# Differences in Perceptions of On-line Education Between Those Who Have and Have Not Experienced On-line Learning

*Christina R. Scherrer[1], Renee J. Butler[2], and Shekinah Burns[3]*

**Abstract** – Recent years have seen significant growth in on-line education. However, many students and faculty are still not very familiar or comfortable with it as a course delivery method. The purpose of this research is to study both student and faculty perceptions of on-line education and characterize the differences that exist between those who have used an on-line delivery method before and those who have not. For students, these differences included effectiveness of several aspects of the learning experience, difficulty level of the courses, interaction opportunities, and likelihood of taking various types of courses in the future. Faculty differences included belief in its effectiveness and its opportunities for suitable interaction. Results from this research can be used to inform strategies for new faculty and courses to include in a university's on-line portfolio as well as to shape marketing and advising efforts aimed at students.

*Keywords:* On-line instruction, survey, perceptions, e-learning

## INTRODUCTION

In recent years there has been significant growth in the popularity and offering of on-line education for many reasons [1,2]. With fuel costs uncertain, this is expected to grow even faster [3]. For example, a recent study by Eduventures found that 64 percent of students enrolled in on-line programs lived within the same geographic area as the institution offering the program [4]. However, many students and faculty are still not very familiar or comfortable with it as a course delivery method. The purpose of this research is to study both student and faculty perceptions of on-line education and characterize the differences that exist between those who have used an on-line delivery method before and those who have not.

To accomplish this goal, we surveyed students that have taken courses on-line, have not taken courses on-line, and that have taken partially web-based courses. We also surveyed faculty members who have taught on-line courses and those who have not. Although almost every survey participant agreed that on-line courses are more convenient for students and are becoming very popular in general, there were also noted differences in perception. For students, these differences included effectiveness of several aspects of the learning experience, difficulty level of the courses, and interaction opportunities. There were also significant differences in their stated likelihood of taking various types of courses (quantitative, qualitative, lab-based, etc.) in the future. Faculty who have taught on-line classes were significantly more likely to believe in its effectiveness as well as its opportunities for suitable interactions.

---

[1] Southern Polytechnic State University, Department of Industrial Engineering Technology; 1100 S. Marietta Pkwy, Marietta, GA 30060; cscherre@spsu.edu

[2] Southern Polytechnic State University, Division of Engineering; 1100 S. Marietta Pkwy, Marietta, GA 30060; rbutler@spsu.edu

[3] Southern Polytechnic State University, undergraduate student; 1100 S. Marietta Pkwy, Marietta, GA 30060; sburns@spsu.edu

Additionally, faculty in both groups believed that success in on-line courses is very dependent upon student maturity, while that theme was absent in the student surveys. Faculty and students also had differing perceptions on the best on-line technologies to use for courses. In this paper we expand upon these themes, and provide statistical analysis of the survey results.

## BACKGROUND

Much research has been done in recent years to attempt to study the effectiveness of on-line education and characterize best practices associated with on-line delivery. However, much of this work ignores the student perceptions, which are a key input to the education process.

The Alliance for Higher Education Competitiveness extensively surveyed 21 institutions of higher learning that felt they were implementing successful e-learning programs and looked for best practices associated with that group [5]. They found many commonalities for success, including support from administration, a goal of moving full programs on-line rather than only individual courses, and the belief that on-line courses/programs are higher quality than traditional offerings. They gathered some information on student perceptions, but from the point of view of the single person most responsible for on-line education at the institution, rather than from the students themselves. Similarly, a report by the Sloan Consortium, summarizing a survey of more than 1100 degree granting institutions of higher education in the United States, claimed that a large majority of all institutions agree that students are as satisfied with on-line courses as they are with face-to-face offerings. However, this was again the perception of the chief Academic Officer, not actual students [1]. Blakelock and Smith also studied attitudes surrounding distance learning, and found a growth in acceptance of distance learning in general, but their study focused on English composition faculty and administration [6].

