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Classroom Seating Considerations for 21st Century Students and Faculty

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This quantitative, cross-sectional research study explored students' perceptions of five different seating styles within typical classrooms in an urban public higher education institution. The five seating styles included: modern mobile chairs, tablet arm chairs, fixed tiered seating with tablet arms, rectangle tables with standard chairs, and trapezoid tables with chairs on casters. To operationalize measurement of student perceptions, the Classroom Seating Rating Scale for Students (CSRS-S) was developed from the classroom and seating design literature to measure the dimensions of Comfort & Space, Learning Engagement, and Interactivity. Across all dimensions, students rated significantly highest the modern mobile chairs and trapezoid tables with chairs on casters, while traditional tablet arm chairs and fixed tiered seating with tablet arms scored lowest. Results indicate the need for campuses to (re)consider the purposes and roles of seating styles within the 21st century classrooms, with seating selection based on principles of universal design.

Introduction

Learning environments symbolize an institution's vision of educational philosophy. Learning spaces should represent, too, the inclusivity of learners and educators in planned decision making to foster attainment of learning goals for all constituents, yet too often these decisions are made by those far removed from the classroom. Also, learning space should illustrate the value of a proactive strategic direction, but, despite the growing body of literature, many educational institutions remain handcuffed by dwindling budgets, enrollment concerns, and classroom seating capacities. If ignored or left unchecked, these spaces become misaligned to student and faculty expectations, resulting in, minimally, frustration with classroom spaces while, at worst, posing as true barriers and impediments to learning and teaching. To remain viable in today's competitive educational market, higher education institutions must acknowledge that learning and pedagogy are changing in the 21st century while reaffirming their commitment to facilities planning. Consequently, considering the needs of multiple stakeholder groups, especially students and faculty, becomes vital to this reaffirmation in order to adequately support modern educational practices and learning space planning.

Several institutions serve as best practice models for creating learning environments that promote active learning, critical thinking, collaborative learning, and knowledge creation (Warger & Dobbin, 2009). Leaders in innovative classrooms include North Carolina State University - the *SCALE-UP Project* (Beichner, 2008) and the *TILE* classrooms at the University of Iowa (Van Horne, Murniati, & Saichaie, 2012; Soderdahl, 2011). Also, the Active Learning Classrooms – *PAIR-up Model* at the University of Minnesota are critical references for designing and evaluating learning spaces (Whiteside, Jorn, Duin, & Fitzgerald, 2009; Whiteside, Brooks, & Walker, 2010). Texas Wesleyan University's *Classroom.NEXT Project* encouraged interdisciplinary teams consisting of both students and faculty to participate in the design of a next-generation classroom, illustrating how collaboration was central for success (Collier, Watson, & Ozuna, 2011). These institutions connote a shift in facilities planning and classroom design toward collaborative, student-centered solutions and outcomes, and incorporating the users into design planning becomes a helpful component of sound facilities planning (Hoskins, 2011; Potthoff, 2009).

As buildings age and student populations change, many higher education institutions might begin to review, plan for, and engage in these types of innovative renovations. Located in the City of Buffalo in Western New York, Buffalo State, State University of New York, is engaging in such discussions and facilities planning presently and for the future. According to their Facilities Master Plan, Buffalo State projects a capital expenditure estimate of $350 million from 2009 to 2016 to build or renovate 14 buildings that contain instructional spaces such as classrooms and teaching labs. Compared to the aforementioned innovative classrooms, many learning spaces at Buffalo State could be considered antiquated, and as academic buildings are constructed or renovated, new spaces should be planned with those ideal learning spaces in mind.

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One such project, the renovation of a museum gallery to an academic space with eight technology enhanced classrooms, led to the idea of examining classroom seating styles and configurations. During initial consultations concerning this renovation, it was noted that these spaces were air-conditioned, filled with natural light, and would be equipped with the latest educational technologies. Though the plan was to purchase traditional tablet arm chairs for these classrooms, the architects agreed to try something new. Hence, seating became a crucial component of this renovation project with the potential to transform each space into something other than the typical classroom.

An informal review of campus stakeholders revealed many specific criteria required in seating styles for these rooms. Each stakeholder had unique needs: the Registrar's Office requested a style that does not further reduce classroom seating capacity; Custodial Services required an easy-to-clean model with proven durability; Facilities Planning was concerned with overall spatial aesthetics; faculty advocated for easily movable seating to encourage active and collaborative learning; students wanted comfortable seating that accommodated different sizes, had adequate personal storage, and demonstrated sufficient surface workspace; and Disability Services requested unbiased "one seat for all" seating with solid back support, comfortable for most students with specialized needs, supporting individually wide ranges, preferences, and abilities related to body size and posture. Based on the stakeholder recommendations, the decision was made to outfit one classroom with modern mobile chairs with the goal of assessing the seating styles across campus.

