

Student Perceptions of an Online Materials Engineering Course

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There is much debate regarding the effectiveness of online instruction^{4,11,12,15}. Researchers such as Russell¹⁵, and Hansen et al⁴, concur with Lewis' conclusion that "distance education is just as effective as traditional education in regards to learner outcomes"⁹. They also agree with Lewis' findings that students in online courses tend to have more favorable attitudes toward distance education than traditional learners have, and that online students feel as if they "learn as well as if they were in a regular classroom"⁹.

Phipps and Merisotis¹¹ voice concerns about the findings of such studies and state that among other shortcomings, the research on such findings does not take into consideration the differences of the students and their learning styles and how the learning styles relate to the use of particular technologies. Phipps and Merisotis also note that the research on distance education "does not adequately explain why the dropout rates of distance learners are higher"¹¹.

Nonetheless, distance education is here to stay. As asserted by Kenneth Green, project director of the Campus Computing Project, "the genie will not go back into the bottle: demand for technology will continue, not diminish; the opportunities for distance and online education will grow, not recede"³.

From a higher-education perspective, online learning communities enable learners to have significant control over the time, location, and method of study, and allow instructors to work with students in many different locations. Examples of this are the responses to a questionnaire that was delivered to 23 University of Pennsylvania students following an online course in telecommunications¹. Frequently offered statements were that the students appreciated the convenience of the asynchronous course; the online discussions were helpful and more people participated online than would in the traditional classes; and students found the sharing of ideas and assignments useful. But most students who participated in the study missed the development of personal relationships with other students and the professor and they were concerned about the material they received in relation to the material that students received in the regular course¹. From the results of the University of Pennsylvania survey and others that are similar, it is obvious that both boon and bane can be the results of online learning participation.

As faculty members and administrators acknowledged the permanence of the online course, questions regarding student perceptions of the medium in various disciplines surfaced. The concern for feedback from students about learning and collaborating online prompted several studies^{16,17,18,19}, including the student perceptions survey conducted in December of 2001.

A Survey of Student Perceptions of an Online MSE Course

Principles and Applications of Engineering Materials is a 3-credit, semester long, lecture based course offered to Georgia Tech engineering students by the School of Materials Science and Engineering (MSE). Approximately 700 undergraduate engineering students annually take the

course in sections containing approximately 55 students. There is a relatively even mixture of sophomore, junior, and senior engineering students that enroll in the class. The pre-requisites consist of one year of physics with calculus and a semester of chemistry. The course is required for aerospace, biomedical, chemical, materials, mechanical, and textile and fiber engineering majors, and is frequently taken as an engineering elective by civil and environmental, electrical and computer, and industrial systems engineering students. It may be taken in the sophomore, junior, or senior year. In this course, materials selection is treated as a part of engineering design, and the relationships between structure, property, processing and performance are described.

The motivation for teaching Principles and Applications of Engineering Materials in an online format arose from three considerations. First, the Georgia Tech Co-op program accommodates approximately 2,700 engineering students on co-op assignments across the United States. Many of these students desire to take required courses while away on their co-op assignments. Second, the Georgia Tech Regional Engineering Program (GTREP) that was established in 1999, provides a distance learning need for Principles and Applications of Engineering Materials. GTREP affords students in Southeast Georgia the opportunity to earn a Georgia Tech degree without leaving their communities - using, in this case, distance learning connections to bring Georgia Tech directly to the students. Third, offering the course in a distance-based format provides local full-time and non-traditional students with an opportunity to enroll and participate in courses with added time flexibility.

The MSE online course is maintained within an online course management tool called WebCT. WebCT, short for Web Course Tool, is a software application that resides on a server and is accessed on the computer through use of a web browser such as Internet Explorer or Netscape Navigator. The course management tool allowed the instructor of the online MSE course to design a course that enabled her to administer timed exams; manage grades; inform students of important dates using the course calendar; and provide student feedback via the online grade book, and real-time quizzes. A detailed introduction to the course, course materials, exam archives, and links to weekly-videotaped instructor-led lecture modules and in-class discussions were also provided for the students within the WebCT course. Students communicated with the instructor and their classmates via the course-contained email, and course bulletin board.