One notable exception is a study of faculty and doctoral students in an on-line program in a school of computer and information sciences to obtain perceptions of what environmental factors are indicators of quality in on-line courses [7]. The study concluded that environment created by the community of learners, accessibility to the instructor, and clear and timely feedback were the most important factors, with the faculty and graduate participants very much in agreement on these factors. Another study was conducted to test satisfaction levels, retention, and grade performance of on-line students for a fiber optics course. This study found that on-line students were significantly more satisfied with the course. However, all students (including those considered traditional) viewed pre-recorded class lectures without the instructor present [8]. Williamson et al. [9] also present faculty and student perspectives on an on-line course, but their results are limited because they focus on the point of view of one student in a single course.

## METHODS

Southern Polytechnic State University (SPSU) is a special-purpose institution in the University System of Georgia, with a mission to offer bachelors and masters degrees and continuing professional development in science, engineering, technology, and related fields. The university enrolls approximately 4,000 students, many of whom are nontraditional. Three departments offer on-line degrees (2 masters degrees and 1 bachelors degree), three additional departments offer on-line certificates, and still others offer additional on-line or hybrid courses. The university is also affiliated with eCore, a program developed by the University System of Georgia to offer all required core undergraduate classes on-line. The university offers a variety of on-line learning experiences, including asynchronous learning using just pre-recorded audio and text chat and synchronous learning, using Wimba Live classroom for live audio/video interaction.

E-mails were sent to all faculty at the university during summer semester 2008 and all students enrolled at the university during fall semester 2008 inviting them to take a survey. Participants were incented to take the survey by earning an entry into a gift card drawing, and the survey took approximately 5 minutes to complete. Many of the questions were written on a 5-value Likert scale, which we centered at 0 for analysis. There were also a few open-ended questions for qualitative analysis as well as demographic questions to assist in analyzing the results. (Copies of the survey questions are available by request from the authors.) The survey was administered over the course of

two weeks (faculty) or one week (students), using Survey Monkey's free hosting software (www.surveymonkey.com). Data was later imported into Microsoft Excel and Minitab for analysis.

Three-hundred thirty two surveys were fully completed (approximately 8% of the student body), and verified to be from a representative cross-section of SPSU's student population. Ninety-eight of the students had never taken an on-line course before, 125 had taken 1 or 2 on-line classes and 103 had taken 3 or more. Table 1 summarizes the demographics of students who completed the survey, and table 2 contains some comparisons between the survey population and the student population.

| Demographic | Students |
|---|---|
| Never taken an on-line course | 98 |
| Taken 1 or 2 on-line courses | 125 |
| Taken 3 or more on-line courses | 103 |
| Part-time student | 100 |
| Full-time student | 232 |
| Working more than 35 hours per week | 128 |
| Working 10-25 hours per week | 105 |
| Working 10 or fewer hours per week | 91 |
| Living on campus | 81 |
| Living less than 10 miles from campus | 77 |
| Living 10-25 miles from campus | 81 |
| Living more than 25 miles from campus | 90 |
| Freshman | 49 |
| Sophomore | 57 |
| Junior | 79 |
| Senior | 75 |
| Graduate student | 75 |
| Engineering/Engineering technology major | 175 |
| Male | 234 |
| Female | 96 |
| **Students completing the survey** | **332** |

*Table 1: Demographics of student survey respondents*

Thirty-nine faculty surveys were fully completed, which is approximately a 25% response rate. Of the faculty respondents, 17 had taught 3 or more on-line courses, 6 had taught 1 or 2, and 14 had taught none. Seventeen of the faculty were from Engineering or Engineering Technology Departments. Twenty-one were tenured or tenure-track faculty.