Theoretical Context

Since Buffalo State is in the process of renovating several buildings containing academic classrooms, it became important to select a comparable modern chair that meets the needs of 21st century students and faculty. With numerous seating styles available in the furniture industry, guiding principles were necessary to select a chair or seating style which soundly supports classroom learning and modern teaching efforts. Many of the Principles of Universal Design developed by the Center for Universal Design (1997) at North Carolina State University were helpful in the seating selection process. The Instructional Resources Office of Buffalo State began looking at new and unique types of classroom seating styles that corresponded to the Principles and Nair and Fielding's eight truths about classroom comfort (Center for Universal Design, 1997; Nair & Fielding, 2007). To guide seating selection, the literature pertaining to classroom and seating design was reviewed, which further aided in the development of the survey instrument used for measurement within this study.

When applied within the context of higher education institutions, universal design is an approach which seeks to build and maintain a learning environment for all students and faculty (Shaw, 2011). The main Principles of interest in this study included: equitable use, flexibility in use, low physical effort, and size and space for approach and use. After considering and applying these principles to seating design characteristics, it was determined the modern chair needed to accommodate students of diverse shapes, sizes, preferences, and abilities. Equally important, though, was consideration of the instructor as user. Although they may not directly use the chair themselves, the chair becomes a classroom tool through which work, learning, and collaboration are realized. With the variety of pedagogical styles present in academe, the instructor should not be disregarded when it comes to seating selection.

As Salmen (2011, p. 13) stated, "…one size does not necessarily fit all…" and, as students and instructors become more diverse physically and relationally, providing options and alternatives within the classroom becomes essential (Scott, McGuire, & Shaw, 2003; Cornell, 2002). The construction of the chair needed to be comfortable and spacious, yet easily flexible, with multiple means of engagement, and facilitative of shifting tasks or purposes within the classroom. Embedding choice into the classroom is essential given the diversity of learners, instructors, and instructional modalities, and seating styles in classrooms are easily changeable environmental variables that impact choice, purpose, inclusivity, and functionality.

Literature Review

Although much research today is around the totality of the classroom learning space, this study focuses on issues pertaining to the classroom's seating style. As Cornell (2002) alludes, the furniture within classrooms not only is part of that environment but a tool within it as well. Cornell (2002) highlighted dimensions important to furniture design. One such dimension was "comfort, safety, and health" (pp. 35-36). Since students must sit for lengthy periods of time, static posture may impede learning, diminish attention span and concentration, and result in fatigue, drowsiness, or even pain or discomfort. Another dimension was "psychological appeal" (p. 37). Traditionally, learning predominantly was a solitary, internal process whereby information was transferred from the "expert" to the "student" via the standard lecture. However, modern pedagogies support a shift from passive learning to that of active learning. Thus, chairs and seating styles are necessary tools within the classroom environment

which facilitate methods of pedagogy and strategies for improving learning engagement and attention.

According to Espey (2008), student learning may be affected by various physical characteristics of a classroom, not the least of which is the chair or seating style. In fact, ergonomically correct chairs and seating styles are an important element in the physical learning environment, especially as the present student population changes in terms of body shapes and sizes. Milshtein (2006) reinforces the importance of ergonomic correctness. When seated, only 14 percent of an individual is supported by their feet while sitting; 86 percent of their weight is supported by the chair.

Research suggests sitting in fixed-type tables and chairs could affect the development of musculoskeletal disorders, poor posture, back pain, neck pain, and other health-related concerns (Thariq, Munasinghe, & Abeysekara, 2010; Milshtein, 2006). Breithecker (2006) points out that brain activity is reduced when the body becomes inactive, such as when students remain relatively motionless within traditional classrooms. Another study highlighted that incorrect computing, an activity in which sitting is common, may increase one's risk for back and neck pain and injury, resulting in missed school and work (Yildrim, Capanoglu, & Cagatay 2011). To prevent these types of health problems, Breithecker (2006) suggests engaging in active-dynamic sitting, which is accomplished through the use of a chair with a swivel feature and constructed to be flexible or open on all sides. Enabling any movement when seated encourages postural change, which promotes effective and continual movement. Such movement improves blood circulation, stimulates muscles, and allows pelvic and spinal shifting.

Another factor affecting chair and seating style selection appears to be its ability to foster teamwork and collaboration in the classroom. Some teachers and professors may think it is not feasible to adjust furniture in classrooms to accommodate different learning activities (Budge, 2000). However, learners do benefit academically from social interactions with their peers, and more and more campuses and faculty are supporting efforts to shift pedagogical styles when delivering content in courses (Joint Information Systems Committee, 2006; Whiteside, Brooks, & Walker, 2010; Beichner, 2008). Active learning, team-based learning, and problem-based learning are just a few examples of modern pedagogies for which classroom seating considerations are important. The research of Veltri, Banning and Davies (2006) provides examples of student comments about the social impact of furniture in the classroom. For those students, furniture facilitated group work and peer interaction, and students believed rooms without such furniture would not enable them to complete necessary coursework. Yildrim, Capanoglu, and Cagatay (2011) also emphasized the importance of seating arrangement in computer classrooms and how it contributed to collaborative learning and performance. Consequently, chairs and seating styles need a degree of flexibility and mobility to support the goals of active learning and teaching methods.

