Reconsidering the Learning Environment (Literature Review)

Introduction

City Tech has a firmly established policy of pragmatically filling General Education (GenEd) classrooms with tablet arm chairs for students to sit facing the front of the room where the professor's equipment is situated (desk, chair, podium, computer technology, and writing surface) for projecting information and learning experiences to the waiting minds of receding students. The need for this arrangement rests on the need of maximizing the seating for City Tech's growing student enrollment, but its continuance without reflection depends on an institutional and historical inertia for pedagogical models of the past and different generations of students than we now have. However, pedagogical research on improving student learning outcomes through reconfigurations of teaching spaces, utilization of innovative classroom furniture, and enhanced environmental conditions of learning spaces point the way forward for all higher education but more specifically for our college, which is itself reconfiguring itself as a leader within CUNY and the region. Simply put, the research on improving classroom spaces demonstrates an improvement in student learning outcomes without any changes to course content or pedagogical techniques. Essentially, improving the learning space will improve student success, which will in turn improve retention rates, graduation rates, and overall student development.

The literature review below discusses recent findings in the field of classroom design. It is organized in three sections: Philosophy, Furniture, and Environment.

Reconsidering Classroom Design Philosophy

As reported widely in contemporary pedagogical research, Wulsin argues that, "The traditional transference model of education in which a professor delivers information to students, is no longer effective at preparing engaged 21st-century citizens. This model is being replaced by constructivist educational pedagogy that emphasizes the role students play in making connections and developing ideas, solutions, and questions. Already, teachers are creating active learning environments that place students in small work groups to solve problems, create, and discover together" (Wulsin 2). The driving need for this change is, "To prepare students to be effective agents of change in a complex and interconnected world" (Wulsin 6). One of the most effect ways to accomplish this has to do with classroom design: "Well-designed space has the ability to elevate discourse, encourage creativity, and promote collaboration" (Wulsin 2). Considering the needs of City Tech GenEd classrooms, which need to accommodate the pedagogical approaches of many different teaching styles and subject matter, flexibility ensures these things: "Within the classroom walls, learning space should be as flexible as possible, not only because different teachers and classes require different configurations, but because in order to fully engage in constructivist learning, students need to transition between lecture, group study, presentation, discussion, and individual work time" (Wulsin 2). This flexibility for the classroom space mean that, "classrooms should be effective in multiple configurations" (Wulsin 14). Some of the possible, "Classroom configurations include linear (lecture, presentation, video), horizontal (class discussion), cluster (small group discussion and activities), and network

(decentralized instruction)" (Wulsin 14). The linear configuration represents the majority of City Tech classroom setups. City Tech classrooms can be reconfigured into other classroom arrangements, but they can only be done so by moving top-heavy tablet arm chairs noisily across the floor, which disturbs neighboring classrooms and offices above, below, and to the sides of the reconfigured classroom during each reconfiguration.

There are a number of university centers and higher education programs involved in planning, testing, and reporting on innovative classroom design for improved student outcomes. Some of these include SCALE-UP (Student-Centered Active Learning Environment for Undergraduate Programs), TEAL (Technology Enhanced Active Learning), The Link (flexible classrooms at Duke University), and ATLAS (Alliance for Technology, Learning, and Society at UC-Boulder). Another is the Center for the Enhancement of Teaching and Learning (CETL) at the Georgia Institute of Technology (Georgia Tech), which promotes best practices in all aspects of improving student learning outcomes, including those focused on classroom design and environment. Considering the need for better student learning outcomes, they argue for five philosophical principles of good classroom design: 1) "Classrooms should facilitate student engagement," 2) "Classrooms should facilitate student collaboration," 3) "Classrooms should facilitate connections between teachers & students," 4) "Classrooms should incorporate appropriate technology," and 5) "Classrooms should have flexible physical arrangement" (CETL 1). All of these apply equally to "Ramblin' Wrecks from Georgia Tech" as City Tech's students enrolled in GenEd classes.