In addition to reporting summary statistics in the results below, we often used the mean of the Likert scale responses to make comparisons between questions and between demographics. There is some disagreement about which tests of the equivalence of sample means on results from a Likert scale are appropriate. For this reason, we chose to use non-parametric tests, specifically the Mann-Whitney U-test [10], since they are the most conservative. Unless otherwise noted, if a difference between two means is claimed in the results, the p-value is no more than 0.01, and often much less. Full results are available from the authors by request.

| | SPSU student population | Survey sample demographics |
|---|---|---|
| **Part-time student** | 30.6% | 30.1% |
| **Full-time student** | 69.3% | 69.9% |
| **Freshman** | 20.0% | 14.6% |
| **Sophomore** | 19.7% | 17.0% |
| **Junior** | 19.2% | 23.6% |
| **Senior** | 29.0% | 22.4% |
| **Graduate student** | 12.0% | 22.4% |
| **Male** | 77.8% | 70.5% |
| **Female** | 22.2% | 28.9% |

*Table 2: Comparison of student survey respondents to total student body*

## STUDENT RESULTS

Analysis of the results found that 89.2% of the students who have taken 3 or more on-line courses are working at least 10 hours per week, and 65.7% are working at least 35 hours per week. The students are relatively evenly split between part-time and full-time students, and most are upperclassmen or graduate students. There does not appear to be any age or sex bias in that group, compared with the population of SPSU.

Students who have not previously taken on-line courses before have a more negative view of the learning experience as well as the effectiveness and convenience of interacting with their professor in an on-line course. They are also more likely to feel that it is important to have student-student interaction in a course. Students who have taken on-line courses before are less likely to believe that on-line courses are easier than traditional courses. Differences between the means of the students who have taken no on-line courses and those who have taken 3 or more on-line courses are statistically significant at 99% for all questions in Table 3, except for question 7. Excluding question 7, the mean from the group of students who had taken 1 or 2 on-line courses falls between the other two groups' means, but is not always statistically different from both groups.

| **Questions (-2=strongly disagree to +2=strongly agree)** | **no on-line courses** | **1 or 2 on-line courses** | **3 or more on-line courses** |
|---|---|---|---|
| 1) On-line courses give you a better learning experience than you would receive in a traditional course. | -0.68 | -0.44 | -0.13 |
| 2) On-line courses are less difficult than traditional courses. | -0.12 | -0.32 | -0.80 |
| 3) Interacting with your instructor via email or chat windows is more effective than face-to-face interaction. | -0.83 | -0.65 | -0.51 |
| 4) Interacting with your instructor via email or chat windows is more convenient than face-to-face interaction. | 0.54 | 0.82 | 0.92 |
| 5) Student-student interaction is an important part of most courses. | 0.81 | 0.60 | 0.40 |
| 6) You personally perform better in a course when you have some type of student-student interaction. | 0.60 | 0.40 | 0.18 |
| 7) Graduate students perform better in on-line classes than undergraduate students. | 0.13 | -0.06 | 0.34 |

*Table 3: Mean responses for questions for students who have taken no on-line courses previously, those who have taken 1 or 2, and those who have taken 3 or more.*

While all groups characterized on-line courses as more convenient, those who have taken them before feel more strongly so (See Table 4). Those who have taken on-line courses before feel that there are fewer distractions in an on-line course, while those that have not are neutral. Students who have not taken an on-line course before feel that presentations would be higher quality in an on-line course, while those who have taken are neutral. Those who have taken on-line courses before feel that on-line classes relate to more successful mastery of the material while those who have not feel that traditional classes do. Students who have not taken an on-line course before feel that feedback from the instructor is better in a traditional course, while those who have taken are neutral. P-values in Table 4 are less than 0.01 in all cases for the difference between no on-line courses and 3 or more on-line courses. As before, the group who has taken 1 or 2 on-line courses falls between the other two groups, but with varying levels of statistical significance.