Flexible, easily configurable seating arrangements within classrooms and the ability to shift from lecture mode to group mode during a session are attributes desirable in modern classroom design (Brown & Lippincott, 2003; Gilbert, 2008). Hill and Epps (2010) researched the extent to which the overall classroom environment aligned with students' expectations, and they found the overall fit between the classroom and the students' values was predictive of student satisfaction. When that fit becomes incongruent or misaligned, student learning and tasks could be interrupted or halted, resulting in ill feelings toward the classroom, instructor, or even the institution. Furthermore, Espey (2008) found three-quarters of students indicated mobility of desks as one of the most important classroom features that positively influences their learning. Movability and maneuverability of seating is valued by 21st century students because it facilitates the ability to work in groups or teams, which is becoming more common within the classroom. When seating configurations need to be altered within class, students may expect inherently that the classroom environment, especially seating, will be moldable to the task or purpose at hand. Good seating design enables seamless and transparent change from task to task, but poor design likely evokes irritability, annoyance, or even anger about not being able to accomplish learning or teaching goals, thus interrupting comfort, learning engagement, and collaboration.

Methodology

Institutional Context

Established in 1871 as a teachers training institution (named then as "Buffalo Normal School"), Buffalo State is classified today as a Carnegie Master's/L institution. Based on Fall 2011 enrollment data, 11,659 students were enrolled overall, with 8,803 of those students designated as full-time undergraduates. Twenty-five percent of the institution's undergraduate enrollments are minority students, with 23 percent classified as underrepresented minorities. To date, this is the highest full-time undergraduate enrollment and highest percentage of minority students in the history of Buffalo State. Women represent 58 percent of total undergraduate enrollment. Average age of undergraduate students is 20.4 years. Since approximately 2,500 students

are housed on campus, arguably Buffalo State caters largely to the needs of a commuter population.

Procedure & Sample

The goal of this research study was to determine which classroom seating styles possessed design characteristics important to students and faculty. Their perceptions of and attitudes toward those characteristics (or lack thereof) would influence their satisfaction ratings with those styles. During the Fall 2011/Spring 2012 semesters, after the IRB proposal was approved, seating styles or configurations were examined in classrooms across the campus. After extensive consideration of the literature, reviewing stakeholder input, and comparing marketing materials from classroom furniture retailers, the Director of Instructional Technology selected and purchased a modern mobile chair for testing within one classroom. Five total seating styles were selected for comparison: modern mobile chairs, tablet arm chairs, fixed tiered seating with tablet arms, rectangle tables with standard chairs, and trapezoid tables with chairs on casters. (See Figures 1a through 5b for photos of these styles and their associated classrooms.)

Figure 1a.

Figure 2a.

Figure 3a.

Figure 4a.

Figure 5a.

Since the modern mobile chair seemed to possess design characteristics valuable to the expectations of today's students and faculty, it was hypothesized those chairs would score significantly higher than the other seating styles.

For each style, the total number of courses taught in the identified classrooms was determined, and a random sample was preselected for survey outreach. Instructors assigned to teach a course in a preselected room were sent a package containing an instructional memo, the Classroom Seating Rating Scale for Faculty (CSRS-F), and copies of the Classroom Seating Rating Scale for Students (CSRS-S). Instructors were asked to complete the faculty survey, administer the student questionnaires in class, and return

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Figure 1b.

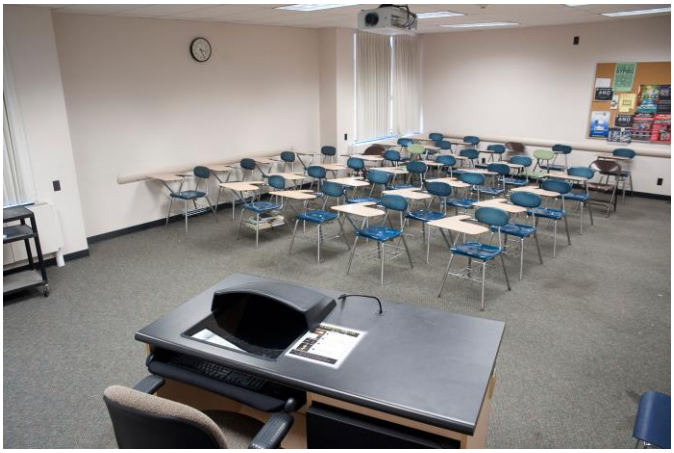

Figure 2b.