CETL's philosophy for improved engagement, collaboration, and flexibility is supported by Baepler and Walker's work on active learning classrooms (ALCs), namely "*educational alliances* between students and instructors and among students, *relationships* that help to improve both the student learning experience and the learning outcomes that students achieve" (Baepler and Walker 27). In their study, Baepler and Walker's "focus on alliance is built on the general proposition that the social context in which teaching and learning takes place can affect, either positively or negatively, student academic and developmental outcomes" (Baepler and Walker 28). In addition to finding that the most effective learning involves active participation by students and instructors, they find that, "many aspects of the ALC design promote effective communication and feedback, in particular *proximity*, *new lines of communication*, the use of appropriate *technology*, and the promotion of *higher quality communication*" (Baepler and Walker 33). With the non-hierarchical structure of an ALC, communication flows in different directions between students and instructor, and among students, which supports more ways of sharing, discovering, and questioning. They describe how "the physical configuration of the ALCs, in particular the round tables, is designed to facilitate [student cooperation on projects and assignments]" (Baepler and Walker 35). While they focus on ALC classroom design centered around a node or round table-focused design, a classroom with furniture supporting reconfiguration and flexibility can be utilized by a City Tech professor wishing to deploy ALC in her pedagogy.

Supporting the concept of space as a key component of student success, the National Learning Infrastructure Initiative (NLII), an Educause Program, argues that changing ideas about space (physical and virtual), and deepening understanding about how space affects how we learn has led to a fundamental shift in classroom design away from traditional classrooms to learning spaces. They state that, "As a result, the notion of a classroom has expanded and evolved; the

space need no longer be defined by 'the class' but by 'learning.' Learning space design as an important consideration for colleges and universities" (NLII 1). They discuss how "designing space is an important institutional activity" that "[conveys] an image of the institution's philosophy about teaching and learning" (NLII 1). Due to the usefulness demanded of buildings (50-100 years), pedagogical trends (10 years), and technology (annual), they assert that, "the stakes are too high to risk settling for inadequate design" (NLII 1). More to the point, they argue that, "Learning, rather than heating systems, lighting controls, or computer projectors, should be at the center of learning space design" (NLII 1). They provide six components to learning space design. First, "the vision for a learning space derives from the underlying learning philosophy of the institution and its programs," and it should include, "A focus on learning," and "the interactive campus" (NLII 2). They identify analysis as the second step: "Before beginning the design of a learning space, several types of analysis and information gathering are recommended," and the areas of analysis include: "Disciplinary needs," "External benchmarking," "Learning modes," "Existing space use," "Gap analysis," and "Curricular reform" (NLII 3-4). The third component is assembling the appropriate team to create the learning space design, and it involves reaching out to all stakeholders and involving advocates who can put the design into practice (NLII 4). The fourth component is the design considerations, which includes, "A number of principles, considerations, and constraints [that] can impact learning space design. Maintaining a balance among these factors, while keeping learning as the primary objective, is a critical role for institutional leaders" (NLII 5). Design considerations include: "Design learning spaces around people," "Support multiple types of learning activities," "Enable connections, inside and outside," "Make space flexible," "Accommodate information technology," "Design for comfort, safety, and functionality," and "Reflect institutional values" (NLII 5-6). The fifth concern is policy considerations, such as the very important need for accessibility. Finally, the sixth component is assessment: "Ongoing assessment of learning spaces results in iterative design and continuous improvement" (NLII 6). The result of good learning space design has the potential to pay tremendous dividends for the institution as a whole: "Good learning space design can support each institution's mission of enabling student learning. In fact, the convergence of technology, pedagogy, and space can lead to exciting new models of campus interaction" (NLII 7). With City Tech's evolving mission as a senior college faced with goals of improving student retention and graduation rates, good learning space design seems like an easy way to meet those goals while adapting a design that also reflects City Tech's institutional values.

