Assessment of the Effectiveness of an Online Learning System in Improving Student Test Performance

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Abstract:

Colleges and universities, particularly public institutions, are facing higher enrollments and declining resources from state and federal governments. In this resource-constrained environment, faculty are seeking more efficient and effective teaching strategies to improve student learning and test performance. The authors assessed an online learning system's effectiveness for improving student test performance in a face-to-face learning environment. Results indicated that implementation of the online learning system improved student test performance compared with control test questions and with test performance during a prior semester before system implementation. Implications and limitations are discussed.

Keywords: online learning | organizational behavior | performance | student learning | technology

Article:

Colleges and universities, particularly public institutions, increasingly are facing higher enrollments and declining resources from state and federal governments. Total state funding for higher education has declined by 15% since 2008, adjusted for inflation (Nicas & McWhirter, 2012) and cuts were $1.1 billion for fiscal 2013 (Simon, 2013). Higher education institutions are implementing strategies to increase efficiency including larger class sizes, employing adjunct faculty, and greater use of online education. Some business schools are using online learning systems to supplement classroom instruction. This study was designed to provide evidence about the effectiveness of one such publisher-developed system, the Connect online learning system (CLS), in improving student learning and test performance in a face-to-face class. We compare student test performance before implementation of an online learning system with test performance after system implementation. Scholars are beginning to assess the effectiveness of such systems in undergraduate business courses, as we detail in the next section.

The efficacy of various teaching strategies, in face-to-face versus blended and online formats, across a range of business courses, has been the subject of recent scholarly investigation. For example, Flanagan (2012) reported students in a business statistics course performed better in face-to-face classes than online. Kohli, Peng, and Mittal (2011) reported online learning and assessment tools helped low-performing students in a business statistics course. In a blended class format, Tsai, Shen, and Tsai (2011) found student-regulated online learning activities led to higher grades in a Taiwanese database management course. Sargent, Borthick, and Lederberg (2011) found online videos were a useful supplement to enhance student performance in face-to-face accounting classes. Relatedly, in a face-to-face class environment, use of the clicker technology as an audience response system improved student accounting test performance (Premuroso, Tong, & Beed, 2011). In a comparison of online and hybrid courses, Estelami (2012) found improvements in perceived learning and performance varied as a function of the qualitative versus quantitative nature of the course. Thus, Estelami concluded that the efficacy of online activities varies as a function of the nature of the course. The present study contributes to this evolving research stream by focusing on the effectiveness of the CLS in a face-to-face organizational behavior (OB) class environment.

The purpose of this research was to determine whether use of the CLS improved student test performance in an undergraduate, face-to-face, required, OB semester-long course. This research question was addressed by comparing student performance on test items before and after implementation of the CLS. Three questions were employed to test the effectiveness of the online learning system. First, student performance on (experimental) test items addressed by the CLS homework was compared to a random sample of (control) test items not covered by the CLS homework on the same tests, during the same semester. Then, second, student test performance was compared before and after implementation of the online assignment system on a common set of test items over two semesters. Third, student test performance on experimental versus control test items was compared in the semester prior to implementation of the CLS to provide evidence about the comparative difficulty level of the two groups of test items. The next section presents background educational theory which formed the theoretical foundation for the research.

Theoretical Background: Cognitivism

No single learning theory accounts for all aspects of learning; therefore, it is possible learning is not a unique act, but rather an assortment of processes that together produce understanding. Three dominant theories of learning include constructivism, behaviorism, and cognitivism. Constructivism proposes that knowledge is socially constructed and focuses on learning goals, and conditions and methods of instruction (Driscoll, 2005). Behaviorism, founded by Skinner (1969), postulates that learning is a function of consequences of behavior. This study is grounded in a third paradigm, Cognitivism, and rooted in several theoretical perspectives. Cognitivism attempts to understand how information comes from the senses and is processed in the brain (Driscoll, 2005). Cognitive theorists are concerned with observable behaviors, such as test performance, while making inferences about the underlying (unobservable) mental processes (learning) which produce the behaviors (test results). Cognitive theorists stress the acquisition of knowledge and internal mental operations—mainly how an individual senses, perceives, processes, stores, and retrieves events and information. Similar to constructivists, cognitivists

pay specific attention to the effect of environmental conditions (e.g., the CLS) on the learning process. Thus, we examined the observable behavior, test performance, to deduce the impact of the online assignments in the (underlying) learning process.

