Online Pre-Test Discussion Groups to Augment Teaching

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The effects of asynchronous threaded preparatory test discussions with other students, and guided by an online instructor, are examined in this paper. Test scores for interactive "online" nursing students taught using the pre-test discussion activity over three semesters are compared with the test scores of non-interactive "offline" nursing students taught without the online pre-test activity in a nursing foundations course over the previous five semesters. Online students are found to perform statistically (p-value < 0.05) better than offline students when engaged in higher level cognitive pre-test discussions given later in the semester. The online pre-test discussion activity improves student performance unevenly: test scores of online students for some instructors did not statistically (p-value > 0.05) improve when compared to test scores of offline students for these same instructors. Furthermore, a statistical cluster analysis indicates students' scores may have improved because of special attention students received as a result of being involved in the new online pre-test learning activity.

Keywords: asynchronous online learning, critical learning, group learning, threaded discussion, preparatory test discussions

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1. Introduction

Universities are encouraging faculty to develop online courses and to incorporate technology in their teaching. These technologies are changing the teaching and learning environment, making it more efficient and convenient. Computers allow the students to learn in a non-threatening environment. Online dialogue fosters collaborative learning and enables students to think critically, recognize the importance of peer communication, and appreciate different perspectives.[6,9,12]

Collaborative learning is any kind of group learning where there are some meaningful learning interactions between learners.[7] Many online instructional methods encourage students to work together on academic tasks. An important first step in collaborative online learning is developing a sense of group or community. Each member assumes the responsibility for their own learning as well as the learning of other group members.[1,5,14]

Online collaborative learning promotes critical thinking. Lally & Barrett[8] reported that students found an online seminar offered more opportunity for "thinking space" than is available in a face to face context. More than half the students reported that they usually read through email messages more than once which allowed time for reflection before responding to the group. As students improved on the depth of their responses, they led the group to higher level thinking skills.

Foundations level nursing students, in particular, must develop higher order thinking skills in order to be successful when taking nursing examinations. Simply memorizing facts does not prepare students for unpredictable clinical situations. Nursing requires learning of facts and procedures, along with the ability to evaluate unique patient situations. Reflecting, clarifying, analyzing, and reasoning are crucial for nursing competence. Students demonstrate

this knowledge through their performance on tests.[11,12]

Teaching these thinking skills at the beginning level can be very challenging. Novice nurses rely on clear rules for making clinical decisions because they have no experience on which to base an analysis of the clinical situation.[3] But rules cannot tell them the most relevant tasks to perform in an actual patient care situation. Consequently, an emphasis on clinical practice and clinical judgment is frequently found in nursing literature. Martin states: "As persons develop clinical nursing expertise from novice to expert nurse through the use of knowledge and experience, they also develop critical thinking and use it consistently to make objective and appropriate clinical decisions." [10,p244] The development of clinical judgment is critical in the learning environment and relies on the quality and quantity of the interactive discussions students have with faculty and other nurses.[4]

Critical thinking is supported by carefully designed instructional activities. Goals and objectives must be developed to effectively design an interactive learning experience.[2,17] Salmon[1] developed a model of teaching and learning online. She identified the essential role of the e-moderator (a teacher who works with learners online) as promoting human interaction and communication through the modeling, conveying, and building of knowledge and skills. Participants learn about the use of computer networking along with learning about the topic with and through other people. The five stages of Salmon's model include: access and motivation, which involves setting up the system and accessing; online socialization, whereby participants begin sending and receiving messages; information exchange, where participants concentrate on exploring answers to problems or issues; knowledge construction, in which participants engage in active learning and appreciate differing perspectives; and the final stage of development whereby metacognition promotes integration and application of the learning experiences.

Salmon's research provided the inspiration for the development of the online collaborative pre-test discussion activity for a nursing foundations course described in this paper. Based on student comments, the instructors identified that students in the nursing foundations course found the four tests and one final exam overly challenging. Students were frequently frustrated because they had studied and felt they "knew" the content, yet did poorly on these tests. It appeared to the instructors that students had difficulty applying their knowledge to a specific patient care situation. The voluntary internet-based test preparation activity was introduced to assist students with learning test-taking strategies, learning how to apply their knowledge in specific patient care situations, and, therefore, to improve their performance on nursing tests.