Reconsidering Classroom Furniture

Considering the already-existing configuration of City Tech's current GenEd classroom space, flexibility can be most easily acquired through new types of furniture that fulfill the current focus on tablet arm chairs while adding new affordances that transform the current transmission classroom designs into dynamic active learning environments.

Steelcase Education, a furniture manufacturer for educational environments, collaborated with academic researchers to test perceptual differences to learning between traditional/transmission pedagogy classrooms and new/active learning pedagogy classrooms through a self-reported assessment by students and faculty they called the Active Learning Post Occupancy Evaluation (AL-POE) tool (Scott-Webber et al. 1). They note that, "The success of any student is influenced

by many variables. Academic studies have investigated several of them, from socioeconomic background to internal motivation to the influence of different teaching styles. Still often overlooked or underemphasized is the role of classroom design" (Scott-Webber et al. 1). They go on to say that, "More recently researchers have explored how a learning environment impacts students. The consensus is that learning spaces have physical, social, and psychological effects" (Scott-Webber et al. 2). Having students and instructors use a traditional classroom or one of Steelcase Education's scenarios (Verb, Node, media:scape, or LearnLab) without any "training from Steelcase on active learning practices. The settings were simply provided for their use as they saw fit" (Scott-Webber et al. 2), they found in the self-reported results that indicate "a highly positive and statistically significant impact of active learning classrooms on student engagement" (Scott-Webber et al. 3). Specifically, they report that the new classroom environments "improved active learning practices and had more positive impact on engagement compared to the old classrooms" (Scott-Webber et al. 3), "the majority of students rated the new classroom better than the old classroom on each of the 12 factors [collaboration, focus, active involvement, opportunity to engage, multiple means, in-class feedback, real-life scenarios, ways of learning best, physical movement, stimulation, comfortable to participate, and enriching experience]," "Overall, active learning practices and the impact of the physical space significantly improved in the new classrooms for both students and faculty," and finally, "The majority of students and faculty reported that the new classrooms contributed to higher engagement, the expectation of better grades, more motivation and more creativity" (Scott-Webber et al. 4). Based on their findings, they suggest, "As a result of the development of the evaluation instrument and this managed research program, decision makers at educational institutions, architects and designers can be assured that investments in solutions intentionally designed to support active learning can create more effective classrooms and higher student engagement" (Scott-Webber et al. 5). However, they also recommend training for faculty to maximize the learning possibilities for students using the new layouts and furnitures.

Bidwell discusses the classroom configurations tested by Steelcase Education and reported by Lennie Scott-Webber, Aileen Strickland, and Laura Ring Kapitula in the white paper annotated below, "How Classroom Design Affects Student Engagement." In addition to illustrating the types of configurations and how they were used at Ball State University and University of Minnesota-Rochester. Gary Pavlechko of Ball State tells Bidwell that, "Never did I realize just how valuable a piece of furniture can be to how one perceives the learning opportunities" (qtd. in Bidwell par. 7). He goes on to say that faculty members in the redesigned classrooms, "[seem to be] getting lost within the learning space," and ""They have become so much a part of the learning experience, versus being just the teacher in the process. . . . Direct instruction has been around for a very long period of time, but when we talk about true learning, most experts will say that in order to understand how to teach effectively, you have to be yourself an effective learner" (qtd. in Bidwell par. 15-16). Bidwell reports that Ball State faculty have to go through a "six-semester professional learning process, which in part involves observing already-trained faculty" (Bidwell par. 17), because they only have a few classrooms currently configured with this new furniture and they want to ensure that those faculty assigned to those classrooms will use its affordances for the benefit of students.