Of particular interest for this study were the works of Bruner (1964) and Vygotsky (1978) which propose interactional theories of cognitive development. According to Bruner, the product of cognitive development is thinking. An intelligent mind creates from experience "genetic coding systems that permit one to go beyond the new data to new and possibly fruitful predictions" (Bruner, 1978, p. 241). Bruner (1964) proposed three stages of cognitive development: enactive representation, iconic representation, and symbolic representation. We focused on the second and third stages. In iconic representation, images are used to represent understanding. For example, instructions with diagrams are used to facilitate understanding and learning. The diagrams act as scaffolds to support understanding of the written instructions. In symbolic cognitive representation, familiar symbols, including language are employed to teach new concepts in a topic with which the learner already has familiarity, thus building on the iconic stage. According to Bruner (1964), learners will pass in and out of these stages based on their level of expertise within a given topic. In order to assimilate new material, learners must progress through each stage to establish deep understanding of the content.

Vygotsky's (1978) research also focuses on the learning process. However, he emphasizes the importance of social context to the act of learning. Vygotsky asserted all learners have a zone of proximal development (ZPD). "ZPD is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance [expert] or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). Thus, here we investigate the effectiveness of the online assignments in moving a student through the ZPD, that is, from capability to complete the assignment with text resources and immediate feedback to the ability to successfully applying the concepts in a testing format.

A related theory is Ausubel's (1960) meaningful learning theory. According to this theory, the learner actively incorporates substantive knowledge into his/her existing cognitive structures. Learning takes place in a top-down, deductive manner. Ausubel made a distinction between rote learning and meaningful learning. According to Ausubel, rote learning is strictly memorization without connections to other cognitive structures, while meaningful learning makes connections with what the learner already knows. Ausubel also proposed the concept of anchoring ideas, which are specific and relevant to the learner's cognitive structure. Anchoring ideas provide the foundation for connecting new ideas to the existing structure (Driscoll, 1994). For example, constructs and their definitions can provide anchors on which the learner can build new information, such as theories. While foundational courses in a business curriculum introduce students to concepts and theories which require rote learning, these courses also should enable meaningful learning where learners connect the memorized material to previous and to new learning experiences.

Nentl and Zietlow (2008) pointed out that in most business school curricula, the purpose of foundational business courses, such as introduction to accounting, management, finance, and organizational behavior, is the acquisition of knowledge and comprehension of fundamental

business concepts and theories for application in later, higher level courses. Thus, a primary purpose of OB courses is to expose students to models, concepts and theories. This exposure builds on memorized facts that are anchored to prior understandings. Ultimately, students are able to predict and explain behavior in organizations because of meaningful learning experiences through the iconic and symbolic representation stages. This knowledge may be applied in such subsequent management courses as human resource management, organizational theory, organizational change and development, and the capstone strategy course. Accordingly, student mastery of fundamental OB knowledge and its application is critical to the successful completion of subsequent courses. Therefore, instructional strategies should emphasize active assimilation and accommodation of new information based on learners' existing cognitive structures.

The cognitive paradigm focuses on the inherent mental activities involved in the learning process (Yilmaz, 2011). An effective learning framework includes provision of a conceptual model to help learners organize new information, making the concepts understandable, and integrating the new concepts into the learner's long-term memory. Feedback, to help the learner monitor progress and direct learning efforts, is an important element of effective learning systems. Additionally, it is important to provide a variety of learning opportunities to help the learner generalize the concept or principle to other settings. Three hypotheses in the context of the established theoretical foundation are presented next. Then we turn to a more detailed review of the nature of the OB course and the online homework assignments.