| **Questions (-2=strongly related to on-line to +2=strongly related to traditional)** | **no on-line courses** | **1 or 2 on-line courses** | **3 or more on-line courses** |
|---|---|---|---|
| Convenience | -1.24 | -1.65 | -1.84 |
| Better student-to-student interaction | 1.47 | 0.94 | 0.59 |
| Better student-to-teacher interaction | 1.08 | 0.74 | 0.55 |
| Better class discussions | 1.39 | 0.81 | 0.39 |
| Less distractions | 0.13 | -0.41 | -0.72 |
| Better quality presentations | 0.45 | 0.38 | -0.13 |
| More effective feedback from the instructor | 0.61 | 0.18 | -0.14 |
| More student effort | 0.41 | -0.40 | -0.82 |
| More successful mastery of course material | 0.65 | 0.27 | -0.12 |
| Better learning outcome | 0.69 | 0.33 | -0.13 |

*Table 4: Mean responses for questions for students who have taken no on-line courses previously, those who have taken 1 or 2, and those who have taken 3 or more.*

All groups of students would be more likely to take a qualitative course on-line than a quantitative course, and even less likely to take a lab-intensive course. However, the students who have taken on-line courses before said they were more likely to take more on-line courses in the future, in all category types (See Figure 1). A majority of students who have taken 3 or more courses on-line would prefer to take a qualitative course on-line instead of through traditional course delivery methods. A majority of those students would also either prefer or be equally likely to take a quantitative or major course on-line.

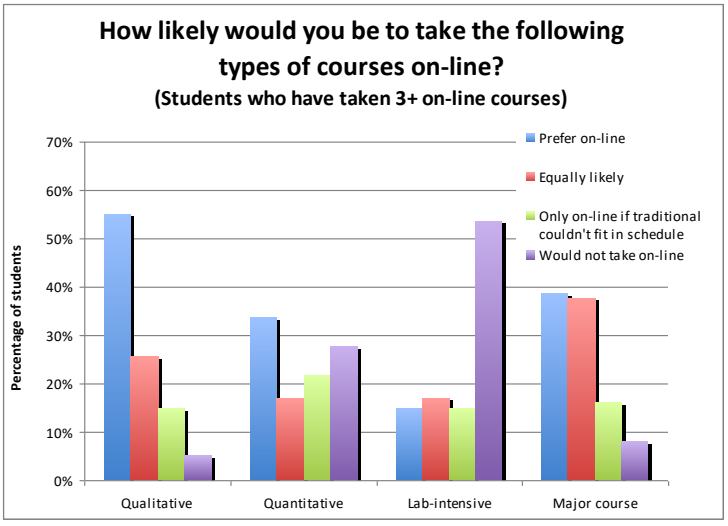
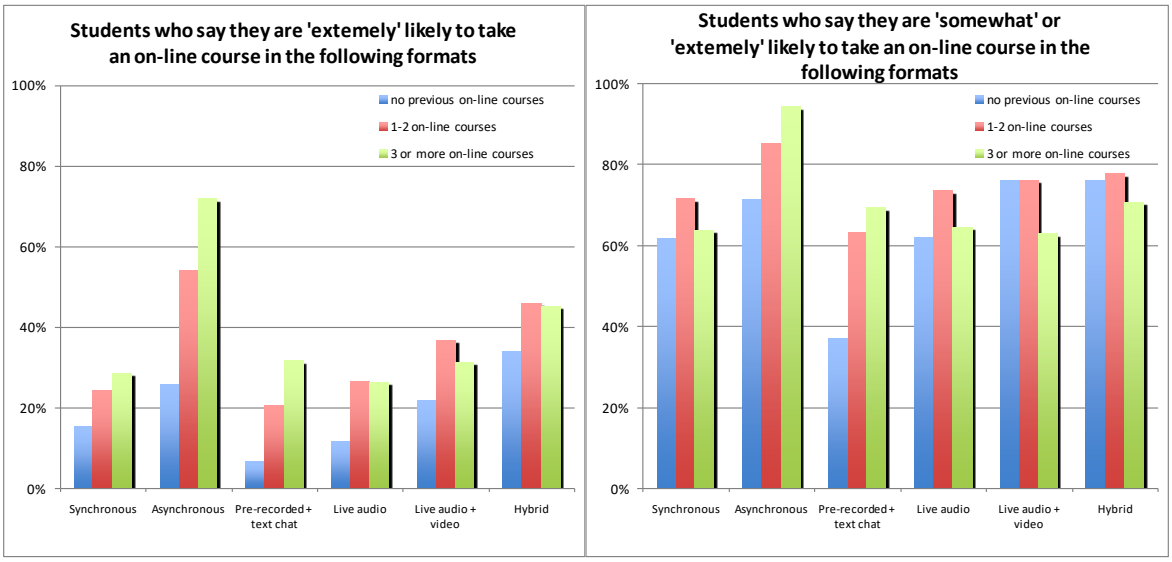