Mirror the studies above, Henshaw and Reubens report in their case study how one simple change--adopting a new desk--achieves modest goals for active learning in a traditional classroom space. The reason behind their modest experiment is true for many institutions

including City Tech: “Unfortunately, much of the time that students set aside for learning does and will continue to take place in classrooms that are not schedule for major renovation, and in buildings that were not designed with broader learning goals in mind. As a result, most institutions are left to consider more immediate options for making classroom space suitable for the evidence-based interactive instructional methods that a growing number of faculty members are adopting” (Henshaw and Reubens par. 1). Considering how best to use available dollars for the greatest active learning impact on a traditional classroom, they note, “Some of the most cost-effective solutions are updates on traditional designs” (Henshaw and Reubens par. 7). They settled on the tablet arm chair, which they explain, “is almost ubiquitous in campus classrooms throughout the world. The primary enhancements to the design include the use of casters, more flexible surface work space, and beneath-seat storage options for student book bags and other personal items. None of these represent revolutionary innovations, but together they begin to address a pressing need in the typical college classroom” (Henshaw and Reubens par. 7). For their experiment, they note the availability of The Node by Steelcase, but they partnered with Kreuger International (KI) and campus stakeholders to design a new adjustable, tablet arm chair on castors dubbed the KI Learn2. On using the KI Learn2 tablet arm chairs, students and faculty reported it taking less time to move desks, it generating less noise when moving desks, and it being more comfortable due to the tablet being adjustable and larger than typical tablet arm chairs. Faculty also appreciated being able to move around the room more easily (except when bookbags littered walk spaces as the KI Learn2 has no under-chair storage space), and being able to work more closely with individual or teams of students by simply pulling up a chair or having students bring their chairs to where the instructor is seated.

Cornell argues that new furniture and classroom arrangements enable the work of education and learning, which in turn, produces graduates ready for a rapidly changing workplace. He argues, “Furniture is both tool and environment,” which until recently supported, “[an] educational system suited [to] the industrial economy” (Cornell 33). He advocates for change, because, “The industrial economy has given way to the knowledge economy” (Cornell 33). This is even more true for our students at City Tech and their future careers. In the knowledge economy, he sees education and work as being closely aligned as a reciprocal cycle of learning and work, which necessitates changes to the tools that make learning and doing possible: “Successful leaders realize they need learning organizations. Successful educators realize they need to prepare a different breed of citizen. In a sense, work needs to become more like school, where learning is an expected part of the job. And conversely, school needs to become more like work, anticipating the kinds of skills and knowledge students will require for a happy and successful life. Work activity, or pedagogy in the case of education, has changed drastically. New methods require new tools and environments. Since furniture is a tool with a specific function, it too must change” (Cornell 34). He frames the need for change in classroom furniture around “user-centered design,” with the users being: “instructors and learners” (Cornell 35). He suggests four, interdependent dimensions for designing the best user-centered furniture: 1) functionality, 2) comfort, safety, and health, 3) usability, and 4) psychological appeal (Cornell 35). Importantly, he notes that some cannot be favored over all, because “Unlike Maslow’s, this is not a hierarchy of needs. The dimensions are not additive but multiplicative--poor performance on one undermines the performance of the overall system. Furniture must address all four simultaneously or the efficacy of the design is in question” (Cornell 35). Furthermore, he reminds us to see the bigger picture: “The best solution is one in which furniture, architecture, and technology are designed to work seamlessly and harmoniously” (Cornell 35). While all