Hypotheses

Consistent with cognitive learning theory, the use of CLS homework assignments in the OB classes provided students with additional opportunities to engage with the material, thus enhancing the opportunity for concepts and theories to be enriched and cognitive structures to be anchored. Among the assignments were activities in which students recreated theoretical models and applied the concepts in organizational scenarios. The concept formation, retention, and application learning steps appear to be addressed by the first two sets of questions in each homework assignment. According to assimilation theory, "an assimilation of old and new meanings form a more highly differentiated cognitive structure" (Driscoll, 1994, p. 129). The third set of activities in each CLS assignment included six multiple-choice items that simulated test questions which were, at times conceptual, and at times applied in nature. Based on immediate, automated feedback, the student could see which concepts s/he had mastered and which required additional study. The CLS homework appeared to help the learner link to anchoring ideas that provided meaning to the new information.

This enhanced learning, which might have occurred as a function of the homework completion, could be demonstrated in several ways. First, a comparison of correct response rates on test items which pertained to topics addressed by the homework with items for which no homework was assigned would suggest whether a learning effect for the homework assignments had occurred. If the CLS did not improve learning, there would be no difference in test performance across the two sets of conditions. Thus, we proposed the following two hypotheses:

> Hypothesis 1 (HI): Use of CLS homework assignments would not significantly increase the percent of students who get those test items correct which cover topics addressed by

CLS homework within the semester (fall 2011), compared with responses on test items for topics not addressed by the CLS homework in fall 2011.

H2: Use of CLS homework assignments would not significantly increase the percent of students who get test items correct which cover topics addressed by CLS homework in fall 2011, compared with responses on the same test items when the homework was not assigned in fall 2010.

The difficulty level of the test items employed to test the CLS effects might have differed across topics. Indeed, the topics themselves may have differed in terms of conceptual difficulty and thus in understanding, retention and retrieval by students. To assess whether the topics or test questions differed in difficulty, it was necessary to examine the correct test item response rates within a semester when there were no CLS assignments. This additional assessment was necessary because if the topics or test items addressed by the homework were easier than the control questions, the results of H1 might have overstated the effect of the CLS homework completion. Thus, a third hypothesis was proposed and tested:

H3: There would be no significant difference in percent of students with correct answers between the two groups of questions in the semester when the CLS was not used (fall 2010).

Finally, one additional issue needed to be addressed. At students' request, a fourth test was added in fall 2011 to the three administered in previous semesters. The addition of the fourth test in fall 2011, which meant students had slightly less material to prepare for each test, could have been a possible cause of a change in the correct test item response rate during that semester. A strategy for testing this possibility was to compare the percent of correct responses to the randomly sampled test items not addressed by the CLS homework in fall 2010 and fall 2011. If the additional test had an effect, the percent of correct responses should have been significantly higher in the 2011 semester than in the fall 2010 semester. This analysis was also conducted.

Course structure

The first author taught the required OB course over two successive fall semesters in 2010 and 2011. Course activities included: class coverage of OB topics, students individually reading and studying the text, an individually completed project, and testing. CLS online homework assignments for selected topics were added to the course activities in fall 2011. The instructor employed the same teaching style, content, text, test questions, and assigned identical projects across the two semesters. The course and its components were essentially the same except for two changes from the first semester, fall 2010, to the second, fall 2011. The instructor added in the CLS homework assignments using a set of publisher-provided online learning assessments in fall 2011. More information about the assessments follows. Second, as noted previously, based on student feedback, one additional test was administered, going from three tests in fall 2010 to four in fall 2011. During the fall 2010 semester there were two tests and a third noncumulative test was administered in the final exam period. In the fall 2011 semester, there were three tests during the semester and a fourth noncumulative test during the final exam period. Thus, the

material for which students were responsible for each test in fall 2011 was somewhat less (about one chapter) than in fall 2010.

The online learning system components and process

The online learning system, developed by the publisher to support the text, was an integrated component of the course's learning activities. Each of the CLS homework assignments contained three sets of activities. Two of the activities were drag and drops in which the student saw a set of cues on one side of the screen and a set of boxes on the other side of the screen. Each box had a description beside it that was highlighted when the student moved the cursor over the box. The student highlighted a cue, clicked on it, and dragged it to an appropriate response box. One set of the drag and drops essentially had the student replicate a model presented in the text. A second subsequent set of drag and drops required the student to apply the theoretical concepts to a business scenario. The third activity set was comprised of a set of six multiple-choice questions that assessed the student's knowledge of the theory and its applications. Completion of each assessment took students about 20 min for each attempt, but there was no time limit for each assignment's completion. Students were allowed to use their textbook and class notes as an assist in learning as they completed the homework.