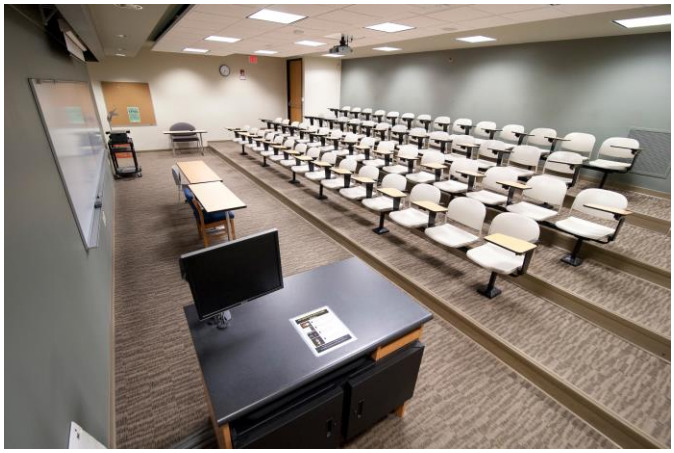

Figure 3b.

Figure 4b.

Figure 5b.

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Seating Category	Number of Valid Surveys (N)
Modern Mobile Chairs	196
Tablet Arm Chairs	123
Fixed Tiered Seating with Tablet Arms	266
Rectangle Tables with Standard Chairs	131
Trapezoid Tables with Chairs on Casters	147
Total	**863**

Table 1. Number of Valid Surveys by Seating Category

completed surveys to the researchers. Utilizing a cross-sectional approach to data collection, 45 of the 73 packets were completed and returned during the Fall 2011 and Spring 2012 semesters (62 percent return rate). A final total of 863 student surveys were completed and returned. Due to a lower faculty response rate, it was determined to continue efforts at collecting data from that group. Consequently, only student data is reported in this study, and Table 1 illustrates the breakdown of valid student surveys by seating category.

Instrument

To operationalize measurement of seating satisfaction, the *Classroom Seating Rating Scale for Students* (CSRS-S), comprised of 15 Likert-type items, was conceptualized from principles of modern seating design and universal design and access (see Appendix). In general, the CSRS-S measures students' perceptions of and satisfaction with classroom seating styles. The CSRS-S was developed to assess rapidly the types of classroom seating on campus with the goal of using data to drive future furniture purchases. Development emphasized the importance of being able to administer and complete the scale quickly and efficiently to minimize disruption of class time and instruction. In this study, scale items were scored as follows: Strongly Agree = 5; Agree = 4; Neutral = 3; Disagree = 2; Strongly Disagree = 1. Items 1, 2, 4, 8, and 10 were phrased in the negative and needed to be reverse-scored to maintain scoring equality with other items. Overall scale scores could range from a low of 15 to a maximum of 75, with higher scores indicating a more positive degree of satisfaction with that seating style.

Psychometric analysis of the CSRS-S was based on 817 valid cases. Items with any missing or indeterminable values were excluded from analysis. Results indicate a Cronbach's alpha reliability coefficient of .93. Confirmatory factor analysis supports a three-factor model indicative of the following scale sub-dimensions related to seating satisfaction: Comfort & Space, Learning Engagement, and Interactivity. Headings and items for these sub-dimensions were self-selected to stem conceptually from the literature on classroom and seating design and universal design. Confirmatory factor analysis supports a three-factor model indicative of the following scale sub-dimensions related to seating satisfaction: Comfort & Space (items 1, 2, 5, 9, 10), Learning Engagement (3, 4, 8, 12), and Interactivity (6, 7, 11, 13, 14, 15).

Results

A one-way, between-subjects Analysis of Variance (ANOVA) was conducted to determine if the type of seating style within the classroom affected overall student survey scores of seating satisfaction. The Levene Test for Homogeneity of Variances indicated equal variance and, thus, supports the usage of ANOVA ($F[4, 812] = 2.17$, $p > .05$). Results of the one-way ANOVA revealed significant differences in overall student survey scores between seating styles ($F[4, 812] = 178.29$, $p < .05$). Post-hoc comparisons were performed using Scheffe's test, and, due to the number of seating factorial conditions, those results are reported more concisely in Table 2. To further clarify groups of seating scores, three homogenous subsets were determined and reported in Table 3. For sake of reference in this section, those subsets include the following seating categories: Subset 1 = modern mobile chairs, and trapezoid tables with chairs on casters; Subset 2 = rectangle tables with standard chairs; Subset 3 = tablet arm chairs, and fixed tiered seating with tablet arms. Post-hoc results indicated significantly more positive perceptions of modern mobile chairs and trapezoid tables with chairs on casters than the other three seating styles. However, their scores did not differ significantly from each other and, thus, are classified as Subset 1. Tablet arm chairs and fixed tiered seating with tablet arms (Subset 3) scored significantly lowest compared to the other three seating styles, and since their scores, too, did not differ significantly from one another, they were classified together as Subset 3. Rectangle tables with standard chairs (Subset 2) scored in the middle. They did not score as highly as Subset 1, but they scored significantly higher than Subset 3. Graphically, Tables 4-7 depict overall and sub-dimension scale scores for each seating category.

