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The Impact of Physical Classroom Environment on Student Satisfaction and Student Evaluation of Teaching in the University Environment

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THE IMPACT OF PHYSICAL CLASSROOM ENVIRONMENT ON STUDENT SATISFACTION AND STUDENT EVALUATION OF TEACHING IN THE UNIVERSITY ENVIRONMENT

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ABSTRACT

Recently, many colleges and universities have made significant investments in upgraded classrooms and learning centers, incorporating such factors as tiered seating, customized lighting packages, upgraded desk and seat quality, and individual computers. To date, few studies have examined the impact of classroom environment at post-secondary institutions. The purpose of this study is to analyze the impact of classroom environment factors on individual student satisfaction measures and on student evaluation of teaching in the university environment.

Two-hundred thirty-seven undergraduate business students were surveyed regarding their perceptions of classroom environment factors and their satisfaction with their classroom, instructor, and course. The results of the study indicate that students do perceive significant differences between standard and upgraded classrooms. Additionally, students express a preference for several aspects of upgraded classrooms, including tiered seating, lighting, and classroom noise control. Finally, students rate course enjoyment, classroom learning, and instructor organization higher in upgraded classrooms than in standard classrooms. The results of this study should benefit administrators who make capital and infrastructure decisions regarding college and university classroom improvements, faculty members who develop and rely upon student evaluations of teaching, and researchers who examine the factors impacting student satisfaction and learning.

INTRODUCTION

A 2008 technology survey of AACSB-accredited business schools indicates that fifty percent of business schools plan to upgrade their facilities within the next five years, with an average estimated cost of $37,252,600 per school (TBS Roundtable 2008). These facility upgrades include renovation and/or addition to existing facilities and the construction of new facilities. Investments in upgraded classroom environments often incorporate features such as tiered (or stadium) seating, customized lighting packages, upgraded desks, and individual student computers (Conway 2000).

Researchers have examined several aspects of classroom learning environments and the impact of such environments at the K-12 education level (Earthman 2002, Young et al 2003). These studies find that building conditions such as lighting, temperature, student comfort, and classroom technology are significantly positively related to student outcomes, including performance and attitude (Fisher 2001, Hurst 2005). However, there have been relatively few studies that have examined the impact of classroom environment at institutions of higher learning (Siegel 2003). As colleges and universities spend millions of dollars on facilities, it is important to analyze the impact of different environmental features to ensure that students, faculty, and institutions receive the greatest benefit from spending on learning environments. It is important to analyze the impact of upgraded learning environments at the college and university level, as many institutions and university systems are facing budgetary constraints that require enhanced cost and benefit evaluations. Further, additions and upgrades to existing facilities can create large disparities in classroom environments, often within the same building. These disparities may provide an unfair advantage to students enrolled in sections that happen to be in the upgraded classrooms. Finally, physical characteristics of rooms may affect student evaluation of teaching.

Extensive prior research exists on student satisfaction and the student evaluation of teaching in the university environment (Barth 2008, Merritt 2008). Prior research has shown significant relationships between student evaluation of teaching and factors such as instruction quality, course difficulty, and grades (Zabaleta 2007). Additionally, student satisfaction has been significantly linked with the values congruence between instructor and student and with the extent to which the overall course structure aligns with student expectations and preferences (Westerman et al 2002). However, researchers have not examined the impact of the physical classroom environment on student satisfaction measures and student evaluations of teaching. The classroom disparities that can exist within one university highlight the importance of determining the impact of physical classroom environment on both student satisfaction and the student evaluation of teaching.

The purpose of this study is to analyze the impact of classroom environment factors on individual student satisfaction measures and on student evaluation of teaching in the university environment. Two-hundred thirty-seven business students were surveyed regarding their perceptions of classroom environment factors and their satisfaction with their classroom, instructor, and course. Student survey responses were utilized to measure the extent to which they perceived classroom upgrades and their preferences for upgrades in the areas of seating, lighting, and classroom technology.