Each student was allowed two attempts to complete the assignment. At the completion of the first attempt, the student received feedback on the percent of the assignment correctly completed and which parts he/she answered correctly but not the correct responses to the remainder of the assignment. After the second attempt, the student could reopen the assignment and see his or her responses and the correct responses, but could not make any additional changes to the responses. The score that counted towards the student's course grade was the higher score across the two attempts. The rationale for this strategy was to encourage students to complete both attempts. If the student completed one attempt and earned a perfect score, she/he might be discouraged from using a second attempt as a review strategy immediately before the test. On average, students improved their scores by 16.7% between the first and second attempts.

Assignments were set up in a cluster for each set of chapters on which the students would be tested. An assignment cluster opened when the class began each chapter set. For a student to earn credit, attempts for the specific assignment cluster had to be completed before the administration of each test. Access to the relevant assignments closed at the start of the test and remained closed for the duration of the semester. The CLS homework comprised 8% of a student's course grade, large enough to matter but small enough to allow other components of the course to have significant impact on the course grade. For example, each test was worth 20% of the course grade in fall 2010 and 16% in fall 2011 (because of the additional test).

Students completed homework for all the chapters covered in the OB course. There were 37 homework assignments with an average of two per chapter. Thus, for each chapter, two of approximately six topics and theories for which students were responsible for testing purposes were addressed by an online homework assignment.

Methodology

Sample

There were 128 students in the two fall 2010 classes and 164 students across the two sections of the OB course in fall 2011. The students were sophomores, juniors and seniors taking the required course to fulfill a common body of knowledge requirement of all business students.

Measure

All test questions were multiple choice. Students completed the tests during class time. The tests were closed-book and closed-notes. Due to large class size, students completed either of two versions of each test each semester. The tests had the same questions but the order of questions and the order of answer choices varied across the test versions. Each version was alternated in the distribution of tests so that adjacent students had a different version. Each semester, all tests of the same version were machine scored in one run. The raw data from one version of each test in the data analysis was used, resulting in a sample size of 64 students in fall 2010 and 82 students in fall 2011. As a result, the data included students from both classes during both fall 2010 and fall 2011, in effect mitigating a possible time of day effect on grades. While students had an opportunity in the next class to review their tests, students turned in all the tests after the review. Test questions addressed the following topics in OB: corporate social responsibility, diversity, organizational culture, organizational socialization, cross-cultural values, emotional intelligence, perception, attribution, personality, work attitudes, motivation, reinforcement theory, decision making, stages of group development, conflict management, power and politics, leadership, organizational change and development, and stress management. Reliability analysis indicated the test instrument was reliable ($\alpha = .77$). Sample test items are included in the Appendix.

Analysis

To test the hypotheses, test-item responses that had been collected in the required OB course in fall semester 2010, before the use of the online learning system, were compared with responses to the same test items collected in fall 2011, after implementation of the online learning system. Variables included were the responses to the test items along with a semester identifier and whether the test item was addressed by a CLS homework assignment (experimental [CLS] group) or was not (control group). A set of 11 control questions were randomly selected from the test items assessing learning on topics not addressed by the CLS homework. Chi-square analysis and t tests were employed to test the hypotheses and to address the question of a possible number of test effects on correct test items response rates across the fall 2010 and fall 2011 semesters.

Results

To recap, this study evaluated whether use of the CLS improved student test performance across two semesters. This assessment was conducted in three ways. For the null condition, H1 proposed that students would not perform better on test item topics that had been addressed in learning system homework. Second, H2 compared test performance before and after implementation of the learning system and stated there will be no significant difference. Third, H3 tested the assertion that there would not be a difference in the difficulty level of the control

versus CLS-addressed test questions in the semester prior to the intervention. In the next section we report the findings of the analyses.