Method

During the last discussion session for the semester, all students were asked to complete a 50-question survey. The response rate was 84%. The Student Perceptions survey evaluated the students' perception of the instructor and the course with respect to content and delivery. The survey also evaluated the students' comparative perceptions of their experiences within the online course versus a traditional course. Student suggestions for improvement of the course were also collected. The survey included 12 questions that were taken from the course evaluation survey given at the conclusion of the traditional MSE course during prior semesters. Independent samples t-tests were performed on the 12 questions to test for differences between the online course and the traditional course taught by the same instructor in a previous semester. Background information was also gathered to evaluate for any preexisting differences between the students within the online course. The background information included previous experience

in online courses, major, age, miles traveled to class, hours spent employed while taking the online class, and first language identification.

Results and Analysis

The first step in the analysis was a t-test of the differences in the means of student evaluation responses for MSE courses taught by the same instructor using the traditional classroom and the online method. These results are presented in Table 1. The significance level in each statistical test was set to a value of $p < 0.05$.

In the second step, the survey questions were organized into five groups for further analysis and synthesis. The first group addressed students' general perceptions of online courses. The second group regarded student perceptions of the instructor. The third group regarded student perceptions specific to the MSE online course. The fourth group dealt with student perceptions of student-to-student and student-to-teacher interactions. The fifth group focused on student background information.

Group – 1 General Student Perceptions of Online Courses

Students held a general perception that Internet courses are more efficient and allow for more efficient use of time than traditional courses. Reported most by the students as the greatest benefits when taking an online course were convenience and flexibility, self-paced learning, and the opportunity to earn credit while participating in a co-op assignment. The students found the greatest drawback of online courses was the ease with which one can fall behind, with a distant second being slow internet connections that affected ease of course material access, followed by the lack of student teacher interaction. The students did not consider the online course to be easier than the traditional course, nor did they find instructors to be more available than in a traditional course, but 80% of the students reported that they would take another Internet-delivered course if offered.

Group – 2 Student Perceptions of the Instructor

According to students, the instructor of the online course presented and explained the course objectives at the beginning of the course to their satisfaction, demonstrated a thorough knowledge of the course concepts, and provided help to students when needed. These findings are significantly different than those reported by the students of the traditional MSE course of previous semesters. The students also expressed that the instructor explained complex material clearly, seemed to be sensitive to the feelings and needs of all students, and was an effective teacher overall. No significant difference was found between the traditional and online classes concerning those questions.

Group – 3 Student Perceptions of the MSE Online Course

In general, the online course seemed well planned and organized to the students. This finding was significantly different than that given by the students of the traditional course. The students in the online course accessed the course website regularly and considered it easy to navigate. The students gathered the most use from the online quizzes, homework problems, exams, and course calendar. While only 67% of the students reported that they reviewed more than 60% of the videotaped lecture modules, most students reported that they did feel as if they gained a sufficient background in the course topic and that they did not consider the material difficult to

understand. The most offered suggestions to improve the course were to make sure the quiz feature works properly and that questions are tested before giving an exam; find ways to make students more accountable and help them to avoid procrastination; and offer question and answer sessions during the semester.

Group – 4 Student Perceptions of Interpersonal Communications

Students did not communicate with other students or the instructor more during the online course than in other courses, nor did they feel the need to have face-to-face communication after taking the online course. The students reported that they did not participate more in the online course than in other courses and the interactions that did take place were not of better quality than discussions had in traditional courses. They also reported no difference in their comfort level with asking questions in the online course than in the traditional course.

Group – 5 Student Background Information

There was no significant difference in backgrounds for students in the traditional and online courses. Participants in the survey were 21-year-old students in engineering disciplines including biomedical, industrial and systems, civil and environmental, aerospace, and mechanical with 3.07 mean grade point average. For 80% of the students, the MSE online course was their first in such a format. The most frequent reasons for enrolling in the online section for the MSE course were convenience and flexibility; not having to attend class; the ability to earn credit while in co-op; and that it was the only section available at the time of registration. While 56% of students worked at least part-time while enrolled in the course, most lived on or near campus, with co-op students living the furthest from campus. Two of the 44 participants did not list English as their first language. Both of those students preferred the online course environment over the traditional course.

