e-mentor
No. 1 (48) / 2013
www.e-mentor.edu.pl/eng

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Does The Use of Online Technology Improve Student's Performance in Epidemiology?

This article uses the validated measurement tool for the Community of Inquiry (CoI) framework in online settings to assess students' perception of social presence, teaching presence, and cognitive presence, when a synchronous technological tool was utilized in a quantitative online graduate-level course.

Introduction

A major challenge facing instructors teaching quantitative-based online courses, such as mathematics and statistics, is the creation of community of inquiry (CoI), which Garrison and colleagues described as a valuable context for higher-order learning[1]. The CoI framework is based on collaborative-constructivism theory, where complete immersed learning occurs within the community through the complex interaction of the three essential core elements: cognitive presence, social presence, and teaching presence[2]. Thus, a quality quantitative-based online education must incorporate these elements in its instructional strategy.

According to a report by Doug Lederman[3], approximately 6.7 million, or a third, of all students who were enrolled in a post-secondary education took an online course for credit in fall 2011. A large proportion of these students would have been exposed to at least one quantitative course

[1] D.R. Garrison, T. Anderson, W. Archer, *Critical thinking, cognitive presence, and computer conferencing in distance education*, http://communityofinquiry.com/files/CogPres_Final.pdf, [29.06.2010].

[2] D.R. Garrison, T. Anderson, W. Archer, *Critical Inquiry in a text-based environment: computer conferencing in higher education*, „The Internet and Higher Education" 2000, No. 2 (2-3), p. 87–105.

[3] D. Lederman, *Growth for Online Learning*, http://www.insidehighered.com/news/2013/01/08/survey-finds-online-enrollments-slow-continue-grow, [13.02.2010].

in an online environment. Published evidence is available to support the axiomatic that American students develop anxiety when it comes to statistics or other quantitative courses[4]. These anxieties, we assumed, might even be exacerbated when such course is administered online. Thus, a quantitative course administered online must utilize teaching strategies that will minimize the students' anxiety and optimally support high standard and self-initiated learning. Online course management systems, such as Blackboard, or Moodle, in tandem with the synchronous technological tools may potentially improve the CoI framework in online settings.

Epidemiology, one of the core disciplines of public health, focuses on principles and concepts related to the study of patterns of disease and inquiry in human populations and the application of this study to the control of public health problems. Concepts in epidemiology often require critical thinking, which may be challenging to transfer from the classroom to online education[5]. Students who are learning a quantitative-based epidemiology online course in a text-based environment are more likely to lose concentration and interest when reading course materials from the web than the students in the traditional classroom learning environment. Therefore, an instructional strategy framework for online epidemiology environments must focus on innovative instructional methodologies, well-designed assessment techniques, and highly interactive components.

To make an epidemiology online education robust and satisfactory to the students, we need to incorporate the total educational experience contained within the CoI framework. How do we create the CoI in an online classroom environment? Is the asynchronous, text-based environment enough? Currently, data that supports teaching methodologies in an epidemiology online course is very scarce. Anguiano and colleagues described their experience of teaching public health in an online environment[6] and Smith reviewed the application of information technology in the teaching of veterinary epidemiology and public health[7]. However, none of these examine the use

[4] A.J. Onwuegbuzie, *Statistics Anxiety among African American Graduate Students: An Affective Filter?*, „Journal of Black Psychology" 1999, No. 25, p. 189–208.
[5] D.R. Garrison, T. Anderson, W. Archer, *Critical Inquiry in a text-based…*, op.cit.
[6] A.S. Anguiano et al., *The experience of teaching public health using online technology: epidemiology beyond the classroom*, [in:] *5th International Technology Education Development Conference 2011 Proceedings*, Valencia, Spain.
[7] S. Ronald, *The application of information technology in the teaching of veterinary epidemiology and public health*, „Journal of Veterinary Medical Education" 2003, No. 30 (4), p. 344–350.

of online technological tools to evaluate the CoI components in a synchronous online environment.