The results indicate that students do perceive a significant difference in classroom facilities. Students noted differences in the physical characteristics of classrooms, including the seating characteristics, lighting, desk space, and noise levels. Overall, these differences affected the students' perceptions of the instructors' organization, their own enjoyment of the class, their perceived level of learning, and their general sense of satisfaction.

The remainder of this paper is organized as follows: the next section summarizes the literature and develops research questions related to physical classroom environment and its impact on student satisfaction and student evaluation of teaching, this section is followed by a description of the research

design and study methodology, the next section presents the results of the study, and the final section discusses the implications of the study for university administrators, faculty, and students.

LITERATURE REVIEW AND RESEARCH QUESTIONS

Two streams of prior research are relevant to this study: research on classroom environment and research on student satisfaction and evaluation of teaching. While prior research has defined environment in numerous ways, including both tangible and intangible factors in a classroom, this study addresses only the physical characteristics of classrooms. The research related to physical classroom environment has examined such factors as classroom lighting, climate control, classroom technology, desk comfort, and seating arrangements (Conway 2000). Prior literature related to student satisfaction and the student evaluation of teaching has primarily examined the relationship between such ratings and factors including subject matter interest, course design, and teacher performance.

Physical Environment of the University Classroom

The literature related to physical classroom environment has primarily focused on the impact of environment on student attitudes and student achievement on the K-12 education level (Fisher 2001). Young et al (2003) stress the importance of the physical environment and note that student achievement is impacted by such factors as lighting, noise, and climate control. The authors also describe student perception of physical environment, noting that students as young as elementary school age are aware of the physical attributes of their learning environment and have a sense of whether the environment is appropriately updated and conducive to learning.

Lyons (2001) summarizes the importance of physical environment to educational achievement by detailing the existing links in the research literature between classroom conditions and learning. The significant effect of classroom environment on concentration levels, listening, and writing is supported by research results that have found higher test scores and more positive student outlooks in upgraded learning environments. For example, Heschong (2003) found window characteristics had as much power as number of computers or teacher characteristics in explaining variations in student performance on standardized tests and Englebrecht (2003) found that classroom color was important to student mood and productivity.

In the university setting, researchers have recently examined the components of upgraded, or "smart", classrooms that may impact student learning. Griffin (1990) uses person-environment interaction theory to describe the potential impact of physical design, visual factors, aural factors, and physical stimulation on college students. Banning (1993) notes that the physical environment of the college classroom can impact student learning by signaling desirable instructional behavior and by communicating the level of formality that is expected in classroom interaction. Vartabedian (2002) details the computer technology, audio visual components, and network structures that are typically included in classroom

upgrades. These classrooms differ from traditional classrooms by providing a wide range of computer, media, projection, and communication equipment. Fundamentally, upgraded (smart) classrooms should reach more learners as instructors have more communication options and therefore can reach more learning styles (Conway 2000). Troop (2000) discusses the planning for overall classroom design and technology that should be inherent in university classroom upgrades. At the same time the new technology is being added, changes are usually made to other physical attributes of the classrooms such as furniture, lighting, and flooring (Troup 2000). Siegel (2003) links classroom information technology with overall innovation level, and Conway (2000) discusses both the capabilities and limitations of the technology integrated classroom.

The tendency of colleges and universities to upgrade or remodel single classrooms as funds become available can create significant differences in the classroom environments available to students within an individual institution. It is important to determine the extent to which students perceive and value quality differences in classroom environments, as the ability of upgraded classrooms to enhance student learning may provide an unfair advantage to students who are enrolled in course sections that are delivered in upgraded environments. Additionally, the perception of the learning environment is important to administrators of universities, as students may factor the physical learning environment into decisions regarding school enrollment. Administrators also determine the extent to which capital improvement requests will incorporate classroom upgrades and expansions.