After explaining the student assessment used in the nursing foundations course and the online pre-test discussion activity, the data collection and statistical analysis are described and then comments and conclusions are given in this paper.

2. Assessment of Students

The nursing foundations course is given in the first sixteen-week semester of an associate degree nursing program. This course has both a didactic and clinical practice component. Although some course material is available from a local intranet drive, there was no *interactive* online component to this course previous to the introduction of the online pre-test activity discussed in this paper. The students are given two hours of classroom instruction each week. They participate in one six-hour supervised clinical laboratory experience each week. There are two full time instructors who also teach in the clinical setting and one or two part-time clinical instructors. One of the full time instructors is the course coordinator. Fifty students enroll at the

beginning of each semester. These fifty students self-assign into five clinical groups of ten students each.

Student learning is assessed using quizzes, tests, a final exam and two large reports (a care plan report and a senior center report). Regarding this study, however, focus is centered on the four one-hour tests and one two-hour final. The tests and final exam are used to evaluate a student's understanding of both class and lab material. One hour tests are given during week 6, 7, 10, and 11 and are based on didactic and clinical material previously learned. The two hour final examination, given at the end of the semester, is 50% comprehensive and 50% based on the last third of the semester's material.

Eighty-five to ninety percent of the questions for the tests and final exam are multiple choice questions. The other ten to fifteen percent of questions, all mathematical questions, are short response questions. All multiple choice questions are marked by a scantron machine and so are all marked in the same way; that is, the multiple choice questions are reliable. All instructors use the same rubrics to score the short response mathematical questions, to make these questions as reliable as possible as well. The tests and final exam are also checked to see if each question tests what it is intended to test; that is, the tests and final exam are reviewed for validity. In particular, after each test and before the results are disseminated to students, the course coordinator and assisting instructor review the test questions for fairness and accuracy. A review with students is also held after each test. Provided they have a valid rationale, students are given the opportunity to question any test item. Listening to student-to-student comments is also invaluable in discovering their frustration over questions they missed and why they missed them during this review. Sometimes it is another student that identifies the learning obstacle that prevents their fellow student from answering the question correctly. Students are able to reflect

on the thinking skills that led them to a particular conclusion and discuss their reasoning with each other.

3. Interactive Online Pre-Test Discussion Activity

Students are given the option of participating in a voluntary internet-based test preparation activity five times during the semester for three semesters: once each for the four tests and once for the final exam. Written instructions are provided describing how students can access the online activity and who to notify if problems occurred. Students enter into asynchronous threaded preparatory pre-test discussions using the online Web Course Tutor Vista application (Blackboard Incorporated, Washington, DC) with other students.

Online discussions are guided by one instructor called the online instructor. Access to each online discussion is restricted to other students in the same clinical lab group. Five separate online discussion groups corresponding to the five student groups a, b, c, d and e, are active in the week prior to each of the four tests and one final. All twenty-five threaded discussions given in the semester are guided by the online instructor. The online instructor is also an instructor to one or more of the student clinical groups.

The online instructor creates and posts four to six discussion points online each week before all tests and the final. The discussion points are based on topics lists agreed to by all instructors. The same four to six discussion points are posted for each of the five student clinical lab groups. Students are allowed access to view these online discussion points at any time in the week before the test or final. Students are encouraged by the instructor not only to view, but also to respond to these discussion points. Their response is seen by the instructor and also by other students in that clinical group. Other students can then respond to the instructor's original

discussion points or to other student comments.

The design of the online pre-test activity is intended to move a novice nurse up through the chronological stages in group activity of Salmon's model that eventually leads to shared metacognitive activity by participants, including knowledge, comprehension, application, and analysis.[12,13]

To begin with, information is posted online to facilitate the transition from the traditional "offline" test preparation forum of reviewing notes, readings and perhaps even a study group, to the "interactive online" web-based learning environment. This initial information is intended to create a positive experience within the new online learning environment, to foster trust between the student, their online peers and the instructor.