dimensions are important, his discussion of functionality adds to the specifics of furniture adaptability: “Furniture should help the instructor and student achieve their goals using the methods and tools of their choice. Furniture should facilitate learning, not just be a place to sit” (Cornell 37). In one case of deploying new furniture selected for maximizing the four dimensions, he and his fellow researchers found, “First, all four aspects of user-centered design were assessed. Second, professors varied significantly in how they taught, supporting the need for flexibility. Third, what was taught had a strong bearing on how it was taught. . . . Fourth, different display media lend themselves to different uses. All serve a purpose. And finally, the environment had an unpredictable impact on behavior” (Cornell 39). Concluding, he provides these suggestions about how to accommodate the changing pedagogical and learning needs of the contemporary classroom: “To accommodate these changes the physical environment needs to be bigger, more flexible, provide ubiquitous access to technology, promote interaction and a sense of community, enable formal and informal learning, and convey a sense of energy. The environment should be a place people want to be, not a place they have to be. They should be motivated by fun and enjoyment as much as by a desire to learn” (Cornell 41). If these changes are put into place with measurable results, these classrooms become something much more significant in terms of claims about the teaching and learning at the institution: “If properly designed and placed, furniture is more than a place to sit; it can be a strategic asset” (Cornell 42). City Tech’s adoption of innovative learning spaces could become a “strategic asset” in multiple ways: a marketing tool for attracting new students and keeping existing students, a distinction for the institution within CUNY and the region as a pedagogical innovator, and a message to donors and partners that City Tech invests in all aspects of improving student success.

Reconsidering Classroom Environments

Van Note Chism argues that greater attention be paid to the classroom environment and its significant role in education. Unequivocally, she states that, “We know too much about how learning occurs to continue to ignore the ways in which learning spaces are planned, constructed, and maintained” (Van Note Chism 5). The hurdle to overcome is, especially considering the classroom design philosophy across much of City Tech’s campus, “Were the rooms designed as general issue classrooms, however, the problems with flexibility might still remain, since often so-called all-purpose rooms have fixed seating, a clear front and back that favors teacher talk and projection rather than class participation, and space capacity limitations that prevent movement and reorientation” (Van Note Chism 7). She finds this way forward through changing how we think about classroom design: “In this new constructivist thinking, where teachers serve as facilitators for active student engagement, where learning occurs in many locations, and where power is distributed across actors, learning space needs are seen to be far more dynamic and situational than they were under the transmission model. The new way of thinking about facilitating learning implies the need for small-group meeting spaces, project spaces, spaces for whole-class dialogue where the students as well as the teacher can be seen and heard, spaces where technology can be accessed easily, spaces for display of ideas and working documents, and spaces that can accommodate movement and noise” (Van Note Chism 10). In particular, the concepts of “dynamic” and “situational” are key to utilizing existing space with new ways of teaching that are more integrative than the transmission model of education.

Dittoe describes several different examples of active learning classrooms and larger environments. He begins, “Designers of educational spaces have always instinctively known that the built environment has profound effect on its occupants” (Dittoe 81). What was once “gut feeling,” is now supported by a growing body of theory, practice, and assessment (Dittoe 81). He laments that the classroom, “a place that must by its very essence support and encourage learning,” is often, “unfortunately . . . inadequate for this important function” (Dittoe 81). He explores how innovation is taking place at several universities to transition from an instructional paradigm to a learning paradigm where they, “are responsive to the learning paradigm, with the nuances of function, flexibility, and aesthetics necessary to bring the built environment and the educational environment into a harmonious learning relationship” (Dittoe 81). He adds that, “This is a challenge, for this relationship involves not only size and shape and bricks and mortar but also light and color and the essential ambiance that stimulates emotional connections and allows the engagement and inquisitiveness necessary for deep learning” (Dittoe 81). To produce the synergy found in active learning classrooms, he asserts that “Enormous power and creativity can occur when architects are exposed to new ways of thinking about teaching and learning. . . . Similar enhancement occurs when educators learn about the architectural viewpoint and about new developments in space design” (Dittoe 82). Of the spaces he describes, they exhibit differences due to having “different goals,” but all of them, “allow creative and spontaneous learning,” and “provide responsive built environments that encourage students to take charge, with proper guidance, of their own education” (Dittoe 82). These spaces are “student-centered and empowering,” (Dittoe 82). Specifically, he focuses on how they “have affected the educational process in terms of space, furnishings, and equipment, the capacity to be functional and flexible, and provision of appropriate atmosphere and technology sufficient for the educational purpose” (Dittoe 82). Two of his examples stood out for consideration at City Tech in a GenEd course. First, The Prototype Laptop Classroom at Ohio Dominican College provided a challenge to architects to redesign a typically 600 sq. ft. classroom into an active learning classroom. They brought in stakeholders from all of the departments that would potentially use the classroom for input. Showing the datedness of the article, he describes how the classroom has a 2” false floor hiding electrical and ethernet for the classroom’s laptops. The room contains “softly sculpted tables and large padded armchairs,” “white boards lining two walls,” and “audio visual equipment” in the rear (Dittoe 84-85). Better examples are the Innovative Classrooms at Rensselaer Polytechnic Institute, or what they call, “studio classrooms,” used by many disciplines on campus (Dittoe 88). Describing these rooms in detail, he writes, “Studio classrooms at Rensselaer vary from room to room, with two predominant designs--the cluster configuration and the theater-in-the-round configuration. Cluster classrooms situate two to four students at tables around a single workstation. The clusters are arranged in rooms that have normal projection space along one wall but are otherwise flexible with respect to where the instructor is stationed. Often, there is display space all around the room so that students can work at white boards or chalkboards with their peers or the instructor. In these spaces, the instructor can circulate easily while students work, or can stand at one location easily seen and heard by students, who can swing their chairs around to obtain a good sight line” (Dittoe 88-89). Continuing his description, he writes, “In the theater-in-the-round configuration, students work two at a table supporting either one or two computers. The tables are arranged in concentric ovals, often in tiers, with the instructor station at one end and the student chairs on the inside of each oval. Students turn their chairs to the center for whole group discussion or lecture and away from the center for work on the computers. This arrangement prevents students from being

