2006-838: COMPARING STUDENT PERCEPTIONS AND PERFORMANCE IN DISTANCE, HYBRID AND FACE-TO-FACE ENVIRONMENTS

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Comparing Student Perceptions and Performance in Hybrid and Face-to-Face Environments

Abstract

The National Center for Manufacturing Education (NCME) in partnership with the Quality Engineering Technology (QET) Department at Sinclair Community College received a NSF-ATE project grant in August 2003 to develop and test a hybrid instructional delivery methodology. The design uses small group activity-based instructional materials developed under previous grants in conjunction with supportive web-based content and learning objects for the individual online component. This allows face-to-face interaction to occur despite the groups' working at different locations and times. Web-based supplemental instructional materials and learning objects created and under test support the previously developed instructional modules.

The primary outcome of the NSF-ATE grant, *A Distributed Hybrid Approach to Creating a Community of Practice Using NSF Funded Manufacturing Engineering Technology Curriculum Modules* — DUE 0302574, is evaluating the effectiveness of the delivery method as a means to increase the number of students in manufacturing-related programs by providing institutions, companies, and students a way to work together both onsite and online in a cost-effective, practical way. Previous ASEE presentations on this grant have focused on the theoretical backgrounds, students' perceptions about distance versus pure face-to-face instruction, and the organization of the hybrid lecture and laboratory sections. This paper defines the current results related to meeting the project objectives, in particular student perceptions and academic performance, when comparing the use of a hybrid delivery mode versus traditional face-to-face instruction[1,2].

Background

The goal of the funded project is to develop, test, and evaluate the effectiveness of new web-based primary instructional materials, leading to a certificate in *Continuous Process Improvement*, which utilizes a unique distributed-hybrid delivery model. This is accomplished by expanding delivery options by blending onsite and online learning within a distance delivery system that economically expands the geographic area serviced by an individual college. The blended delivery system consists of small group face-to-face activities, web based synchronous and asynchronous communications tools and supporting web or video based instructional materials and learning objects.

Houdeshell and Pomeranz (2004) cited the need for qualified technicians and manufacturing practitioners, at a time when the number of TAC/ABET accredited Associate degree programs in Manufacturing Engineering Technology has dropped and postulated possible solutions. "One proposed solution to increase the viability of manufacturing related technology programs is to service a larger geographical area through the use of distance education" [1] The use of traditional distance education delivery methods has inherent problems of higher attrition for lower division undergraduates, greater difficulties in applying teamwork skills, and potential lack of student access to equipment for appropriate laboratory experiences. While use of computer simulations can provide realistic instruction for many laboratory experiences, many of

the current solutions require either moving the laboratories to the students or moving the students for extended time to the laboratories[1]. The blended delivery method provides a workable alternative to pure distance education while at the same time provides connection to a small face-to-face group. The goal of this project is to develop, test, and evaluate the effectiveness of new web-based primary instructional materials, leading to a certificate in *Continuous Process Improvement* (CPI), which utilizes a unique distributed-hybrid delivery model. The next section outlines the current progress in meeting the supportive project objectives with primary focus on project objectives 4 and 5, related to effectiveness and barriers to adoption.

Grant Progress and Challenges

Current Status of Project Objectives

Table 1 describes that current status of the 5 project objectives with an expected completion date by fall 2006. The first unexpected obstacle towards completion of the project objectives occurred in 2004 with the challenge of no students volunteering to join a "hybrid" site, i.e. not coming to class but meeting with an instructor/facilitator in a small group to carry out the activities. Houdeshell (2005) interviewed classes as to their reluctance to be excused from coming to face-to-face classes at the college. Several students cited "I learn a lot from other students' questions"[2]. As a result our external evaluator, Social Science Research and Evaluation Corporation (SSRE), developed a questionnaire to determine students' perceptions concerning distance education versus face-to-face instruction.

Table 1
Distributed Hybrid Project Objectives and Current Status

Project Objectives	Status
1. Supplement eight existing NCME face-to-face instructional modules (delivered within five college classes) with web-based declarative and structural supporting materials, within a reusable learning object format, suitable for a distributed-hybrid method of delivery;	The following NCME modules have been supplemented: *Basic Statistical Variation, Probability, Sampling and Hypothesis Testing, Statistical Experiments, Teamwork, Quality Foundations, Process Control, Financial Management, Supply Chain Management*, and *Introduction to Just-in Time* using web-based templates and assessment instruments based on Merrill's Five-Star Instruction Principles [3, 4].
2. Pilot test the materials and delivery method at a total of two or more industry and college sites with an average of four or more students per site per term;	Current pilot testing occurring at Sinclair Community College, and under development at Illinois Valley Community College.
3. Develop a web-based virtual "community of practice" over the length of the program that includes subject matter experts, participating students, and module instructors for the purpose of creating self-sustaining, student-led environments for sharing and growth;	Practice web seminars have been held, a discussion board has been installed, and pilot testing of the web-based community of practice for faculty's planned for Spring 2006.
4. Test the effectiveness by comparing student performance and retention in at least four modules; student, faculty, college, and industry satisfaction; and institutional and	This paper reports the progress to date on student performance and retention. Other measures to be completed by July 2006.