Assessment of the technology used to support an online course is very important for several reasons. The technology has the potential to affect the frequency and manner in which students and the instructor interact with one another, provide and receive feedback, and interact with course materials. A successful online course with adequate technological support creates a CoI where students: interact with one another, interact with the instructor, and interact with the course materials to develop new knowledge and skills. Students mostly perceive that they learn more, are more satisfied with the instructor and the learning experience, and have greater retention, when the online course has a strong CoI[8].

To bridge the existing gap, we evaluated the students' perception of the synchronous use of Google plus in a graduate-level online introductory epidemiology course and its influence on the three core elements of the CoI model. We also examined student outcome and assessed whether the introduction of a technological tool to facilitate synchronous online discussions has been a factor in causing quality performance on the final examination.

Research Methodology

Twenty students enrolled and completed an online graduate-level epidemiology course in fall 2010 and 16 students enrolled and completed the same course in fall 2011. In fall 2011, we introduced synchronous online discussions in addition to course materials and handouts, which students can access directly on the blackboard. A synchronous online discussion was not available prior to fall 2011. Thus, we designated fall 2010 and fall 2011 as control and treatment groups respectively. The major difference between the control and the treatment groups was the presence of synchronous discussion among the treatment group. These online synchronous discussions were facilitated using an online technological tool Google plus. All other factors such as, curriculum, instructor, and course delivery management system were essentially the same.

[8] J.B. Arbaugh, M. Cleveland-Innes, S.R. Diaz, D.R. Garrison, P. Ice, J.C. Richardson, K.P. Swan, *Developing a community of inquiry instrument: Testing a measure of the Community of Inquiry framework using a multi-institutional sample,* „Internet and High Education" 2008, No. 11, p. 133–136.

The sixteen students who were enrolled in the fall 2011 were required to meet with the instructor once every two weeks for synchronous discussions. The instructor clarified key concepts during the course and practice questions were distributed and discussed. Furthermore, the instructor encouraged social interaction, encouraged student reflection, and provided hands-on activities. We prospectively monitored students' participation and progress from the beginning of the semester until the end.

We administered an anonymous survey, which has been validated for CoI constructs[9], to students who were enrolled in the fall 2011 two weeks before the final examination. Participation in the survey was voluntary, and the study was approved by the principal investigators' institution IRB. We also collected students' final examinations scores, which was a weighted combinations of student's performances in examination 1, examination 2, examination 3, group project, and literature critique, from both the fall 2010 and the fall 2011 courses.

Data Analysis

The CoI survey composed of series of questions measured on a 5-point Likert scale (ordinal responses on a scale of 0 = strongly disagree to 5 = strongly agree) and partitioned into three sections. Section one was composed of thirteen questions designed to measure the teaching presence construct; section two was composed of nine questions designed to measure the social presence; and section three was comprised of twelve questions designed to measure the cognitive presence. An additional three questions were added to measure the overall satisfaction with the course and with the instructor. The principal component analysis would have been an ideal analysis for this type of dataset. However, to obtain reliable results using principal component analysis, the minimal number of subjects should be larger than 100 or five times the number of variables being analyzed[10].

Ordinal responses were scored using the scale (0 = Strongly Disagree) to (5 = Strongly Agree). Mean responses for the 34 items ranged from 3.33 to 4.63, with a standard deviation range of 0.52 to 1.12. Collective thirteen questions designed to measure the teaching presence yielded

[9] K.P. Swan, J.C. Richardson, P. Ice, R. Garrison, M. Cleveland-Innes, J.B. Arbaugh, *Validating a measurement tool of presence in online communities of inquiry*, „e-mentor" 2008, No. 2 (24), p. 1–12.

[10] SAS Institute Inc., *Principal Component Analysis*, support.sas.com/publishing/pubcat/chaps/55129.pdf, [15.02.2013].

a mean score of 3.87 (s.d. = 0.85). Social presence items collectively yielded a mean score of 4.28 (s.d. = 0.72), and Cognitive presence yielded a mean score of 4.04 (s.d. = 0.66).