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Seating Category	Comparison Seating Category	Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Modern Mobile Chairs	Tablet Arm Chairs	17.772*	1.069	.000	14.47	21.07
	Fixed Tiered Seating with Tablet Arms	17.832*	.878	.000	15.12	20.54
	Rectangle Tables with Standard Chairs	11.899*	1.043	.000	8.68	15.12
	Trapezoid Tables with Chairs on Casters	-.908	1.003	.936	-4.01	2.19
Tablet Arm Chairs	Modern Mobile Chairs	-17.772*	1.069	.000	-21.07	-14.47
	Fixed Tiered Seating with Tablet Arms	.061	1.015	1.000	-3.07	3.19
	Rectangle Tables with Standard Chairs	-5.873*	1.161	.000	-9.46	-2.29
	Trapezoid Tables with Chairs on Casters	-18.680*	1.125	.000	-22.15	-15.21
Fixed Tiered Seating with Tablet Arms	Modern Mobile Chairs	-17.832*	.878	.000	-20.54	-15.12
	Tablet Arm Chairs	-.061	1.015	1.000	-3.19	3.07
	Rectangle Tables with Standard Chairs	-5.934*	.987	.000	-8.98	-2.89
	Trapezoid Tables with Chairs on Casters	-18.740*	.946	.000	-21.66	-15.82
Rectangle Tables with Standard Chairs	Modern Mobile Chairs	-11.899*	1.043	.000	-15.12	-8.68
	Tablet Arm Chairs	5.873*	1.161	.000	2.29	9.46
	Fixed Tiered Seating with Tablet Arms	5.934*	.987	.000	2.89	8.98
	Trapezoid Tables with Chairs on Casters	-12.807*	1.100	.000	-16.20	-9.41
Trapezoid Tables with Chairs on Casters	Modern Mobile Chairs	.908	1.003	.936	-2.19	4.01
	Tablet Arm Chairs	18.680*	1.125	.000	15.21	22.15
	Fixed Tiered Seating with Tablet Arms	18.740*	.946	.000	15.82	21.66
	Rectangle Tables with Standard Chairs	12.807*	1.100	.000	9.41	16.20

* The mean difference is significant at the 0.05 level.

Table 2. Scheffe test. Post-Hoc Comparisons

	Seating Category	N	Subset for alpha = 0.05		
			1	2	3
Scheffe[a, b]	Modern Mobile Chairs	184	57.17		
	Tablet Arm Chairs	116			39.40
	Fixed Tiered Seating with Tablet Arms	247			39.34
	Rectangle Tables with Standard Chairs	126		45.27	
	Trapezoid Tables with Chairs on Casters	144	58.08		
	Sig.		1.000	1.000	.943

Means for groups in homogenous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 151.58
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Table 3. Homogeneous Subsets

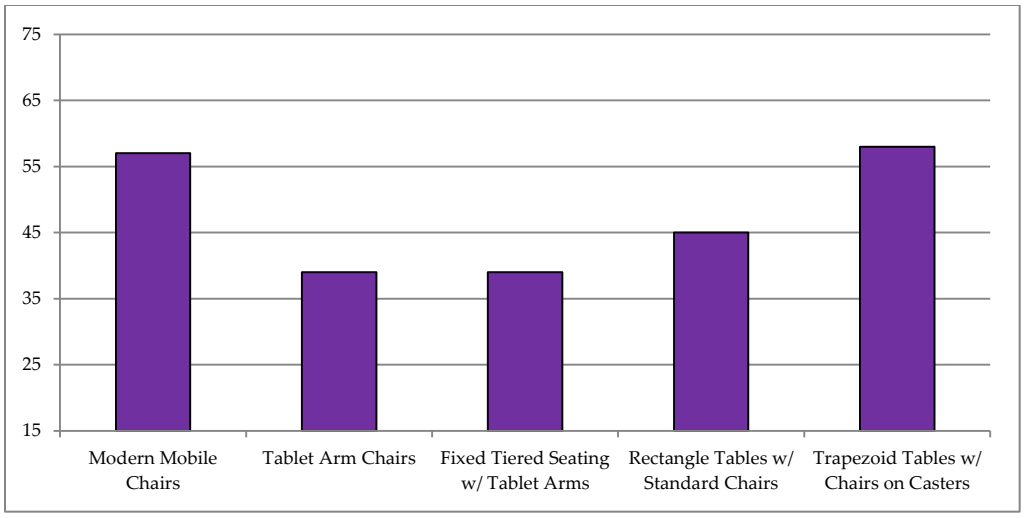

Table 4. Overall Satisfaction Scores: Total Ratings.