The online pre-test activity itself ranges from students reading and responding to direct factual questions early in the semester, as preparation for the first test, to reading and responding to posted discussion topics late in the semester, as preparation for the last test and final exam. All pre-test questions are available An example of one of the initial factual questions is given in the box below.

A certified nursing assistant (CNA) working on your team has just given you a report on an elderly patient that s/he ambulated to the bathroom and back to bed. The patient's respirations increased to 34 and heart rate increased to 116 during this ambulation. What is your diagnosis? a. pneumonia b. poor training of CNA c. activity intolerance d. risk for aspiration

For later tests, students assume greater responsibility for their learning. Rather than direct specific questions with specific answers, questions are framed as discussion points for the

student nurses. Students are encouraged to develop and post their own questions related to the topics assigned for the test. Students became instructors in the sense they begin to anticipate possible test questions. An example of one of these later questions is given in the box below.

Let's try something different. A list of vocabulary words and concepts related to dispensing medications is listed below. Based on your experience with past exams, predict how they might be used in a question. Not only see what you can come up with, but also check out the responses you get back from your peers.

Aspirate with plunger
Speed of absorption
Ear pinna
Acromion process
Lateral femoral condyle
Enteric coated
Needle lengths for various injection sites
Watery vs viscous-gauge?
Drip chamber calibration
Infiltration
Macro vs micro drip
Onset of action
Peak plasma level
Drug half-life
Mixing medications (vial & ampule)

4. Data Collection

The students who did not have access to the online pre-test activity are referred to as "offline" students in this paper. Students who did have access to this online activity are referred to as "online" students. Online students are identical to offline students in all regards except online students have access to the online pre-test activity.

Each semester, fifty students are accepted into the nursing foundations course. The scores of all 236 (of the 250 possible students) offline students who completed this course in the five semesters between fall 2002 and fall 2004 are used in the study. Eighteen of the 150 interactive online students in the three semesters between spring 2005 and spring 2006 either did

not complete or did not allow their scores to be used in the study. A student's interactive online activities during the threaded asynchronous pre-test discussions during the semester are measured in four ways: total time spent online, number of sessions online, number of discussion emails posted and number of discussion emails read. Various scores are collected for each student in this study including: the overall score; the overall mathematics score; the mathematics, non-mathematics and combined mathematics and non-mathematics parts of both the four test scores and the one final score; the five or six quiz scores; and two reports: the care plan and senior center reports. The students are categorized in four different ways: according to instructor (1, 2 and 3), lab group (a, b, c, d and e), lab day (Tuesday and Thursday) and semester (fall and spring). The data collection procedure was reviewed and accepted by the University's Committee on the Use of Human Research Subjects.

5. Statistical Results

Various statistical analyses, including two sample t test procedures, chi-square distribution analysis and cluster analyses, are used to compare the test scores of the offline and online students. All model assumptions are checked using residual plots, a variety of other plots and different tests. If required, the data is transformed to achieve the necessary model assumptions, before proceeding with any particular analysis. The statistical software package, SPSS (SPSS Incorporated, Chicago, Illinois), is used in all of these statistical analyses.

A two-sample t-test revealed that, for many assessment items, the average scores of the 132 online students are significantly greater (with p-values less than 0.05) than the average scores for the 236 offline students (Table 1). In particular, the online overall student averages of

the final exam and tests scores were all significantly greater, by 2%, than the associated offline student scores.

Table 1 about here.

Further detailed analysis revealed that although there is a non-significant difference in average scores between online and offline students for the early semester test 1, the average scores for later semester tests 2, 3 and 4 are all significantly greater, typically around 2%, for the online students than for the offline students.

The difference in average scores is found to be different between online and offline students for different instructors and lab groups (Table 2). The average online score for instructor 2 is significantly (p-value < 0.05) improved, typically by 5%, over the average offline score for many of the assessment items. However, there is typically no significant difference in the average online and average offline scores for instructors 1 and 3. Furthermore, the average online scores for lab groups a, c and d, particularly lab group a, are significantly (p-value < 0.05) improved, typically by 5%, over the average offline scores for many of the assessment items.

Table 2 about here.