Since our sample size was small, we used summative standardized agreement score to generate an aggregate score for each of the CoI components. We summed items in each of these sections to create a summative standardized agreement score using the following formula:

$$Summative\ Standardized\ Agreement\ score\ = \frac{Observed - minimum}{Maximum - minimum}\ x\ 100$$

where observed score equals the summation of all items in each section; minimum score equals number of item multiplied by the number of students multiplied by the minimum scale value; maximum score equals number of item multiplied by the number of students multiplied by the maximum scale value. The minimum scale value is one and the maximum scale value is five.

Additionally, we used the Wilcoxon-rank sum test with continuity correction to compare the median scores on the final examinations between the ("treatment") fall 2011 and the ("control") fall 2010 groups.

Findings

Of the 16 students in the treatment group, nine (56.3%) completed the CoI survey. Using a summative standardized agreement score, 77.7% of the respondents perceived that the use of the technology facilitated teaching presence; 88.8% of the respondents perceived that the use of the technology facilitated social presence; while 75.5% of the respondents perceived that the use of the technology facilitated cognitive presence. Overall, 77% of the respondents were satisfied with the course and with the instructor; although, almost all respondents agreed that the instructor did not provide feedback in a timely fashion.

We examined students' responses to three items from each of the CoI survey domains:

(1) Teaching presence: *The instructor clearly communicated important course topics*: 89% of those who responded agreed or strongly agreed that the instructor clearly communicated important topics in this course. This result suggests that our students valued the instructor's involvement and support in an online environment;

(2) Social presence: *I felt comfortable interacting with other course participants*: 88% of those who responded agreed or strongly agreed that they were comfortable interacting with their peers.

(3) Cognitive presence: *I can describe ways to test and apply the knowledge created in this course*: All respondents agreed or strongly agreed with this statement. It appeared that students perceived that they have learned and have acquired advanced knowledge to help them discharge responsibilities in public health practices.

We used the Wilcoxon- rank sum test with continuity correction to compare the median score on the final examination in the fall 2011 ("treatment group") and in the fall 2010 ("control group"). Students who took this course when the Google plus was used synchronously to facilitate discussions (fall 2011) performed better (80% vs. 90%; $p = 0.0004$) than the control group (fall 2010) when no synchronous technology was used.

Discussion

Overall, our data appeared to suggest that the synchronous use of online technology, in this case Google plus, was beneficial to our students and enhanced the three components of CoI model. Additionally, it appeared that our students perceived that the use of synchronous online technology enhanced social presence the most and teaching presence the least. We are very pleased with several comments that we received from students at the end of the semester. For example, one student posted a comment at the end of the survey that "I have taken online public health courses in other institutions before. However, the curiosity and interest I gained from this course is unbelievable. The instructor, considered us as an adult, professional and midcareer students by creating groups and by building a sense of team-work. This helped us learn from each other and reach consensus for the answers of our group projects. I become even more interested in epidemiology and biostatistics." We also learned a great deal from this survey that students valued timely feedback. For instance, a student posted a comment that "I thought the course and the instructor were effective. My only complaint is that sometimes I would not receive feedback from the instructor through e-mail when I submitted a question."

The statistically significant higher median score on the final examination that we observed between the ("treatment group") fall 2011 and the ("control group") fall 2010 might be due to several reasons other than a synchronous online technological tool (Google plus). For example

students' background might be responsible for the higher score in fall 2011. More of the students who enrolled in fall 2011 had prior medical background compared with those in fall 2010. Despite this limitation, we believed that instructor's presence was most pronounced when an online technological tool Google plus was used synchronously to facilitate online education in fall 2011.

We would like to acknowledge the small sample size for this study. The survey was administered anonymously; however, poor participation might be due to fear among students that their identity would be uncovered and may influence their final grade. We will continue to collect data for the next four to five years to increase the sample size. We are also in the process of collaborating with other institutions. Such collaboration will not only increase the sample size considerably and make the interpretation more robust but also afford an opportunity to examine a variety of variables that come with studying more heterogeneous student populations.

Conclusions

In conclusion, the total educational experience among our students who enrolled in an online graduate-level epidemiology course was positive. The respondents appeared to perceive that the synchronous use of online technology, Google plus, in an online environment enhanced the three domains of CoI.

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