Given the level of spending that institutions expect to allocate to facility and classroom upgrades (Valenti 2002), it is vital to understand the value placed on physical classroom environments by college and university students. While extensive research has found that primary and high school students are affected by their physical environment, those effects may not transfer to college level students because college students are older and typically spend less time in an individual classroom facility. Thus, our first research question is:

> *RQ1a: Do university students perceive significant differences in the physical environment*
> *of their classrooms?*

It is equally compelling to determine the specific attributes of classroom physical environment that are most salient to college and university students. Prior research has investigated a variety of factors such as lighting, windows, carpeting, room temperature, sound, ceiling height, and color. At the college level, institutions are typically upgrading classroom technology simultaneously with other aspects of the physical environment (Troop 2000). Limited research into student perceptions of smart classrooms has indicated that technology upgrades are not valued equivalently (Tornabene 1998) and that some upgrades can place students at a disadvantage (Marcellus and Ghrayeb 2002). Further, understanding college students' perceptions of and value placed on classroom upgrades can assist administrators who make budgetary decisions. Our second research question is as follows:

RQ1b: Which physical classroom environment factors are most noticed by university students?

The extent to which college and university students recognize classroom upgrades and knowledge of the individual environment factors that are preferred by students will provide important information to university administrators who made decisions about the timing and extent of resource allocation to learning environments.

Student Performance and Opinions

If university students prefer certain classroom environments, then it may affect their performance and opinions. Many prior studies that have examined business student performance have found that factors such as aptitude, attendance, gender, and class size can impact performance (e.g., Springer and Borthick 2007, Ballou and Huguenard 2008). This research examines another factor that may affect performance: the physical characteristics of the classroom. Our third research question is as follows:

RQ2a: Are the expected grades of students related to the physical characteristics of the classroom?

Extensive prior research exists on college and university student satisfaction and student evaluation of teaching effectiveness. This research has found that many factors affect satisfaction and student evaluations of teaching including instructor enthusiasm, organization, examinations and grading, coverage of material, knowledge of subject matter, and communication skills (Barth 2008, Hooper and Page 1986). There also has been extensive research on variables that potentially bias student evaluation of teaching such as race, age, gender and expected grade in the class (Merritt 2008).

While an extensive body of research has developed related to student satisfaction and the student evaluation of teaching, limited studies have analyzed the impact of environment on satisfaction and evaluation of teaching at the college and university level. Westerman et al (2002) analyze three factors and their impact on student satisfaction in business school students. These factors included the congruence between student values and perceived instructor values, the agreement between student and instructor personalities, and the extent to which the overall classroom environment aligned with student expectations. The authors found that both values congruence and overall classroom environment fit were significant predictors of student satisfaction.

Other studies that have analyzed student satisfaction with upgraded classrooms have focused on the upgrades to classroom technology. Tornabene (1998) found that students preferred "smart" classrooms, meaning those with enhanced technology, to traditional classrooms. Marcellus and Ghrayeb (2002) found that students preferred smart classrooms for the transmission of basic facts and information, yet felt that traditional instruction with the instructor writing on the blackboard was more conducive to

presentation of problem solving. Given the mixed findings related to smart classrooms and the likelihood that comfort levels may enhance student satisfaction, it is important to determine the extent to which physical classroom environment impacts the student evaluation of teaching. Our final research question is as follows:

> *RQ2b: Do physical classroom environment factors impact student satisfaction and the student evaluation of teaching?*

METHODOLOGY

Two accounting instructors, one teaching intermediate accounting the other accounting information systems, taught two sections of the same class during the same semester. Each taught one section in an updated classroom and one section in a "standard" classroom. Table 1 provides a diagram showing the courses and a count of the students involved. As can be seen in the table, the classes were of approximately equal size. The instructors taught each section of the same class using the same syllabus, the same exams, the same homework, the same books, projects, lecture notes, and lecture styles. One instructor taught in the updated room first, while the other taught in the standard room first. The Instructors both taught one afternoon section (either 2:00 PM or 3:30 PM) and one evening section (5:00PM). The instructors made every effort to treat the courses and students in both rooms equally.