> H1 predicted that completion of the CLS homework in fall 2011 would not result in a significant increase in the percent of students who got test items correct for topics addressed by the homework compared with test items for topics not addressed by the homework. The mean percent of correct test items for the CLS-addressed topics was 80.82%, as shown in Table 1. The mean percent correct for test items not addressed in the homework was 71.82%. The t-test analysis indicated that student test scores were significantly higher on those test items after completion of the homework in fall 2011, $t(53) = 11.1$, $p < .0001$, compared to performance on the control test items during that same semester. Thus, the first hypothesis was rejected.

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Table 1 of 2

TABLE 1 Mean Percent Correct for Online Learning System: Addressed and Control Test Items

Question type	Number of questions	Fall 2010	Fall 2011	Overall	*t*	*p*
CLS-addressed questions	45	71.89%	80.82%	76.10%	5.11	.0001
Control questions	11	69.36%	71.82%	69.62%	0.19	*ns*
Overall	56	71.47%	79.32%	75.94%	5.73	.0001
t		0.79	11.10	7.89		
p		*ns*	.0001	.0001		

H2 predicted that completion of the CLS homework would not significantly improve student test performance compared with the prior semester when there was no CLS homework. That is, the use of the CLS would not significantly increase the percent of students' correct responses to test items addressed by the CLS homework in the fall 2011 semester, compared with the student responses to the same test items before implementation of the CLS homework in the fall 2010 semester. The students' mean score on the test items which addressed the topics covered by the CLS was 80.82% after implementation of the CLS assignments in fall 2011, and was 71.89% in fall 2010 before implementation of the CLS. The students' mean score on these items was significantly higher in fall 2011, $t(118) = 5.11$, $p < .001$, as shown in Table 1. H2 was not supported by the findings; thus, H2 was rejected.

In a further test of H2, there were 44 test items that assessed learning on topics addressed by the CLS homework and 11 items which served as control test items. Of the 44 test items addressed by the homework, students' correct response rates significantly improved on 16 (36.3%) of the test items and significantly declined on three (6.8%) test items. Of the control group test items, student performance significantly improved on one test item (9%) and declined on one test item (9%), as shown in Table 2. The findings suggested that students' performance improved on the test items whose topics were addressed by the CLS assignments. In summary, comparison of the

percent of students who got items addressed by the CLS homework correct on the tests also suggested that the CLS assignments improved learning, contrary to H2.

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An analysis was conducted to determine whether the test items might have differed in difficulty. H3 predicted that there would be no significant difference in percent of students with correct answers between the groups of questions in the semester when the CLS was not used (fall 2010). As shown in Table 1, in fall 2010, students got an average of 71.89% of test items correct in the (subsequent) CLS test item group and 69.36% of the control items. This difference was not statistically significant; thus H3 was accepted.

Analysis also was conducted to determine whether there was a test effect due to the addition of a fourth test in the fall 2011 semester. In this analysis, student performance on the control items in fall 2010 was compared to those same items in fall 2011. For test items that served as controls, the mean correct test item response rate in fall 2010 was 69.36%, while in fall 2011 the mean correct test item response rate was 71.82%. The means were not significantly different. These results suggested that the addition of a fourth test did not improve student performance on the tests, as measured by percent of test items correct, contrary to students' expectations.

Finally, a post hoc analysis was completed to determine whether students simply spent more time on the material in fall 2011 which could account for the improved test scores. In fall 2010 on the end-of-semester course evaluations, 37% of students reported they had invested more or much more time on the course while 38% reported investing more or much more time on the course in fall 2011. Sixty-one percent reported investing an average amount of time in the course in fall 2010 compared with 57% in fall 2011. Two percent reported spending less or much less time investment in the course in fall 2010 compared with 6% in fall 2010. It appeared that completing the CLS homework assignments may have facilitated more efficient use of study time for some students since the amount of work invested was similar across semesters while test scores improved significantly. These findings appeared to add confidence to the results regarding the study hypotheses.

Outcomes Summary

In summary, completion of CLS assigned homework improved student test item scores compared with test items for which no homework was assigned. Scores also improved from semester to semester with the addition of the CLS homework, compared to the prior semester (fall 2010), before assignment of the CLS homework. The addition of a fourth test in fall 2011 did not appear to be the cause of the improved test item scores. Student investment of additional time in the homework also did not appear to be the cause of the improvement on the test item scores.