*Figure 1: Likelihood of taking various types of courses on-line (students who have taken 3 or more courses on-line).*

Figure 2 illustrates the percentage of students who say they are "extremely likely" (graph a) or either "extremely likely" or "somewhat likely" (graph b) to take a course in several different delivery methods. All groups were more likely to take an asynchronous course than a synchronous one. Students who have not taken an on-line course before would be more likely to take a hybrid course than other methods (either synchronous or asynchronous), while those who have taken on-line courses are relatively equally likely to prefer any delivery method. Students who have not taken on-line courses before are especially wary of courses using only pre-recorded material and text-chat (though this is in conflict with their preference for asynchronous courses!).




(a) (b)

*Figure 2: Percentage of students who say they are "extremely likely" (graph a) or either "extremely likely" or "somewhat likely" (graph b) to take a course in several different delivery methods.*

## FACULTY RESULTS

Faculty who had taught on-line previously had very different perceptions than those who had not. Because the sample size of those who had taught one or two classes on-line was very small, and their results were not consistently similar to either other group, they are removed from this analysis. Thus, in the following, those who have taught on-line before refers to those who had taught three or more courses on-line. The summary results are in Table 5. Differences between the two groups are statistically significant with a p-value of less than 0.01 for all rows in bold. Full results are available from the authors upon request.

One area of disagreement was in the performance of students taking on-line courses. Those faculty who had taught on-line before felt that undergraduate students in on-line courses perform as well as those in traditional courses, while those who had not taught on-line disagreed. Both groups felt that graduate students perform better in on-line courses than undergraduate students do, and both felt that nontraditional students perform better in on-line courses than traditional students. Faculty who had taught on-line previously said that on-line courses result in more successful student mastery of the course material in general, while faculty who had not taught on-line were neutral.

Another area of disagreement was interactions. Faculty who had taught on-line courses generally felt that interactions were equal in the two methods for all types of interactions, including student-to-student interaction, student-to-teacher interaction, and class discussions. Those who have not previously taught on-line felt that all were significantly better in the traditional environment. For example, eighty-five percent of faculty who had not taught on-line courses felt that there is better student-teacher interaction in traditional course. Forty percent of faculty who had taught on-line courses felt interaction was better on-line and twenty-five percent felt it was equal between the two. Faculty who have taught on-line before also felt that students communicate more with them and with each