Table 1: Research Design		
Room Type	Intermediate Accounting Students	Accounting Information Systems Students
Updated	62	61
Standard	56	58

Some of the characteristics that differentiated the classrooms were the seating, room capacity, lighting, entry, and computing equipment. In the updated classroom, the seating was tiered with tables in fixed rows and rolling cushioned chairs, while the standard classroom has one-armed movable desks on a level floor. The upgraded classroom had larger capacity—it held 85 students while the standard classroom held 60. The upgraded classroom had flexible lighting (lights could be on or off in different zones of the room) while the standard classroom had fixed lighting (all on or all off). The upgraded classroom was rear entry from the left and right, while the standard classroom had side entry at the front and back of the room. Finally, the upgraded classroom had computer workstations at each student desk. The layout of the classrooms can be seen in the following photographs. Photographs 1 and 2 show the standard classroom, while photographs 3 and 4 show the upgraded classroom.

Photo 1

Photo 2

Photo 3

Photo 4

Data Collection

Data was gathered via a survey instrument that was administered to students during the third to last class session of the term. Survey data containing feedback on physical environments can provide insight on the environment's effectiveness (Prakash 2005). All responses were anonymous but students were given course points for completing the instrument by signing a classroom roll as they turned in the instrument. They were also given the option of completing a course assignment rather than doing the survey (no students chose this option). The researchers obtained informed consent from the students. The instrument collected data on the students' backgrounds, perceptions about the classroom physical environment, the perceptions of the instructor and instruction, and expected grade in the class. The survey questions were developed after consulting previous questionnaires about classroom environment and adding questions from the university's standard end of course evaluation. Likert scales were used for the opinion questions on the environment and instruction. About one-third of the opinion questions were phrased in the negative to avoid a "yea-sayer" bias (Alreck and Settle 1985). The instrument was pilot tested using a separate group of students to ensure the clarity of questions and that the length of the instrument was not excessive.

RESULTS

The students who participated in the study provided demographic information including major, degree goal, age, gender, university GPA, hours worked, attendance, and expected grade. To ensure respondent accuracy and attention to task, the self-reported demographic data was compared to demographic data obtained from university records. The self-reported data reflected the independently obtained data, suggesting that the students responded seriously to the survey instrument.

Chi-square tests were run to compare for student population differences between the two courses. Some demographic categories were collapsed in order to have valid chi-square tests. There were only two significant differences between the classes: the intermediate course had more non-accounting majors (25% in intermediate versus 6% in the accounting information systems class) and the expected grades were higher in the accounting information systems class (91% expected an A or B while only 66% expected an A or B in intermediate). These differences are explicable because the intermediate class is frequently taken by students who have an interest in accounting but have not selected accounting as a major, and because the accounting information systems class grade is based in large part on out of class projects, thus giving the students more control over their graded output.

Data Analysis

The first research question was whether university level students would perceive differences in the classrooms (RQ 1A). T-tests were run comparing the responses between the upgraded and standard

classrooms on each of the questions pertaining to physical aspects. On fourteen of nineteen questions about the classroom physical factors, the students noticed significant differences in the rooms. Table 2 reports the T-tests results in order of strength. Overall, the students strongly preferred the updated classroom.

Rank	Q	Survey Question	Updated Room	Standard Room	Difference	T	P
		Table 2: Student perceptions on Physical Classroom Environment **Survey Scale: 5 = strongly agree, 1 = strongly disagree**					
1	14	I have enough desk space to take notes in this classroom.	4.6702	2.2805	2.39	17.45	.0001
2	24	This classroom is better than most of the classrooms on this campus.	4.3085	2.2198	2.089	16.11	.0001
3	38	I would prefer that this course be taught in another classroom.	1.6809	3.7561	-2.0752	14.21	.0001
4	15	I have enough desk space to take tests in this classroom.	4.6596	2.7073	1.952	13.55	.0001
5	23	This classroom is large enough for the number of students enrolled in the course.	4.6383	2.8293	1.809	13.28	.0001
6	26	This classroom is fitted with the latest in classroom technology.	4.117	2.3902	1.727	12.42	.0001
7	12	The seats in this classroom are comfortable.	3.9468	2.561	1.389	9.48	.0001
8	22	Noise coming from outside of the classroom is often a problem in this class.	2.0426	3.3537	-1.3111	7.71	.0001
9	13	I am always able to find a desirable seat in this classroom.	4.4468	3.378	1.069	7.42	.0001
10	20	The arrangement of seats in this classroom is appropriate.	4.0638	3.0244	1.039	6.93	.0001
11	27	This classroom is fitted with an appropriate level of classroom technology for the course material.	4.266	3.3415	.924	6.83	.0001
12	17	The lighting in this classroom is appropriate during audio/visual presentations.	4.1915	3.6463	.545	4.12	.0001
13	28	Every classroom on campus should have stadium (tiered) seating.	3.9043	3.2561	.648	3.87	.0002
14	16	The lighting in this classroom is appropriate during lectures.	4.3298	4	.33	2.95	.0037
15	18	I sometimes have difficulty seeing the instructional materials displayed by the professor in this classroom.	No significant difference				
16	19	I am often distracted by other visual items in this classroom.	No significant difference				
17	21	It is easy to hear the professor in this class.	No significant difference				
18	25	Computer access during class would enhance my learning in this course.	No significant difference				
19	29	I expect to have crowded classrooms on this campus.	No significant difference				