Addressing the Seven Principles for Good Practice in Undergraduate Education with the Online MSE Course

According to Chickering and Gamson², good practice in undergraduate education are practices that (1) encourage student-faculty contact, (2) encourage cooperation among students, (3) encourage active learning, (4) provide prompt feedback, (5) emphasize time on task, (6) communicate high expectations, (7) respect diverse talent and ways of learning.

Encourage Student-Faculty Contact

Contact with the instructor is positively correlated with student motivation and student success¹⁴. The instructor of the online MSE course held regular office hours, offered email as a means of communicating during non-office hours, and held a weekly discussion session during which students were encouraged to ask questions about the course content and homework problems.

Encourage Cooperation Between Students

Though the instructor implemented no formal cooperative learning experiences, students were strongly encouraged to interact with each other, and were highly motivated to do so as a result of the quiz question database. Students were required to take online quizzes throughout the course and were permitted to take each quiz five times. Consequently, they were exposed to many, but not all of the questions in the database. The students therefore sought the assistance of others in

order to obtain additional questions to use for studying, as the quiz comprised 50% of the formal exams.

Encourage Active Learning

Examples of active learning allowed by the Internet include the student's ability to (1) cover material at a comfortable pace, (2) skip material that is already understood, or (3) explore topics that are uniquely interesting¹⁴. During the online MSE course, each student had access to content modules, which were digitally videotaped instructor-led lectures. The modules could be viewed at any time and electronic controls enabled the students to review or bypass any portion of the module.

Provide Prompt Feedback

Providing timely feedback is essential for keeping students abreast of their progress. Besides office visits and email exchange, the students also received feedback on their responses to the quiz questions. Each quiz problem was in fact a small portion of the textbook posed in the form of a question, with an accompanying comment explaining the learning objective of the question, and the key point to remember. This information immediately followed the quiz, providing prompt feedback for the students. Also, soon after each quiz or exam was taken, each student could securely access his or her assessment grade online, providing additional prompt feedback for the students.

Emphasize Time on Task

As revealed by the students, effective use of time is a major concern for them. The placement of the course on the Internet allowed the students to address the course content at any time, from any place. The online course enabled the students to have access to the course outline, the course calendar, and weekly updated course announcements so that they may stay abreast of course deliverables.

Communicate High Expectations

Taking the quizzes and receiving the feedback from the assessments made students aware of what they were expected to know. The course objectives and grading structures were also included in the syllabus that was accessible at all times throughout the course. From the beginning, it was related to the students that the course would be quite demanding. This fact was communicated not only through the course syllabus and outline, but also through weekly updated announcements explaining the topics to be covered and associated objectives.

Respect Diverse Talents and Ways of Learning

By delivering the course via the Internet, students who favored visual or auditory instruction were able to augment their learning. Illustrative pictures and diagrams used in the textbook, homework assignments, quizzes, and exams, aided the visual learners in understanding the course concepts. The self-paced instructional modules incorporated a multimedia PowerPoint presentation and video, which benefited the auditory and visual learners. The modules also offered an alternative to the traditional lecturer, which perhaps favored students who did not fare well in a traditional setting.

Discussion and Implications

The findings of the study demonstrate that students can perceive an online course to be just as effective as a traditional course. By all accounts, the backgrounds of students in both circumstances were equivalent. It is important to note that there was no significant difference in the perception of instructor sensitivity to the feelings and needs of students between the online and traditional course. One student even noted that he or she felt like there was less potential for bias in the online course. This suggests that levels of interpersonal comfort and compassion are obtainable even in an intangible environment.

Though there is great potential for heightened interaction within the online course format, the participants of this survey did not experience increased student-to-student or student-to-instructor communications. Recommendations for improving interpersonal communication amongst the course participants might involve the inclusion of formal collaborative exercises for the students that require peer communications and group work and result in a course deliverable such as an assignment, project, presentation, or paper^{5,6,7,8}.