| -2 = strongly disagree to +2 = strongly agree | No previous on-line | 3+ previous on-line |
|---|---|---|
| **Undergraduate students who take online courses perform as well as those who take traditional courses.** | **-0.6** | **0.4** |
| **Graduate students who take online courses perform as well as those who take traditional courses.** | **0.1** | **0.8** |
| International students perform better in online courses than they would in traditional courses. | -0.3 | -0.3 |
| Graduate students perform better in on-line courses than undergraduate students. | 0.4 | 0.4 |
| Non-traditional students perform better in on-line courses than traditional students. | 0.2 | 0.6 |
| **Students communicate more with you in online courses than they do in traditional courses.** | **-0.6** | **0.4** |
| **Students communicate more with other students in online courses than they do in traditional courses.** | **-0.5** | **0.2** |
| **Online delivery methods are very similar to those of the traditional classroom.** | **-1.4** | **-0.4** |
| Online courses are more difficult to instruct than traditional courses. | 0.8 | 0.3 |
| **It is more difficult to help students with specific problems with the course material in online courses.** | **0.6** | **-0.4** |
| You are/would be more lenient towards students who take online courses than you are/would be to students in traditional courses. | -1.1 | -1.1 |
| **You enjoy/would enjoy teaching on-line courses.** | **-0.8** | **1.4** |
| **Audio presentations are necessary for online courses.** | **0.9** | **0.1** |
| **Live or synchronous presentations are necessary for online courses.** | **0.8** | **-0.7** |
| On-line courses are becoming an unavoidable part of college instruction. | 0.7 | 1.1 |
| **On-line courses are being demanded by students.** | **0.6** | **1.2** |
| On-line courses are being pushed by administrators. | 0.8 | 0.3 |
| | | |
| **-2 = strongly related to online to +2 = strongly related to traditional** | **None** | **3+** |
| Convenience for students | -1.3 | -1.6 |
| **Convenience for faculty** | **0.3** | **-0.8** |
| **Better Student-to-Student interaction** | **0.9** | **0.1** |
| **Better Student-to-Teacher interaction** | **1.3** | **-0.1** |
| **Better Class discussions** | **1.2** | **0.1** |
| **Less distractions for students** | **0.3** | **-0.9** |
| **Less distractions for faculty** | **0.2** | **-0.8** |
| **Better quality presentations** | **1.0** | **-0.1** |
| Easier to provide feedback to students | 0.3 | 0.2 |
| Requires less student effort | 0.1 | 0.1 |
| Requires less faculty effort | 0.4 | 0.7 |
| **Results in more successful student mastery of course material** | **1.0** | **0.1** |
| | | |
| **-2 = completely ineffective to +2 = very effective** | **None** | **3+** |
| **Synchronous learning (a portion of the course is viewed in "real-time")** | **1.3** | **0.4** |
| **Asynchronous learning (students view the course materials at their own convenience)** | **0.5** | **1.4** |
| **Courses using only pre-recorded material and text chat** | **-0.5** | **0.4** |
| **Courses using live audio** | **1.1** | **0.5** |
| **Courses using live audio and video** | **1.5** | **0.7** |
| A "hybrid" course that is partially held on-campus and partially on-line | 1.1 | 1.3 |

*Table 5: Summary results of faculty survey. Means of Likert scale results for the group of faculty who had taught no previous courses on-line and for the group of faculty who had taught 3 or more courses on-line. (Differences between the two groups are statistically significant with a p-value of less than 0.01 for all rows in bold.)*

other in on-line courses than traditional courses, while those who have not taught on-line before felt the opposite. Faculty who had taught on-line courses felt that there were fewer distractions for students in the traditional environment, while those who had not felt there were fewer in the on-line environment. Sixty-five percent of faculty who had not taught on-line courses strongly agreed that it is more difficult to help students with specific problems in on-line courses than in traditional courses. On the other hand, sixty-five percent of faculty who had taught on-line courses before disagreed with that statement.

Not surprisingly, those who had taught on-line before agreed with the statement that they could enjoy teaching on-line courses, while those that have not, disagreed. Both groups felt that on-line courses are becoming an unavoidable part of college instruction and are being demanded by students, but those who have taught on-line before felt more strongly so. Both groups felt that on-line courses are being pushed by administrators, but the group that had not taught on-line before felt more strongly so.

Both groups agreed that on-line education is much more convenient for the students. Those who have taught on-line before found teaching on-line less convenient for faculty, while those who had not taught on-line before assumed that it would be more convenient for faculty. Faculty who have not taught on-line courses before tend to think the synchronous methods of learning are more effective, while those who have taught on-line feel that asynchronous learning is more effective. Those who have not taught on-line courses before felt that both audio presentation and live presentation are necessary for successful on-line courses. Those who have taught on-line before disagreed that live presentation is necessary and were neutral on whether audio was necessary. Figure 3 shows the percentage of faculty in each group who felt that each method of presentation was highly effective.