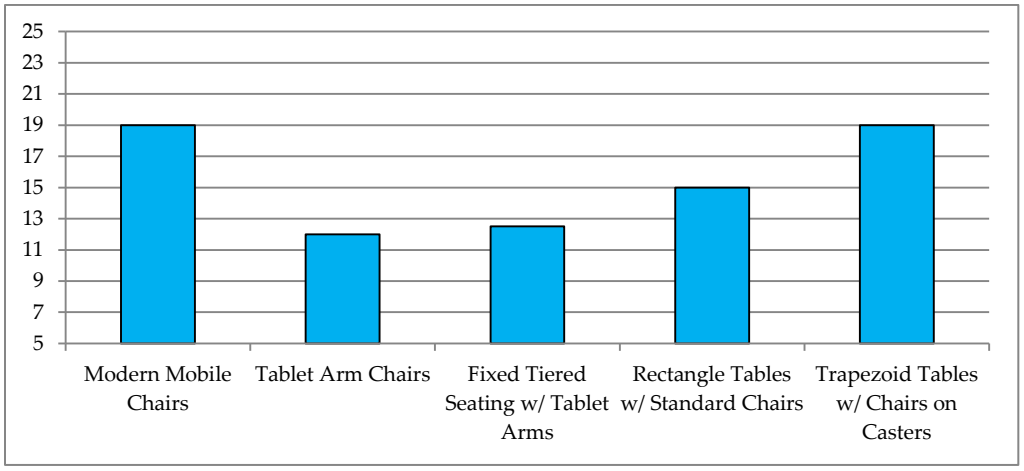

Table 5. Seating Scores for *Comfort & Space*

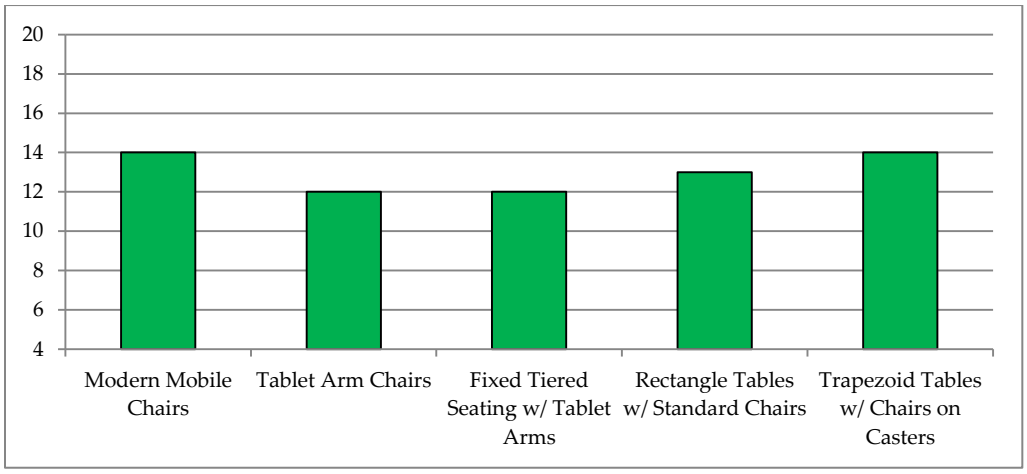

Table 6. Seating Scores for *Learning Engagement*

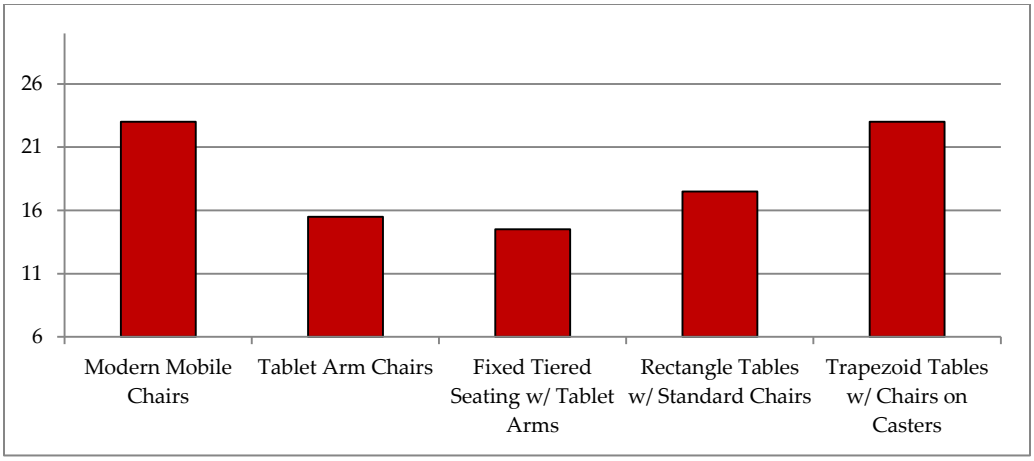

Table 7. Seating Scores for *Interactivity*

Discussion

As hypothesized, students seemed more satisfied with the modern mobile chair than most other seating styles with the exception of trapezoid tables with chairs on casters. Although inherently different, the two seating styles in Subset 1 seem to possess design characteristics important to students. One design feature of clear importance appears to be mobility. For Subset 1 styles, casters enable mobility for quick, easy transitions between various modes of teaching, learning, and task, and mobility, too, might ensure a sense of flexibility within the classroom space. The ability to swivel or pivot easily helps keep an open line of sight between the student and instructor, with visual focal points (e.g. a whiteboard, screen projections, etc.), and with other students. Even the personal work surfaces for each of these seating styles are movable – the modern mobile chair via its swivel arm, and the trapezoid table via its casters. Mobility fosters interactivity as well. The lack of mobility in Subsets2 and 3 might hinder or prohibit the ability for students and instructors to engage in collaborative work. Without that type of flexibility, traditional forms of instruction or activity, such as the lecture, may work best in those classrooms. Also, mobility likely spurs postural change and physical movement, which, in turn, promotes active sitting. As the literature review showed, passive sitting may cause negative health effects to students sitting in less-than-mobile seating configurations, which results in diminished comfort if not lethargy or pain, and more than likely those symptoms staunch the ability to concentrate, focus, and learn effectively.