Project Objectives	Status
industry return on investment when compared to face-to-face or pure web based instruction;	
5. Research and create a dissemination plan that addresses adoption barriers identified in the project.	Plan currently under development based on barriers outlined in Rogers (1995) *Diffusion of Innovation* [5].

Houdeshell (2005) reported the results of the questionnaire submitted to 200 level Quality Engineering Technology students in three different face-to-face and two pure distance-education 200 level courses. The questionnaire allowed the use of a paired data t-test to determine preferences related to distance learning and pure face-to-face instruction[6]. The questionnaire was administered to 200 level distance-learning students enrolled in the same course as one of the face-to-face course sections and to two additional courses. No significant differences among the responses among the three distance education courses were observed. No differences were apparent for these questions except for the statement: "Being required to attend class is helpful in motivating me to learn the material." The distance education students scored this as less important as a motivator when compared to the face-to-face students. Overall the only major perceived benefit for distance learning is convenience.

In order to meet this challenge the Principal Investigators in conjunction with the QET department split courses that have designated lecture-laboratory components into two separate courses. For example the current three credit hour course, QET 201 Statistical Process Control (SPC), became two courses QET 201 SPC, two credit hours, a two lecture hour course, and co-requisite QET 181 Laboratory for SPC, one credit, two laboratory hours per week course. With this course combination a variety of options are possible: Offering totally face-to-face, offering the face-to-face laboratory course (at the college and offsite) with a distance-learning lecture class (hybrid), or offering a pure distance-learning experience. Table 2 outlines the possible course combinations under a hybrid mode. Using the same methodology and paired data questions from the original survey additional data was collected from classes that have been offered in the new course combinations. These are reported and discussed in the next section.

Table 2
Hybrid Course Offering Combinations

Course	Face-to-Face	Web	Day	Eve	Sat	Off site
QET 201		X				
QET 181	X		X	X	X	X

Student Perception Survey Results

Over the past year, additional students were surveyed in both face-to-face and hybrid offerings as to their preferences for course delivery modes. The paired data t-test results displayed in Table 3 provide insight into the students' perceptions as to the benefits of face-to-face instruction versus pure distance delivery and face-to-face instruction versus a hybrid delivery. Students enrolled in face-to-face, distance education, and hybrid (pre and post course completion) defined the major survey sample sets. First, distance education students overwhelmingly prefer face-to-face courses except for the convenience of distance education classes. Referring to the

Table 3 results (-0.8***) for the question *"How convenient would it be to take the course in the face-to-face format? Distance-learning? or Hybrid formats?"* indicates that for a paired data t-test enrolled distance education student preferred distance education classes over face-to-face classes at a significance level probability, by chance alone, of less than one in a thousand. Those students that have not taken either distance education or hybrid courses, perceive that face-to-face instruction (0.4) is preferred to pure distance education, and the results are inconclusive or no difference for students preference (0.4, 0.0) concerning pure face-to-face over a hybrid delivery. This could be based on the students' comfort level with the content material and learners' orientation, as well as, the impact of small sample sizes[7]. As in the case with pure distance education, the post course completion results for the hybrid indicate convenience as an important consideration equivalent to face-to- face instruction.

The students also completed questions related to their learning styles and social interaction. No differences were apparent for these questions except for the statement; "Being required to attend class is helpful in motivating me to learn the material." The distance education students scored this as less important as a motivator when compared to the face-to-face students. It is apparent that marketing and informational materials must be developed and distributed that explains both the benefits and methodology of the hybrid delivery system.

Table 3
Survey Results —Student Perception of Face-to-Face, Distance Education, and Distributed Hybrid Delivery Modalities

Comparative Questions (1 to 4 scale)	Average Paired Data Difference Response (FtF-DE or FtF-Hybrid)			
	F-to-F[a]	DE[b]	Hybrid Pre[c]	Hybrid Post[d]
How much feedback on your coursework would you expect to get in the face-to-face format? Distance-learning? or Hybrid formats?	1.1***	0.6***	0.3*	0.6
How helpful would you expect the feedback on your coursework to be in the face-to-face format? Distance-learning? or Hybrid formats?	0.5	0.6***	0.2	0.7*
How easy would it be to learn the materials in the face-to-face format? Distance-learning? or Hybrid formats?	1.6***	0.7***	0.6**	0.4
How easy would it be to get your questions answered in the face-to-face format? Distance-learning? or Hybrid formats?	0.7	0.8***	0.6**	0.7
How convenient would it be to take the course in the face-to-face format? Distance-learning? or Hybrid formats?	0.4	-0.8***	0.4	0.0
How easy would it be to work with other students in learning the material in the face-to-face format? Distance-learning?or Hybrid formats?	1.2*	1.0***	0.7*	0.8

Paired data t-test probabilities: *p<0.05, **p<0.01, ***p<0.001, Sample sizes: a = 24, b = 56, c= 18, d= 7

The next section addresses two of the questions raised in objective 4: Test the effectiveness of the hybrid delivery method by comparing student performance and retention in at least four modules.