With regard to student retention, perhaps a response to the Phipps and Merisotis¹¹ question of “why the dropout rates for distance learners are higher” can be found in a suggestion for improvement of the course made popular by the students that participated in the survey. Many of the students recognized the need for guidance and self-motivation when dealing with the course material. When those two components are not provided, it is quite possible that a student could fall dangerously behind or become severely disinterested. Either scenario could compel a student to withdraw from a course.

In all, students favored the flexibility and convenience of the online MSE course. They appreciated being well informed by the instructor of the expectations, objectives and concepts of the course, and the overall organized nature of the course. Nonetheless, students identified ways to improve the online course experience. Suggestions included testing exam questions and ensuring that all course features worked properly; giving the course a less-opened structure to help students avoid procrastination; and providing ways to encourage student-to-instructor communications.

The majority of the students enrolled in the course confirmed Green's³ prophetic words of the perpetual and growing existence of the online academic environment. Those individuals stated that all things considered, they would take another Internet-based course. Perhaps as new online courses are being developed and existing online courses are being revisited, instructors who are interested in providing an effective online experience for their students can consider the perceptions of the surveyed MSE students and the design of the online course with regard to Chickering and Gamson's seven principles, to assist them with achieving their goals.

Table 1 – Results of the Student Perceptions Survey of an Online Materials Science Course

Group 1 Questions	M	SD	t statistic	Count	%
General Student Perceptions of Online Courses					
Internet-based courses are more flexible than classroom-based courses.	4.61	.83	p < 0.05		
Internet-based courses allow for more efficient use of my time than classroom-based environments	4.48	.86			
Internet-based courses are easier than classroom-based courses.	3.09	.86			
What is the best thing about taking an online course?					
Convenience/flexibility				32	
Self-paced learning				14	
Can earn credit while in co-op				3	
More efficient use of time				1	
Great for visual learners				1	
No teacher bias				1	
Don't have to go to class				1	
What is the worst thing about taking an online course?					
Easy to fall behind				22	
Slow Internet connection				5	
Lack of student/teacher interaction				5	
Lack of student interaction				3	
Material was hard to understand				3	
Nothing				3	
Can't ask questions during the modules				2	
Lack of access to a computer				1	
Computer problems				1	
Instructors in Internet-based courses are more available than instructors in classroom-based courses.	3.24	.79			
I would take another Internet-delivered course if it were offered.					
Yes				37	80
Not Sure				7	15
No				2	4
Group 2 Questions					
Student Perceptions of the Instructor					
The instructor presented and explained course objectives at the beginning of the course.	4.52	.5	.0061		
The instructor's online presentation of course materials held my interest.	3.61	1	.2930		
The instructor explained complex material clearly	3.89	.82	.3286		

Group 2 Questions (continued)	M	SD	t statistic	Count	%
Student Perceptions of the Instructor			p < 0.05		
Considering everything, the instructor was an effective teacher.	4.17	.68	.0763		
The instructor did a good job of covering the course content and objectives	4.24	.6	.0294		
The instructor demonstrated a thorough knowledge for the course topics.	4.74	.49	.0247		
I felt free to ask the instructor for help	4.35	.67	.0305		
The instructor seemed to be sensitive to the feelings and needs of all students.	4.46	.75	.2587		
I had fewer problems getting help in this course than in other courses.	3.41	.69			
Overall, I am satisfied with how this course was delivered.	4.22	.84			
The instructor always responded to my questions.	4.37	.68			
The instructor was aware of when students did not understand concepts.	3.78	1.01			
Group 3 Questions	M	SD	t statistic	Count	%
Student Perceptions of the MSE Online Course			p < 0.05		
This course is an appropriate course to be taught over the Internet.	4.09	.76			
I would recommend this course to my colleagues.					
Yes				39	85
Not Sure				5	11
No				2	2
What letter grade do you expect to earn in this course?			.3940		
A				18	39
B				24	52
C				3	7
D				0	0
F				0	0
The website was easy to navigate.	4.39	.71			
The course seemed well planned and organized	4.13	.8	.0443		
Examinations and quizzes covered the course content and objectives.	4.26	.61	.0958		
Overall, I am satisfied with the learning that occurred in this course.	3.93	.90			