Discussion

Four themes evolve from the interplay between the theoretical foundation for this study and the results found therein. These themes serve as the basis for this discussion. First, cognitive theory provides a context for understanding and interpreting the results. Second, the directions provided to the students by the instructor may have played a supportive role in enhancing the effect of the CLS on test performance. Third, the role that immediate automated feedback played is discussed. Fourth, the importance of the structuring of the homework is emphasized. Finally and additionally, several unaddressed questions and limitations of the current study are presented along with directions for future research. Each of these themes is presented subsequently.

First, the results suggest that additional student work beyond studying the text improves test performance. The findings suggest the online learning system is an effective strategy for enhancing student learning of course material and test performance. Consistent with cognitive theory, the CLS supplements the instructor's course materials as a cognitive organizer, presenting information in a logical format and also scaffolds the learners' progress by providing clarifying examples. Computer-scored assignments make it possible to enhance student learning without imposing significant time commitments in grading and record-keeping for faculty. The instructor can regularly check student performance on the homework, but does not have to grade the assignments. A critical component of the online learning system is the quality of questions assigned for homework. Cognitive learning theory indicates that the questions should facilitate student comprehension and retention of theories and models, provide opportunities for students to apply them, and provide immediate feedback. The learning system appears to address these requirements.

The results also are consistent with Bruner's (1964) theoretical iconic representation. Recall that in iconic representation, images (e.g., diagrams of models) are employed to enhance student understanding by providing scaffolding in support of written information. In the homework, the first section of each CLS assignment involved replication of the theoretical model of interest. This activity required the students to attend to the model and manipulate its conceptual components, thus reinforcing mastery of the model. Consistent with symbolic representation (Bruner, 1964) in which familiar symbols including language are used to teach new concepts in a topic with which the learner has familiarity, the second part of the online homework assignment involved applying the model to an organizational context. The questions were sufficiently challenging to require that students reflect on different aspects of the model and its implications. Consistent with the cognitive learning paradigm, this section fostered attention and deeper thinking about the model and its application. Finally, the third section of the homework served as a practice test in which students responded to conceptual and application questions in a multiple-choice format, similar to the testing format. This third section might have enabled students to assess their level of mastery and to build confidence in their mastery of the material.

Overall, from a cognitive theoretical perspective, the CLS appears to provide an effective learning framework which includes the use of conceptual models to help learners organize and assimilate new information. Complex concepts are made understandable, and the learners seem able to integrate these new concepts into their existing cognitive structures. Immediate feedback allows the learner to monitor progress and self-direct learning efforts.

The second theme pertains to the directions provided to students regarding the online homework assignments. Students were allowed, even encouraged by the instructor, to complete the assignments twice and the vast majority of students took advantage of both attempt opportunities. Thus, students had several opportunities for exposure to learn through homework completion which may have facilitated the learning process. Grades on the homework assignments improved between the first and second attempts, suggesting students became more adept at recalling and applying the material. It is also possible that students simply became more adept at completing the assignment, but the improved test performance suggests increased self-efficacy and improved comprehension.

Beyond the provision of directions, the instructor placed no restrictions on students about how they completed the assignments and encouraged them to use their texts to reinforce their learning. To enhance the relevancy of the assignments to students, the instructor pointed out to the students in class that the purpose of the assignments is to help them learn the material and to prepare for the tests. There were 37 assignments worth a total of 8% of their course grade. If a student should have another student complete the work on her/his behalf, the benefit would be minimal, both in terms of test performance and impact on the course grade. So the main measurable potential benefit of completing the assignments accruing to the student appeared to be on test performance.

The third emergent theme pertained to the role that feedback appeared to play in student learning. Since the software scored responses and provided immediate feedback, students could refine their study strategies in real time. Immediate feedback upon completion of each online homework assignment also gave students the opportunity to see the correct answers, thus scaffolding student learning and anchoring the new content to existing cognitive structures. For students having particular difficulty in applying concepts to stated models, the feedback illustrated specific content that needed review before entering a testing situation.

Fourth, and last, the structuring of the learning assignments within the course by the instructor is important. Students complete the assignments outside of class. Thus, they are unsupervised. Our experience has been that students see these out-of-class assignments as open book and open notes and may even complete the assignments together. Thus, it is important to structure the assignments with these considerations in mind.