The chi-square statistical analysis of the *grade distributions* of online students with offline students confirms much of the two-sample t test analysis of the difference in average scores of online students with offline students (Table 3). There are significantly (p-value < 0.05) more As and Bs for online students, compared to offline students, particularly for the students of instructor 2 and lab group a.

Table 3 about here.

A cluster analysis showed that although online students' scores are better than offline students' scores, it does *not* appear as though the online pre-test activity is *directly* related in this

improvement. In one cluster analysis, the dendrogram indicates that *none* of the mean overall online measurement variables (time spent online, number of sessions, number of emails posted and number of emails read) are closely correlated with any of the mean overall course measurement variables (Fig. 1). All four mean overall online measurement variables are most closely correlated to one another: the rescaled distance cluster combine (RDCC, a measure based on the furthest neighbor Pearson correlation between variables) had a value of 7 (out of a possible maximum of 25).

Figure 1 about here.

6. Discussion and Conclusions

The non-significant difference in average scores between online and offline students for the early semester test 1, but significantly different average scores for later semester tests 2, 3 and 4 seems to indicate that the online students were performing better when allowed access to the higher level cognitive pre-test questions given later in the semester. This suggests the benefits to student learning of moving up the thinking hierarchy from knowledge to analysis and reflection.

The difference in average scores is found to be different between online and offline students for different instructors and lab groups. It appears that the online pre-test discussion activity is not improving instructor/student performance uniformly. This activity seems to benefit some instructors/students more than others. Further reflection reveals that instructor 2 is thought to be more demanding on her students than other instructors. It is possible that instructor 2's better prepared students benefits more than the other students from the online pre-test activity because of the cross-pollination during the WebCT pre-test online discussion between this

instructor's students and the other students. The online pre-test activity seems to allow instructor 2's better prepared students to fulfill their full potential.

It is surprising that the cluster analysis indicates that although online students' scores are better than offline students' scores, it does *not* appear as though the online pre-test activity is *directly* related to this improvement. It is possible that students' scores improve not because of the online pre-test activity itself but because the students feel they are being singled out for special attention as a consequence of being involved in the new online pre-test learning activity. Therefore, this may be an example of the much disputed Hawthorne effect.[15]

7. Future Work

Problem with voluntary nature of data: This could cause some problems in the results, I think. Some people are more comfortable with online discussion than others, so will be more likely to use and benefit from it. It'd be good to somehow control for this variation in students' affinity for online interactions.

Who made the list of these discussion points? Was it made by the online instructor, or was it by consensus of all the instructors? Was the list made to cover all the topics on each test, or just some of them? My concern here is any potential for confounding factors in the design of the discussion points – if the online instructor made a list of discussion points that didn't match with the test very well, or which over/under-emphasized some topics.

I'd be curious to see what the students came up with. In my experience, students often come up with questions that have too much given information, too little given information, or information that is self-contradictory. It would be pretty cool in the future for you to look at how well-formulated students' questions were, to see if there's any improvement over the semester, if it correlates with exam performance, etc.

This would be more convincing if you tested for longitudinal correlations – for example, was there a jump in time spent online from test 1 to test 2, to match the relative jump in test performance? You compared the overall means in the previous section, but you could also compare them from test-to-test – run some sort of MANOVA, perhaps?

Also, it's not clear how many students actually engaged in higher-level thinking, or how often. It'd be really cool to analyze students postings and analyze them to see who was demonstrating higher-level cognition, and when, and compare this with their test performance over time. Something to think about in the future, maybe.

How are the students placed? Are they randomly assigned, or self-assigned by the students themselves? If the groups are self-assigned, then you're more likely to have a confounding factor affecting the outcomes of the online discussions (e.g., groups of friends may interact more).