distracted by the workstations while they are interacting or listening and affords the instructor a view of the screens from the center when the students are using the computers" (Dittoe 89). In both cases, "the basic design permits teachers to move fluidly from whole-group to small-group activity, from presentation to active engagement" (Dittoe 89). He remarks that, "These spaces reveal the subtle yet profound ways in which surroundings affect activity. It is disturbing to accept the bland classrooms of today as suitable for the most important of human endeavors--learning" (Dittoe 90). In addition to considerations of filling existing spaces with new equipment and furniture, Dittoe's observations point to the fundamental need for purpose-designed and built spaces for learning. Of course, these spaces should be dynamic and flexible, but they need to thought out, assessed, and learned from for improved learning space utilization in the future. One way to accomplish this at City Tech would be to design, build, and test a small number of GenEd classroom spaces. Knowledge gained from these experiments could be expanded to other classrooms when the need and funding arise for classroom remodeling in City Tech's campus buildings.

Should experimentation with innovative classroom design be undertaken at City Tech, Barrett et al. provide insights for such research on these classroom spaces and a tested experimental model that attempts to understand "the complex problem" of "the holistic impact of built spaces on people 'in the wild'" (Barrett et al. 678). This model is "an Environment-Human-Performance (E-H-P) model that allowed the measurement, and so assessment, of built spaces and their human impacts" (Barrett et al. 679). This model was designed by considering "the hypothesis that the characteristics of the brain's functioning in synthesising sensory inputs highlights the importance of three broad design principles concerning our environment, namely: naturalness, indivdualisation and the appropriate level of stimulation. In this case, these relate, respectively, to: our basic animal demands, the needs of pupils in particular and the implications of the school-learning situation" (Barrett et al. 679-680). Of the classrooms studied, "It should be remembered that the spaces have been assessed in functional terms, focusing entirely on the impact of the differences between spaces on the academic performance of the pupils. In this context, it can be seen that parameters to do with the design principle of 'individualisation' are prominent" (Barrett et al. 688). Some of the most notable findings of environmental factors that support student learning that are addressable by reconfiguration of existing spaces include: natural light, "Classroom has high quality and quantity of electrical lightings," "The space adjacent to the window is clear without obstruction," "Classroom has a high-quality and purpose-designed Furniture Fixture & Equipment (FF&E)," "Interesting (shape and colour) and ergonomic tables and chairs," "More zones can allow varied learning activities at the same time," "The teacher can easily change the space configuration," "With regard to the display and decoration, classroom needs to be designed with a quiet visual environment, balanced with a certain level of complexity," "Colour of the wall, carpet, furniture and display can all contribute to the colour scheme of a classroom. However, it is the room colour (wall and floor) that plays the most important role" (Barrett et al. 688). Finally, they found that the six environmental factors of light, choice, flexibility, connection, complexity, and color "account for, in the order of, 25% of the learning progression of pupils" (Barrett et al. 688).