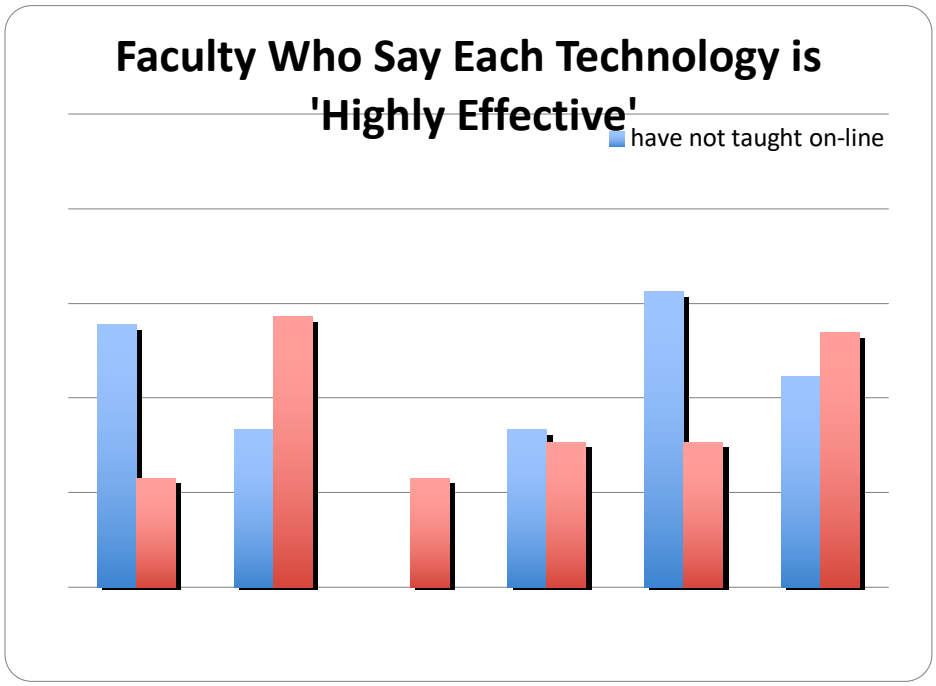



*Figure 3: Percentage of Faculty in Each Group Who Say Various Technologies are 'Highly Effective'*

## CONCLUSIONS AND FUTURE STUDY

This study confirms that there are significant differences in perception regarding on-line education between those who have and have not previously experienced on-line learning. These differences are present for both faculty and students. This study also confirms many of the popular beliefs about students who are likely to take on-line courses.

Overall, students are more interested in taking qualitative courses on-line than quantitative or lab-intensive courses. More than two thirds of students surveyed in total expressed an interest in taking on-line courses in the future. As universities continue to expand their on-line offerings, the views of their various stakeholders are important to consider. Results from this research can be used to inform strategies for new faculty and courses to include in a university's on-line portfolio as well as to shape marketing and advising efforts aimed at students.

While it is certainly difficult to assign causality in this case, students who have taken on-line courses are likely to think more highly of them than those who have not. Perhaps if students can be encouraged to take one on-line course in a non-threatening environment, or experience an on-line learning module in a traditional course, they can determine whether it is a delivery method that works well for them. In addition, it is important to be aware that students are more comfortable with the idea of taking qualitative courses on-line. There appears to be significant apprehension toward taking lab-based courses on-line.

The study also highlights a need for careful advisement of students who wish to take on-line courses to align expectations. There appears to be a belief among students who have not yet taken an on-line course that such courses are easier or require less student effort, while those who have taken on-line courses no longer feel that way. Similar advisement may be necessary for faculty. Faculty who have not previously taught a course on-line have different expectations of student communication, for example.

There are also some interesting differences in perception between faculty and students. Faculty from both groups felt that graduate students and non-traditional students perform better in on-line courses than undergraduate students, while the students disagreed. Students who have taken on-line courses before feel that there are fewer distractions in the on-line classroom than a traditional course, while faculty who have taught on-line courses feel the opposite.