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Table 1.—Average scores, differences in average online scores and average offline scores, standard errors in average scores and p-values for two-sample t-test of the differences in average scores of 236 offline students for five semesters between fall 2002 and fall 2004 and the average scores of 132 online students for three semesters between spring 2005 and spring 2006, for various assessment items.[1]

Assessment items	Online or offline	Average	Difference between online average and offline average	Standard error of average	P-value of difference
overall	online	0.85		0.00	
	offline	0.83	+0.02	0.01	**0.00**
math	online	0.80		0.01	
	offline	0.79	+0.01	0.01	0.53
final (math)	online	0.83		0.01	
	offline	0.78	+0.05	0.01	**0.00**
final (no math)	online	0.84		0.01	
	offline	0.82	+0.02	0.01	**0.01**
final	online	0.84		0.01	
	offline	0.81	+0.03	0.01	**0.00**
tests (math)	online	0.77		0.01	
	offline	0.79	-0.02	0.01	0.10
tests (no math)	online	0.86		0.00	
	offline	0.84	+0.02	0.01	**0.00**
tests	online	0.85		0.00	
	offline	0.83	+0.02	0.01	**0.00**
quizzes	online	0.82		0.01	
	offline	0.80	+0.02	0.01	0.14
care plan	online	0.94		0.00	
	offline	0.94	0.00	0.01	0.53
senior center	online	0.94		0.01	
	offline	0.92	+0.02	0.01	0.34

[1] Significant (p-values < 0.05) results are indicated by bold numbers.

Table 2.—Differences in average online scores and average offline scores, standard errors in differences and p-values for two-sample t-test of differences for 236 offline students over five semesters between fall 2002 and fall 2004 with 132 online students over three semesters between spring 2005 and spring 2006 for various assessment items and for various categories of students.

