Version 8 was the course management system used each semester. The tracking tool was used to generate reports of student interactions. Interactions tracked in this study are listed in Table 2 and classified using Moore's (1989) types of interaction. The grade book tool was the source of data on students' grades.

Data were analyzed with PASW Statistics 18 Release 18.0.0. Means, standard deviations, and Pearson correlations were used to summarize the data. Effect sizes for Pearson correlations were based on Cohen's (1988) descriptors.

Results

Objective 1. Describe student interaction by grade group and year.

Table 3 shows the means and standard deviations for interactions by grade group and year. Overall, there were 54 comparisons between groups of students who earned grades of B+ or lower and groups who earned grades of A- or A. In 45 of these comparisons, the average number of interactions for the A- or A groups exceeded the average number of interactions for the B+ or lower groups. In every comparison, the A- or A groups had a higher mean for number of sessions, total time in minutes, discussions read and content files viewed than the B+ or lower groups. Furthermore, in a majority of comparisons, the A- or A groups had a higher mean for discussions posted, e-mail messages sent, e-mail messages read and content folders viewed than the B+ or lower groups. In 3 of the 5 years studied, the B+ or lower groups had a higher mean than the A- or A groups for course calendar views.

Objective 2. Describe associations between specific interactions and final percentage grade by year.

Pearson correlations were used to describe the associations between interactions and students' final percentage grade (Table 4). Number of sessions, total time in minutes, discussions read, and content files viewed were positively correlated with achievement in each of the 5 years studied. The influence of specific interactions on achievement varied significantly by year. For example, the effect size for the correlation between number of sessions and final percentage grade was large in 2010, medium in 2011 and 2012, small in 2009 and had no effect in 2008. Other variables with moderate effect sizes in at least 2 years were total time in minutes, discussions posted, discussions read, and content folders viewed.

Table 3. Means and Standard Deviations for Interactions by Year and Grade Group

		Grade group			
		B+ or lower		A- or A	
Interaction	Year	M	SD	M	SD
Number of sessions	2008	120	77	167	77
	2009	156	84	181	82
	2010	128	45	174	80
	2011	100	28	150	69
	2012	79	16	92	35
	All	121	65	151	75
Total time in minutes	2008	2634	1609	4632	3586
	2009	3044	1826	3206	1574
	2010	2945	1236	3237	1296
	2011	2227	697	2781	884
	2012	1688	474	2349	667
	All	2597	1406	3251	2064
Discussions posted	2008	22	6	22	3
	2009	18	2	19	1
	2010	20	3	19	2
	2011	19	4	21	4
	2012	21	2	22	5
	All	20	4	21	4
Discussions read[z]	2008	4289	6959	6911	13195
	2009	2834	3720	3251	4792
	2010	3456	3773	3703	6183
	2011	1101	1199	6620	10796
	2012	818	1040	1004	1000
	All	2763	4421	4490	8820
E-mail messages sent	2008	9	4	10	5
	2009	11	5	14	8
	2010	11	7	11	3
	2011	9	4	11	7
	2012	11	7	11	10
	All	10	5	11	7
E-mail messages read	2008	16	7	18	11
	2009	25	11	26	12
	2010	18	13	25	8
	2011	18	12	19	11
	2012	25	20	20	19
	All	20	12	21	13
Content folders viewed	2008	154	132	249	164
	2009	417	250	376	195
	2010	196	57	252	83
	2011	178	79	223	101
	2012	142	32	172	67
	All	227	178	249	142
Content files viewed	2008	103	41	128	48
	2009	126	48	150	62
	2010	247	100	286	76
	2011	227	99	231	76
	2012	159	66	182	56
	All	166	91	192	83
Calendar views	2008	65	59	53	38
	2009	42	36	123	135
	2010	82	81	68	107
	2011	63	60	73	73
	2012	65	60	44	51
	All	63	60	70	85

[z] The number of discussions read may seem high. Many students likely used the compile function to read messages rather than opening messages one at a time. Compiling opens all messages within a discussion area. This results in all messages being counted as read each time the messages are compiled within a discussion area.