We believe that there is a need for further study into the effectiveness of asynchronous technologies versus synchronous, in light of students' preference for asynchronous courses and the belief of faculty who have taught on-line courses before that it is an effective method of course delivery. Do students (and faculty) believe that learning outcomes are as strong or stronger with asynchronous courses, or does this finding just imply that the convenience of viewing course materials on the students' schedule may outweigh the benefit to them of having an instructor readily available to answer questions? Many of the 'cutting edge' technologies promote synchronous learning, presumably with the belief that it is more effective. There are tradeoffs to consider in student interaction and student convenience, beyond the issue of learning outcomes. We would also like to study the impact of exposure to different on-line learning methods and technologies on the user's perception of on-line education.

A limitation of our study is that it only surveys students from one institution. We do believe that the results of this study do apply to many other institutions, especially those that serve a large number of nontraditional students as we do. However, we are also interested in expanding this study to other institutions as future research.

## REFERENCES


[1] Allen, I. E., & Seaman, J. (November, 2004). Entering the Mainstream: The Quality and Extent of Online Education in the United States, 2003 and 2004. The Sloan Consortium. From www.sloan-c.org

[2] Primary Research Group. The Survey of Distance and Cyberlearning Programs in Higher Education. 2002. New York.

[3] Young, Jeffrey R. "$4-a-Gallon Gas Drives More Students to Online Courses." The Chronicle of Higher Education Pg. 20 Vol. 54 No. 45July 18, 2008 Friday

[4] Carnevale, Dan. “Nonprofit Institutions Could Make Gains in Online Education, Report Says”. The Chronicle of Higher Education, Vol. 53 No. 31, Pg. 30, April 6, 2007

[5] Abel, Rob. Achieving Success in Internet-Supported Learning in Higher Education: Case Studies Illuminate Success Factors, Challenges, and Future Directions. Alliance For Higher Education Competitiveness. February 2005. http://www.a-hec.org/

[6] Blakelock, Jane; Smith, Tracy E. “Distance Learning: From Multiple Snapshots, a Composite Portrait.” Computers and Composition. Vol. 23, Pg. 139, 2006.

[7] Cohen, Maxine S.; Ellis, Timothy J. “Developing Criteria for an Online Learning Environment: From the Student and Faculty Perspectives.” Journal of Engineering Education. April 2004.

[8] Haag Susan; Palais, Joseph C. “Engineering Online: Assessing Innovative Education”. Journal of Engineering Education. July 2002.

[9] Williamson, Christopher; Jennifer T. Bernhard, and Kent Chamberlain. “Perspectives on an Internet-Based Synchronous Distance Learning Experience”. Journal of Engineering Education. January 2000.

[10] NIST/SEMATECH e-Handbook of Statistical Methods http://www.itl.nist.gov/div898/handbook/prc/section3/prc35.htm; last accessed October 2008.

**Christina Scherrer**

Christina Scherrer is an Assistant Professor in the Industrial Engineering Technology department at Southern Polytechnic State University. She received her Ph.D. in Industrial Engineering from the Georgia Institute of Technology. She is a member of ASEE, IIE, INFORMS, and AcademyHealth. Her research interests are in the application of economic decision analysis and operations research to public health and non-profit sectors. She is especially interested in measuring the impact of on-line education on student learning.

**Renee Butler**

Renee Butler is an Assistant Professor in the Division of Engineering and the program coordinator for the systems engineering program at Southern Polytechnic State University. She received her Ph.D. in Industrial Engineering from the Georgia Institute of Technology. She is a member of IIE, INFORMS, and is a licensed Professional Engineer (GA). Her research interests are in the application of operations research to supply chain and logistic problems especially addressing robustness and uncertainty. In addition to her university experience, Dr. Butler has worked for M&M, Mars, Inc. and The Torrington Company.

**Shekinah Burns**

Shekinah Burns is an undergraduate Construction Management student at SPSU. She is a Peach State Louis Stokes Advancing Minority Participation (PSLSAMP) scholar. The authors would like to thank the NSF Peach State Louis Stokes Advancing Minority Participation (PSLSAMP) program for their sponsorship.