One unanswered question is whether any additional assignment beyond studying the text would improve student test performance. For example, some faculty have students complete chapter quizzes at the beginning of class throughout the semester in addition to periodic tests. The system investigated in this study included quizzing, albeit open book, in the third component of each assignment, as well as model replication and application in the first two sections. Thus, it appears that the system in this study may be more effective than in-class quizzes which usually provide only delayed feedback in facilitating student learning and retention of course material. Future research could compare the effectiveness of various teaching strategies in enhancing student test performance.

It is possible that the earlier class was not as academically prepared or capable as the later class and scored lower on the tests in fall 2010, thus suggesting a greater CLS effect. Alternatively, it

may be possible that, having seen questions pertaining to those topics on the CLS activity, students interpreted the activity as a signal that those topics would be sure to be covered on the exam; therefore students may have strategically reallocated their study time for the exam in response. However, the nonsignificant findings with respect to the control test items across the classes suggest a difference in academic potential or allocation of study time probably are not explanations for the difference in test performance across the classes. The test instrument appears to have acceptable reliability and is a valid assessment of student learning of the of the broad course content typically addressed in an undergraduate OB course. Additionally, comparison of student-reported investment of time across fall 2010 and fall 2011 semesters indicated students did not invest substantially more time on the course in fall 2011 than in the prior year. Thus, greater investment of time does not appear to be the explanation for the improved test scores in fall 2011.

Based on the cognitive theoretical perspective, the CLS provided an effective framework for learners to organize and anchor new concepts into long-term memory with consistent feedback to direct metacognitive practices. Study results indicate use of the CLS facilitated student comprehension and retention of theories and models. Use of the CLS in management and OB survey courses designed to present broad-based coverage of the field should produce similar results.

We identified three limitations to the present study. One limitation of this study was that it was conducted across classes in one university. Replication of the study at other universities would enhance the generalizability of the findings. Second, the learning system was compared to the effectiveness of student studying of material. Future researchers should determine whether other computer learning systems or other learning system strategies are as effective in enhancing student test performance. A third limitation is the study was conducted only in a face-to-face setting. The CLS may be more, equally, or less effective in a hybrid or an online-only teaching environment. Future researchers should assess the effectiveness of the CLS in these other class settings. In addition, the sample was a convenience sample; however, the class participants came from across the business disciplines since the course was required of all undergraduate business students. Generalization to non-business students is unknown. Future researchers should determine whether the findings apply to students outside the business disciplines.

As budgetary pressures on colleges and universities intensify, faculty will continue to search for more effective and efficient strategies to facilitate student learning without incurring substantial additional costs to the institution. The CLS appears to be one possible strategy for effectively enhancing student learning and test performance and may see increased use in the future.

Appendix

Sample Test Items Used in the Study

Note: Test items that assess student learning of concepts addressed by the Connect homework are denoted with a “C” after the stem. Control items are denoted “NC”.
1. Political behavior is triggered by ____. C

A. clear goals and objectives
B. vague performance measures*
C. well-defined decision processes
D. strong individual or group cooperation
E. organizational stability

2. Commitment, compliance, and resistance are ____. NC

A. ways to decrease political behavior in the workplace
B. ways of employee empowerment
C. possible outcomes of influence attempts*
D. methods of delegation
E. dimensions of power

3. According to the leader-member exchange model of leadership, in-group exchanges are characterized by mutual ____. NC

A. need for power
B. trust*
C. need for achievement
D. dislike
E. transactions

4. According to Vroom's expectancy theory, _____ represents an individual's belief that a particular degree of effort will be followed by a particular level of performance. C

A. goal difficulty
B. valence
C. instrumentality
D. self-esteem
E. expectancy*

Notes

Note: The Connect online learning system (CLS) was implemented in fall 2011. Test items used in this study to assess student knowledge of course content were the same in fall 2010 and fall 2011. All t tests were conducted comparing test item correct response rates in fall 2010 and fall 2011.

Note: N = 144, df = 1 for each significant $\chi 2$. CLS = Connect online learning system.

*p < .05. **p < .01. ***p < .001.

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