Table 4. Pearson Correlations Between Interactions and Final Percentage Grade by Year

	Year					
Interaction	2008	2009	2010	2011	2012	All years
Number of sessions	.04	.22[a]	.51[c]	.49[b]	.35[b]	.22[a]
Total time in minutes	.43[b]	.05	.08	.20[a]	.60[c]	.22[a]
Discussions posted	.12[a]	.19[a]	-.45[b]	.39[b]	.25[a]	.13[a]
Discussions read	.05	.09	.25[a]	.31[b]	.30[b]	.12[a]
E-mail messages sent	.12[a]	.26[a]	-.18[a]	-.06	.01	.05
E-mail messages read	.18[a]	.10[a]	.05	-.06	-.10[a]	.05
Content folders viewed	.36[b]	-.04	.31[b]	.23[a]	.28[a]	.18[a]
Content files viewed	.35[b]	.13[a]	.03	.06	.10[a]	.12[a]
Calendar views	-.03	.26[a]	-.04	.01	-.04	.05

Note: Effect sizes based on Cohen's (1988) descriptors with [a]=small; [b]=medium; [c]=large.

Conclusions, Recommendations, and Discussion

Overall engagement, as indicated by frequency of interactions and time online, was related to student achievement in the online research methods course over a 5-year period. This is consistent with Pratt-Phillips's (2011) research, which spanned a 3-year period and involved 72 students.

Learner–content, learner–instructor, and learner–learner interaction all had an influence on grades. Interaction with course content had the greatest impact on achievement. To promote positive learning outcomes in online courses, instructors should engage students early and consistently throughout the course through interactions with course content, the instructor, and other students. This recommendation is consistent with Moore's (1989) admonition "that distance educators in all media do more to plan for all three kinds of interaction" (p. 6). It is also consistent with Moore and Kearsley's (2012) transactional distance theory. This theory suggests that distance is present in any educational environment and is a function of structure and dialogue. Greater distance is associated with greater structure and less dialogue. Educators should strive to use online instructional tools to promote interactions that offer an optimal level of structure and dialogue for a particular setting.

The magnitude of associations between grades and specific interactions varied significantly by year. This suggests that instructors should not expect any specific amount or form of interaction to reliably predict a group's achievement, and certainly not an individual's achievement. This suggestion is supported by Parry's (2012) report that Rio Salado College's efforts to enhance student grades were not consistently successful. Rio Salado College implemented interventions when students' online interactions were not consistent with those determined to predict achievement. We know that students differ in the ways they approach learning and in their need for different types of interaction. To accommodate a range of student needs and preferences, students should be afforded a variety of ways to interact with course content, the instructor and each other.

Calendar views were not categorized as learner–content, learner–instructor, or learner–learner interaction. Calendar views produced a small effect in only 1 of 5 years. This suggests there is no direct impact of this organizational tool on student achievement. Even so, the instructor believes the calendar is a valuable navigation aid for students and may indirectly influence achievement.

This study was limited to one online graduate-level course focused on research methods used in agricultural education and related disciplines. As a result, this study should be replicated across a greater number and variety of courses. This study did not account for all possible interactions. For example, the extent to which students used their textbook or communicated with peers and the instructor outside of the course management system was not measured. Future studies should explore data on interactions that occur outside the course management system milieu.

Course management systems can provide an objective record of the number and type of student interactions in online courses. However, they provide no way of knowing if or how students' minds are engaged in the course while they are online. Resnick (2007) provided a sound rationale for focusing not just on amount of time but also on how students use that time. Future research should examine the extent to which students interact and also how they interact, their thought processes, and their preferences for particular tools and techniques. Qualitative methodologies would be particularly valuable for such studies.

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