Group 3 Questions (continued)	M	SD	t statistic	Count	%
Student Perceptions of the MSE Online Course					
Overall, it was a challenge to do well in the course.	3.11	.99	p < 0.05		
Should any online materials be added or eliminated? If so, which?					
Yes				8	17
No				35	76
Suggestions for the instructor if the same course were to be taught online again.					
Make sure quiz feature is working and questions are correct				5	
Make students more accountable				5	
No suggestions necessary				5	
Offer Q&A session				4	
Make modules more interesting				3	
Put files in .PPT format, not .PDF				2	
Put modules on CD-Rom				2	
No mandatory weekly meeting				2	
Provide a better introduction/tutorial Give a practice exam				2	
Make campus lecture earlier in day				1	
Post grades sooner				1	
How useful were the following course materials on the Internet?					
Course calendar	4.22	.76			
Discussion board	3.50	1.07			
Exams	4.33	.70			
Homework	4.35	.77			
Modules	4.00	1.15			
Printable Modules	4.04	1.01			
Quizzes	4.62	.64			
Syllabus	3.9	.69			
Other	.54	1.17			
Regularly accessing the online materials was necessary in order to learn and understand course materials.	4.15	.82			
I am satisfied with the amount of work required for this course.	4.33	.56			
I learned the course material better in the Internet course format than I would have in a classroom-based format.	3.28	1.03			
What portion of the modules did you review?					
0% – 20%				5	11
21% – 40%				3	7
41% – 60%				5	11
61% – 80%				10	22
81% – 100%				21	46

Group 3 Questions (continued)	M	SD	t statistic	Count	%
Student Perceptions of the MSE Online Course					
I feel that I now have a sufficient background in materials science engineering to enable me to effectively communicate as an engineer.	3.8	.78	p < 0.05		
The material presented in this course was difficult to understand.	2.89	.95			
Group 4 Questions	M	SD	t statistic	Count	%
Student Perceptions of Interpersonal Communications					
Class discussion in Internet-based courses is of better quality than class discussion in classroom-based courses.	2.76	.85			
I felt more comfortable asking questions in this course than in classroom-based courses.	3.37	1.04			
I communicated with students more than in other courses.	2.61	1.04			
I communicated with the instructor more than in other courses.	2.87	1.09			
I participated more in this course than in other courses.	2.89	.99			
I often felt the need for face-to-face communication in this course.	2.61	.95			
Group 5 Questions	M	SD	t statistic	Count	%
Student Background Information					
Was this your first online course?					
Yes				38	83
No				7	15
Why did you enroll in the online section for this course as opposed to a regular section?					
Convenience/flexibility				12	
Don't have to go to class				11	
Can earn credit while in co-op				6	
Only section available				6	
Self-paced learning				4	
Thought it would be interesting				3	
Lighten the semester load				3	
Scheduling conflict with other sections				2	
Previous experience with online courses				1	
Wasn't aware that it was online				1	
Great for visual learners				1	

Group 5 Questions	M	SD	t statistic	Count	%
Student Background Information					
Your major is in which of the following engineering majors?			p < 0.05		
Aerospace				12	26
Civil and Environmental				6	13
Chemical				0	0
Electrical and Computing				0	0
Industrial and Systems				5	11
Materials				0	0
Mechanical				21	46
Biomedical				2	4
What is your overall grade point average?	3.07	.48	.0661		
What is your age?	20.93	1.79			
How many miles did you live from campus while taking the course?	9.62	37.21			
How many hours did you work per week while taking the course?					
0				18	39
1 – 10				8	17
11 – 20				7	15
21 – 30				3	7
31 - fulltime				8	17
Is English your first language? If not, was this online course a preferred format?					
Yes				44	96
No				2	4

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