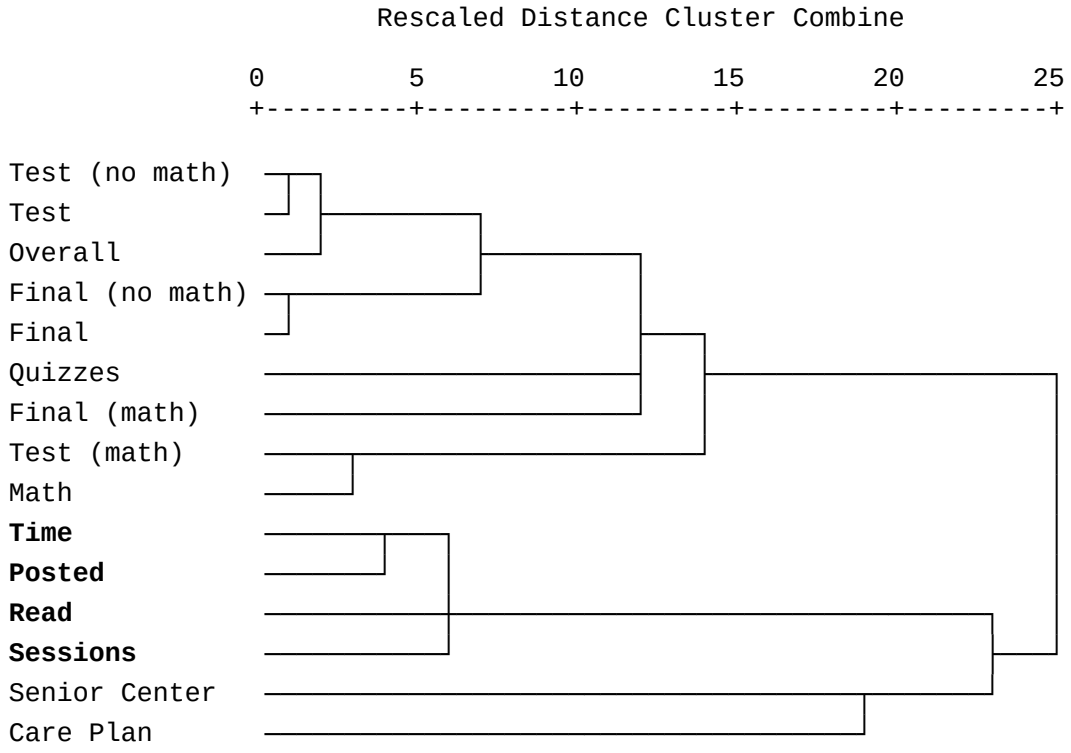
Categories[2] >>	Instructor			Lab Group					Lab Day		Semester	
Assessment items	1	2	3	a	b	c	d	e	Tuesday	Thursday	Fall	Spring
overall	0.01[3] (0.01) 0.46	**0.05**[4] **(0.01)** **0.00**	0.00 (0.02) 0.91	**0.06** **(0.01)** **0.00**	0.01 (0.02) 0.72	**0.04** **(0.02)** **0.02**	**0.02** **(0.01)** **0.05**	0.00 (0.02) 0.97	**0.03** **(0.01)** **0.01**	**0.01** **(0.01)** **0.05**	**0.02** **(0.01)** **0.03**	**0.03** **(0.01)** **0.01**
math	0.00 (0.02) 0.90	**-0.05** **(0.02)** **0.02**	-0.03 (0.03) 0.44	**0.05** **(0.03)** **0.10**	-0.01 (0.03) 0.69	0.05 (0.03) 0.13	0.03 (0.03) 0.37	-0.06 (0.02) 0.14	0.01 (0.02) 0.59	0.01 (0.02) 0.70	0.02 (0.02) 0.45	0.00 (0.02) 1.00
final (math)	0.00 (0.03) 0.90	**0.11** **(0.03)** **0.00**	0.04 (0.04) 0.33	**0.12** **(0.03)** **0.00**	-0.01 (0.05) 0.81	**0.10** **(0.05)** **0.02**	**0.07** **(0.03)** **0.04**	0.00 (0.05) 0.93	0.04 (0.03) 0.13	**0.06** **(0.02)** **0.01**	0.06 (0.03) 0.07	**0.05** **(0.02)** **0.04**
final (no math)	0.02 (0.01) 0.12	**0.04** **(0.02)** **0.02**	0.00 (0.01) 0.70	**0.06** **(0.02)** **0.00**	0.02 (0.02) 0.42	0.03 (0.03) 0.30	0.02 (0.02) 0.21	0.01 (0.02) 0.72	**0.04** **(0.01)** **0.00**	0.01 (0.01) 0.33	0.01 (0.01) 0.35	**0.03** **(0.01)** **0.00**
final	0.02 (0.01) 0.22	**0.05** **(0.02)** **0.00**	0.00 (0.02) 0.98	**0.07** **(0.02)** **0.00**	0.01 (0.02) 0.56	0.04 (0.03) 0.16	0.03 (0.02) 0.10	0.01 (0.02) 0.75	**0.04** **(0.01)** **0.01**	0.02 (0.01) 0.12	0.02 (0.01) 0.20	**0.04** **(0.01)** **0.00**
tests (math)	0.00 (0.03) 0.93	0.00 (0.03) 0.88	**-0.08** **(0.03)** **0.03**	-0.01 (0.04) 0.74	-0.02 (0.03) 0.62	0.00 (0.04) 0.90	0.00 (0.04) 0.83	**-0.10** **(0.04)** **0.02**	-0.01 (0.02) 0.59	-0.04 (0.02) 0.10	-0.01 (0.03) 0.70	-0.04 (0.02) 0.06
tests (no math)	0.00 (0.01) 0.57	**0.05** **(0.01)** **0.00**	0.00 (0.01) 0.79	**0.07** **(0.01)** **0.00**	0.01 (0.02) 0.72	**0.04** **(0.01)** **0.00**	**0.03** **(0.01)** **0.04**	0.01 (0.02) 0.53	**0.03** **(0.01)** **0.00**	**0.02** **(0.01)** **0.00**	**0.03** **(0.01)** **0.01**	**0.03** **(0.01)** **0.00**
tests	0.00 (0.01) 0.69	**0.05** **(0.01)** **0.00**	0.00 (0.01) 0.73	**0.06** **(0.02)** **0.00**	0.00 (0.02) 0.86	**0.04** **(0.01)** **0.01**	0.02 (0.01) 0.09	0.00 (0.02) 0.44	**0.03** **(0.01)** **0.01**	**0.02** **(0.01)** **0.04**	**0.02** **(0.01)** **0.05**	0.02 (0.01) 0.10
quizzes	0.01 (0.02) 0.72	**0.05** **(0.02)** **0.01**	0.00 (0.02) 0.91	**0.07** **(0.02)** **0.00**	0.00 (0.03) 0.90	0.02 (0.03) 0.38	0.01 (0.02) 0.55	-0.02 (0.02) 0.41	0.03 (0.02) 0.12	0.00 (0.01) 0.63	**0.03** **(0.02)** **0.04**	0.01 (0.01) 0.36
care plan	0.01 (0.01) 0.22	0.00 (0.02) 0.85	0.00 (0.02) 0.73	0.01 (0.01) 0.44	-0.01 (0.02) 0.68	-0.02 (0.05) 0.53	0.00 (0.01) 0.55	-0.01 (0.02) 0.49	0.00 (0.01) 0.98	0.01 (0.01) 0.45	**0.02** **(0.01)** **0.05**	-0.01 (0.01) 0.31
senior center	-0.04 (0.02) 0.10	0.03 (0.02) 0.06	0.03 (0.02) 0.16	0.02 (0.03) 0.43	-0.02 (0.03) 0.55	**0.05** **(0.02)** **0.01**	**0.05** **(0.02)** **0.04**	-0.01 (0.02) 0.63	0.01 (0.02) 0.83	**0.03** **(0.01)** **0.05**	0.02 (0.03) 0.43	0.01 (0.01) 0.57