Student Performance and Retention Comparisons

Both standardized tests and course grades are the primary methods for measuring performance and retention. The standardized tests will require several more quarters worth of data in order to make valid comparisons. What is available is course grade distribution data acquired from the registrars' office for the past five years. This summarized data, found in Table 4, organized by course, section number, and delivery mode exhibits the number of students and their course average.

Table 4
Quality Engineering Technology Course Information Involved in the Current Study

Course Name	Course Number	Delivery Mode	Number of Students	Grade Avg.
Survey of TQ and	101-01 Day	Face-to-Face	219	3.08
Laboratory	101-50 Evening	Face-to-Face	196	3.42
	101- D1	Video	16	3.14
	171-01 Day	Face-to-Face	10	3.67
Metallurgy and	132-01 Day	Face-to Face	109	3.64
Laboratory	132-50 Evening	Face-to Face	42	3.94
	132-49	Hybrid	6	
	173-01 Day	Face-to Face	2	
	173-50 Evening	Face-to Face	4	
Statistical Process	201-01 Day	Face-to Face	107	3.07
Control and Laboratory	201-50 Evening	Face-to Face	109	3.01
	201-TC	Web-based DE	15	3.00
	201-49	Hybrid	13	3.25
	181-01 Day	Face-to Face	8	4.00
	181-50 Evening	Face-to Face	5	
Advanced Statistical	202-50 Evening	Face-to Face	32	3.30
Quality Control and	202-49	Hybrid	2	4.00
Laboratory	182-50	Face-to Face	2	3.00

An analysis of the raw course/individual data using a Chi-Square goodness of fit test was used to determine if statistical significant differences in grade distributions occurred when comparing course sections and delivery combinations. Table 5 provides the Chi-Square results with two cases showing significant differences between both the day and evening course sections for both QET 101 and QET 201 courses. These courses had the highest course enrollment and different course makeup, with higher percentages of traditional college students in both of the day course sections. Even with small sample sizes a comparison between a traditional web based distance education class and the hybrid indicated a very significant difference. A review of the raw data indicates the primary cause is the significant number of students withdrawing from the pure distance education course (TC).

Table 5
Grade Distribution Comparisons between Quality Engineering Technology Course Sections

Course and Section Comparisons	df	χ^2	p	Action
101-01 (Day) vs. 101-50 (Eve.)	5	16.61	0.0053	Reject Same Distribution
101-01 vs. 101-D1 (Video)	5	3.54	0.6171	No Significant Difference
132-01 vs. 132-50	5	9.12	0.1042	No Significant Difference
201-01 vs. 201-50	5	14.64	0.0120	Reject Same Distribution
201-01 vs. 201-TC (Web DE)	5	12.85	0.0248	Reject Same Distribution
201-01 vs. 201-49/181-01 (Hybrid)	5	2.50	0.9511	No Significant Difference
201-TC vs. 201-49/181-01	2	10.50	0.0052	Reject Same Distribution

Because of some small sample numbers ongoing data collection is necessary to confirm some of the statistical conclusions. Joining in our efforts is our new partner Illinois Valley Community College, which will be pilot testing materials and serve as a major partner in evaluating our community of practice efforts.

Conclusions

While the benefits of the blended delivery are evident from students that have completed courses using the blended mode focused marketing efforts are needed to explain the delivery benefits, in addition to the high quality course materials. This effort meshed with the implementation plan based on Roger's *Diffusion of Innovations*.

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References Cited

1. Houdeshell, J. and G. Pomeranz. *Preliminary Results from a NSF-ATE Funded Distributed Hybrid Instructional Delivery Project*. in *ASEE Annual Conference and Exposition, "Engineering Education Reaches New Heights"*. 2004. Salt Lake, Utah: American Society for Engineering Education.
2. Houdeshell, J. *Results From the NSF-ATE Distributed Hybrid Instructional Delivery Project*. in *ASEE Annual Conference and Exposition "The Changing Landscape of Engineering and Technology Education in a Global World*. 2005. Portland Oregon: ASEE.
3. Merrill, M.D., *First Principles of Instruction*. 2001, Utah State University: Logan, UT.
4. Merrill, M.D., *First Principles of Instruction.* Educational Technology Research and Development, 2002. 50(3): p. 43-59.
5. Rogers, E.M., *Diffusion of Innovations*. Fourth ed. 1995, New York, NY: Free Press. 519.
6. Duncan, A.J., *Quality Control and Industrial Statistics*. 4 ed. 1974, Homewood, IL: Richard D. Irwin, Inc. 1047.
7. Martinez, M., *Designing Learning Objects to Personalize Learning*, in *The Instructional Use of Learning Objects*, D.A. Wiley, Editor. 2002, AIT/AECT: Bloomington, IN. p. 151-171.