Chairs in Subset 1 have other characteristics which cater to comfort and space. The open seat designs offer easy, non-restrictive access in and out of the seat itself, and they tend to be suitable for people of most shapes, sizes, and abilities. The work surfaces accommodate both left- and right-handed students and are large enough to hold students' personal belongings and work tools (e.g. backpacks, notebooks, computing technologies, books, etc.).

In fact, the modern mobile chairs have a raised storage space as part of its tripod base just under the seat. Particularly at Buffalo State, which typically receives a lot of snow in the winter, it prevents those belongings from resting on slushy, dirty floors.

However, the traditional tablet arm chairs and fixed tiered seating seem less than comfortable. The physical sitting space for these seats is limiting for people of above-average heights or girths, and not only is this uncomfortable physically but also socially as well, resulting in feelings of awkwardness, irritability or embarrassment. Their work surfaces may be less than desirable, too.

Twenty-first century students need space for a multitude of belongings, whether educational, technological, or personal, and small work areas simply will not be viewed positively. These seats typically face forward in classrooms, and if group work is necessary it may be difficult to maneuver these seats into small groups due to their heaviness. Typically these seats are constructed of metal and thick, hard plastic materials to maintain durability, but those materials also pose as challenges or barriers to people with more physically unique needs or abilities.

The rectangle tables with standard chairs have a wide work area but are narrow in depth. Students may have a greater ability to "spread out" physically, but the work surface may not enable collaborative work since their narrow depth inhibits students from sitting across from one another without putting two or more tables together (which is quite difficult given their length). Plus, this seating arrangement is not easily changeable or reconfigurable due to the length of the tables, the lack of casters on both tables and chairs, and their weight. However, large group

discussions may be possible as typically the tables are positioned in a large U-shape where students can see around the room and converse easily with one another. Thus, collaborative interaction and active learning may be limited rather than prohibited. These plausible reasons may be why the rectangle tables with standard chairs scored higher than seating arrangements in Subset 3 but not as highly as those in Subset 1.

Limitations & Threats to Validity

This study examined the impact of seating on students' satisfaction, but other environmental factors or conditions play important roles, too, within the classroom. As Griffin (1990) and Banning (1993) discussed two decades ago, the classroom is a behavioral setting comprised of the physical environment aspect and the human or social aspect. Even then, person-in-environment theories pertaining to spatial arrangements within classrooms, visual design factors, aural factors, touch and movement, and other sensory stimulation variables were debated intently (Griffin, 1990; Banning, 1993). Current research continues to examine the impact of classroom environment variables as factors which affect instruction and learning. Room temperature, presence of natural light, seating capacity, seating location, and room size are only a few other classroom environment variables which might affect student perceptions of and satisfaction with learning spaces (Veltri, Banning, & Davies, 2006; Winterbottom & Wilkins, 2009; Fernandes, Huang, & Rinaldo, 2011; Burgess & Kaya, 2007).

Separately, seating styles may not necessarily "cause" students to learn better or worse, and these results should not be interpreted in such a way. To quote Aristotle, "the whole is greater than the sum of its parts." A learning space is much more than a physical manifestation of parts within a classroom, yet each part is a valuable, necessary component of the whole. Many factors comprise a sound learning space, and those factors, as a whole, may contribute more greatly to effective learning and instruction. For example, Subset 1 seating tends to be more mobile than traditional chairs, which likely fosters greater interactivity. This phenomenon is important to, say, team-based learning pedagogy, and it becomes difficult, if not impossible, to differentiate the effects of the classroom environment from the instructional modality. However, as a whole, it may be true that students learn better from that teaching modality within a modernized classroom environment, of which seating is a part.

For experimentation, this study compared a specific brand of chair to traditional seating arrangements at Buffalo State. Clearly a multitude of other seating styles could be used for further study, and the designs, layouts, and configurations are almost limitless due to the creativity and talent of architects, furniture designers, and facilities planners. Even the campus context of "traditional" seating may vary between institutions, making it difficult to determine what is "modern" or "antiquated" for a given campus. Seating designers and researchers might target student subpopulations as a marketing focus, such as catering to gender preferences, age groups, and people of different sizes and abilities. These styles could be examined, too, from the angles of various stakeholder groups other than students, such as faculty, cleaning staff, disability services staff, and others. True, students and instructors need the classroom as a working and learning space, but other stakeholders should not be overshadowed unnecessarily.