[2] The students were categorized in four different ways: according to instructor (1, 2 and 3), lab group (a, b, c, d and e), lab day (Tuesday and Thursday) and semester (fall and spring).
[3] Three numbers appear in each cell of the table: differences in average online scores and average offline scores, standard errors in differences and p-values for two-sample t-test of differences, in that order.
[4] Significant (p-values < 0.05) results are indicated by bold numbers.

Table 3.—P-values of chi-square statistics that compare the grade distribution of 236 scores of offline students for five semesters between fall 2002 and fall 2004 with the grade distribution of 132 scores of online students between spring 2005 and spring 2006 for various assessment items and various categories of students.

Assessment items	Overall	Instructor			Lab Group					Lab Day		Semester	
		1	2	3	a	b	c	d	e	Tuesday	Thursday	Fall	Spring
overall	**0.00**	0.31	**0.00**	0.16	**0.00**	0.10	0.31	0.20	0.35	**0.00**	0.33	**0.04**	**0.01**
math	0.94	0.35	0.52	0.80	0.65	0.10	0.67	0.77	0.96	0.29	0.82	0.43	0.98
final (math)	0.06	0.60	**0.00**	0.67	**0.01**	0.98	0.06	**0.02**	0.87	0.38	0.06	0.09	0.31
final (no math)	**0.03**	0.06	**0.05**	0.69	**0.00**	0.23	0.78	0.33	0.89	**0.00**	0.83	0.62	**0.00**
final	0.06	0.17	**0.01**	0.52	**0.00**	0.17	0.30	0.21	0.84	**0.00**	0.71	0.39	**0.00**
tests (math)	**0.00**	0.51	0.44	**0.05**	0.92	0.64	0.09	0.45	0.43	0.82	0.26	0.59	0.17
tests (no math)	**0.00**	0.33	**0.00**	**0.02**	**0.00**	**0.03**	0.26	0.31	0.12	**0.00**	0.06	0.10	**0.00**
tests	**0.00**	0.77	**0.00**	0.42	**0.00**	0.44	0.15	0.10	0.66	**0.01**	0.26	**0.03**	**0.01**
quizzes	0.55	0.50	0.09	0.61	0.22	0.16	0.36	0.56	0.72	0.14	0.35	0.46	0.29
care plan	0.73	0.33	0.14	0.57	0.53	**0.02**	0.13	0.35	0.07	0.07	0.67	0.72	0.08
senior center	0.24	0.15	**0.05**	0.70	**0.04**	0.36	0.34	0.10	0.17	0.22	0.24	0.09	0.61

Figure[5] 1.— Dendrogram cluster analysis, using the furthest neighbor Pearson correlation measure method, which compares the relative closeness of the averages of various student assessment items with the averages of various student online activity measurements[6], as calculated over an entire semester.



[5] This diagram was created using SPSS.
[6] Student online activities measured during the threaded asynchronous pre-test discussions during the semester included: total time spent online (time), number of emails posted (posted), number of emails read (read) and number of sessions online (sessions).