The next research question addresses which features of the classroom are most salient to the students. Table 2 show the top 10 differences pertain to desk space (rank 1, 4) overall classroom features (rank 2, 3, 5), technology (rank 6), seating (rank 7, 9, 10) and noise (rank 8). To better distinguish the salient features, the Likert responses from questions on a particular feature were summed. The ability to sum responses across related questions is an advantage of using the Likert scale (Alreck and Settle 1985). Likert responses were reversed where appropriate. T-tests again show that the students perceive significant differences between the upgraded and standard classroom. These results are shown in Table 3. For the summed variables, the strongest results were for seating, overall classroom features, technology, hearing, and lighting.

Table 3: Salient Classroom Features						
Feature	Questions	Updated Room	Standard Room	Difference	T	P
Seating	12, 13, 14, 15, 20	21.787	13.951	7.836	16.35	.0001
Overall/general	23, 24, 28, 29, 36, 38	23.404	16.793	6.612	14.40	.0001
Technology	25, 26, 27, 37	15.532	12.716	2.816	8.42	.0001
Hearing	21, 22	8.3404	6.8659	1.475	6.38	.0001
Lighting	16, 17, 18, 19	15.851	14.817	1.034	2.56	.0114

The analysis for the third research question examines whether the students self-reported "expected grade in the class" is related to the physical characteristics of the classroom. The expected grade is used rather than the actual grade to maintain student confidentiality. A regression model was run with the dependent variable of expected grade and the summed physical characteristics as independent variables. No relationship was found between expected grade and the physical characteristics. As in prior research, expected grade was positively related to GPA and age.

The final analyses evaluate opinion data on the course overall, the students' general satisfaction, and their evaluation of teaching. Questions 31 and 32 address the students' general opinions on the importance of the course and their understanding of how to do well in the course. There were no statistically significant differences in the students' opinion on these questions between the standard room and the upgraded room.

There was a significant difference when comparing the students' general satisfaction (questions 30 and 34) between classrooms. The students enjoyed coming to class more in the upgraded room and had a stronger sense of satisfaction in the upgraded room, as shown in Table 4. To evaluate which features of the classroom most influenced the students' opinions, a regression model was run with the opinion as the dependent variable and the summed physical characteristics as the independent variables. Expected grade was also included as expected grade has been shown to influence student opinions. The regression models were both significant (f <.0001). All of the independent variables were significant positively related to the satisfaction variable except the sum of the technology related questions. The physical characteristics most closely related were seating and lighting.

Table 4: Student overall satisfaction Survey Scale: 5=strongly agree, 1=strongly disagree					
Survey Question	Updated	Standard	Difference	T	P
30. I enjoy coming to this class.	4.0532	3.561	.492	3.39	.0009
34. After this class, I have a sense of satisfaction.	3.6383	3.3049	.333	2.32	.0217

There were six questions pertaining to student evaluation of teaching effectiveness (questions 35-43). Only two of the questions were significantly different between the classroom types, as shown in Table 5. Students in the upgraded classroom perceived the instructor to be more organized, and they felt more strongly that they learned something new each class in the upgraded classroom. To evaluate which features of the classroom most influenced the students' opinions, regression models were run with the opinion as the dependent variable and the summed physical characteristics as the independent variable. Expected grade was also included as expected grade has been shown to influence student opinions. The regression models were both significant (f <.0001). Four of the physical features were significant positively related to the teaching variable: seating, lighting, hearing and general comfort. The technology in the room was not related to the opinion, nor, contrary to prior research, was the expected grade in the class.