Conclusion

The results of this study provided a foundation and justification for future classroom design and subsequent purchase of modern mobile chairs for the eight technology enhanced classrooms renovated in the former art gallery. As further evidence of impact, trapezoid tables and chairs on casters were selected for the next academic building's generally scheduled technology enhanced classrooms. Two buildings currently in the schematic design phase are planning for classroom furniture that models the modern mobile chair.

While this study achieved the goal of using data to drive future furniture purchases, there is a lingering question of how to refresh classrooms in buildings not undergoing renovation. To recognize the physical characteristics of a space, it should be noted that simply exchanging tablet arm chairs with modern mobile chairs in a one to one ratio is difficult due to the size of the base and range of the swivel tablet. One must take into account that a crowded area hinders movability, resulting in the diminishment of one of its greatest strengths: flexibility. Also, changing the furniture in a classroom space may not be seen as an incentive to change teaching style. A research area to consider involves how institutions encounter barriers to new learning space adoption and use. At Buffalo State, the results of this study led to many discussions including: future directions for professional development, the capacity of current staffing to provide more than technical support for faculty encouraged to teach in new learning spaces, why some faculty adapt to the renovated classroom while others do not, and effect of cultural changes in tenure and promotion (Warger & Dobbin, 2009; Beichner, 2008).

Although the CSRS-S did not provide a section for survey participants to add comments, this did not prevent students from sharing their thoughts. One such comment from a classroom with trapezoid tables and chairs on casters was quite illuminating: "I have mobility issues and cannot get my scooter into room. The seats in the classroom made it difficult for me to move around in the classroom."

This issue led to an encouraging, spirited discussion on a potential study to include a comparison of the two seating styles from Subset 1 in relation to the shape, size (square footage), and physical characteristics of the classroom space. Such a study would need to take into account the impact of reducing the number of seats available in an instructional space, possibly involving the stakeholders from offices responsible for enrollment management.

Future research may attempt to determine corollaries between movable furniture, in particular the modern mobile chair, and literature about student and faculty satisfaction with learning environments, some directly related to seating type (tablet arm chairs) and seating arrangements (rows and columns, U-shaped configurations). Literature suggests seating arrangements are important for student satisfaction and academic achievement. However, movable furniture may create learning disruptions to students who prefer seats in the back or front of the classroom. Being told to move into groups in a different part of the classroom may create feelings of ill will for some students with alternative preferences. Consequently, considering the needs of multiple stakeholder groups, especially students and faculty, becomes vital to this reaffirmation in order to adequately support modern educational practices and learning space planning, and involvement of those users may promote acceptance of changes to learning spaces.

Efforts geared toward such renovations and other capital expenditures could be strengthened through data-driven advocacy and outreach. If replicated on other campuses, similar results could lead to the procurement of new seating and, possibly, other classroom (re)design initiatives. These findings can be important and relevant to those in higher education who make decisions about infrastructure and/or capital investments in the upgrading of classrooms and other types of learning spaces. Even more broadly, they can be used to realign the strategic mission of facilities planning with that of modern educational practices and methodologies. One way to achieve this goal is to provide flexible, comfortable learning spaces that encourage interactive, collaborative work. Although seating may be only one element among a multitude of design considerations, it is one of the most easily changeable variables in classroom learning environments, and one that may be more important than people think.

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Appendix 1.

Buffalo State
State University of New York

Classroom Seating Rating Scale (CSRS) for Students

This survey is designed to gather information from students at Buffalo State College to determine classroom seating needs and preferences. The results data will be used for the college to decide upon future classroom seating. You must be 18 years of age or older to participate in this survey. Participation is voluntary, anonymous and should pose minimal risk to participants. Your submission of answers is your consent to participate. Resulting data will be retained for three years in compliance with federal regulations.

Item	Degree of Agreement*				
These seats are uncomfortable.	SA	A	N	D	SD
These seats cause pain while I sit in them.	SA	A	N	D	SD
I can concentrate well while sitting in these seats.	SA	A	N	D	SD
I cannot focus well while sitting in these seats.	SA	A	N	D	SD
These seats are more comfortable than other types of seats in other classrooms.	SA	A	N	D	SD
It is easier to talk to other students when sitting in these seats.	SA	A	N	D	SD
These seats make it easy to engage in group work.	SA	A	N	D	SD
These seats bother or disrupt other students.	SA	A	N	D	SD
I have enough table space to work easily in class.	SA	A	N	D	SD
It is difficult to store my stuff at my seat.	SA	A	N	D	SD
These seats helped the instructor to connect better with the class and me.	SA	A	N	D	SD
I could engage in learning better/more easily while sitting in these seats.	SA	A	N	D	SD
These seats enabled a variety of classroom activities.	SA	A	N	D	SD
I can participate more actively in classroom exercises using these seats.	SA	A	N	D	SD
The seating enhanced in-class exercises.	SA	A	N	D	SD

***SA=Strongly Agree, A=Agree, N=Neutral, D=Disagree, SD=Strongly Disagree**

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