Table 5: Student opinions of teaching effectiveness Survey Scale: 5=strongly agree, 1=strongly disagree					
35. I learn something new every time I come to class.	4.0957	3.7683	.327	2.17	.0310
36. The teacher seldom moves around the classroom to address students.	No significant difference				
39. The professor makes good use of technology to enhance student learning and communications.	No significant difference				
40. Class sessions and materials are well organized and coherently presented.	4.2553	3.939	3.16	2.18	.0307
41. Overall, the professor is very effective.	No significant difference				
42. The professor conveys passion/enthusiasm when teaching this course.	No significant difference				

LIMITATIONS

Before discussing the implications of the results, it is important to note some limitations of this study. First, this study used students from one university during one semester. Thus, the results might not generalize to other institutions. Second, the instructors and students knew the topic of the research was the classroom environment. The instructors might have subconsciously influenced the students to

be more negative towards the standard classroom, known as the Hawthorne effect (Babbie 1989). However, given that the overall evaluation of the instructor effectiveness and enthusiasm was equal between rooms and the instructors attempted to be neutral, we do not believe that the instructors influenced the results. Finally, the results are primarily from non-traditional aged students; 72% were older than 22, and 47% were working more than 30 hours per week. These older working students may have higher expectations of "professional" comfort than typical undergraduates. Tests to examine for this bias however, showed no relationship between age or hours worked and the physical characteristic variables.

DISCUSSION

Universities are expending millions of dollars to improve classrooms or build new educational facilities. The upgrades that universities purchase for classrooms and the schedule of improvements are both addressed in this paper. Results of the study suggest that college students do perceive differences in classrooms. They are particularly affected by classroom seating and overall classroom comfort. However, we do not find that room features affect student performance, as measured by expected grade in the course. This finding differs from research findings that have focused on K-12 education.

In terms of student satisfaction and student evaluation of teaching, we find that classroom features do impact satisfaction and certain aspects of the student evaluation of professors. Students enjoyed coming to class more and were more satisfied in the updated room. Further, the students rated their professors higher in teams of organization in upgraded classrooms, and they also indicated that they were more likely to learn something new each class in upgraded classrooms. This result is particularly interesting because the professors taught the classes using the same syllabus, the same exams, the same homework, the same books, projects, lecture notes, and lecture styles. Faculty members should be aware of this finding and attempt to mitigate the effects of less comfortable rooms by attempting to be more organized in standard classrooms. Also, administrators should be aware that room assignment can affect student evaluations and should rotate faculty assignments to upgraded rooms when feasible.

As universities face limited resources, the timing of classroom upgrades and detailed spending plans are important. The research finding that classroom upgrades do not impact performance suggests that students in upgraded rooms do not have a performance or overall learning advantage. Therefore, improvements should be made as funds become available.

The results of the study suggest that more comfortable desks and chairs, tiered seating, and lighting are more important to students than computing equipment in classrooms. It should be noted, however, that to keep the students in the course sections on an equal footing, the sections were taught without *requiring* classroom use of the desktop computers. In the upgraded classroom, the students had the option of using the computers for online note taking, or in the accounting systems class, for project work. However, the instructors teaching the classes observed little use of the desktop computers for course work. In fact the accounting systems professor reported students bringing laptops to class even when desktop

computers were available and both instructors reported instances of students being distracted by the availability of the desktop computers (using them to play games, shop, or check email). Therefore, because computing equipment tends to be a costly upgrade, this research suggests that upgrading classrooms to include computers at each desk should be limited to rooms for courses that require online testing or extensive computer usage during class meetings.

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