City Tech has a tremendous opportunity to be an innovator in learning spaces for the benefit of its students and to achieve its institutional goals. Considering the philosophy behind learning spaces, there are many different ways to deploy flexibility and adaptability into City Tech's

GenEd classrooms. The most radical, with the greatest potential payoff, would be to remodel a small selection of GenEd classrooms, pair these rooms with instructors willing and able to use these new classroom's affordances in their GenEd classes, and assess how well they work by surveying instructors and students and measuring student learning outcomes against control classrooms (similar rooms in the same buildings that are not remodeled). The most cost effective, with a strong potential payoff, would be to outfit a standard GenEd classroom with new furniture, such as The Node or KI Learn2, pair these rooms with instructors willing and able to use these new classroom's affordances in their GenEd classes, and assess how well they work by surveying instructors and students and measuring student learning outcomes against control classrooms (similar rooms in the same buildings that use a standard tablet arm chair). With this information, City Tech can strategize how best to use these techniques to make improvements that support our students and the goals of the institution. Additionally, publication of these efforts would highlight City Tech's investment in classroom design, which would elevate the institution's prestige and potentially attract investment from donors and partners.

Works Cited

Baepler, Paul and J. D. Walker. "Active Learning Classrooms and Educational Alliances: Changing Relationships to Improve Learning." New Directions for Teaching and Learning 137 (Spring 2014): 27-40. *Wiley Online Library*. 26 Sept. 2015.

Barrett, Peter, Yufan Zhang, Joanne Moffat, and Khairy Kobbacy. "A Holistic, Multi-Level Analysis Identifying the Impact of Classroom Design on Pupils' Learning." *Building and Environment* 59 (2013): 678-689. *Elsevier*. 26 Sept. 2015.

Bidwell, Allie. "A Swivel Chair: The Most Important Classroom Technology?" *U.S. News & World Report* 21 July 2014: n.p. Web. 26 Sept. 2015.

Center for the Enhancement of Teaching and Learning (CETL). "Teaching for Learning: A Philosophical Approach to Classroom Design - Five Basic Principles." Center for the Enhancement of Teaching and Learning. Georgia Institute of Technology. Spring 2009. Web. 26 Sept. 2015.

Cornell, Paul. "The Impact of Changes in Teaching and Learning on Furniture and the Learning Environment." *New Directions for Teaching and Learning* 92 (Winter 2002): 33-42. *Wiley Online Library*. 26 Sept. 2015.

Dittoe, William. "Innovative Models of Learning Environments." *New Directions for Teaching and Learning* 92 (Winter 2002): 81-90. Wiley Online Library. 26 Sept. 2015.

Henshaw, Robert Griffith and Andrea Reubens. "Evaluating Design Enhancements to the Table Arm Chair in Language Instruction Classes at UNC Chapel Hill." *Journal of Learning Spaces* 2.2 (2013): n.p. Web. 24 Sept. 2015.

National Learning Infrastructure Initiative. "Leading the Transition from Classroom to Learning Spaces: An NLII White Paper." *Educause.edu*. Educause. Oct. 2004. Web. 26 Sept. 2015.

Scott-Webber, Lennie, Aileen Strickland, and Laura Ring Kapitula. "How Classroom Design Affects Student Engagement." *360°: Exploring Workplace Research, Insights, and Trends*. Steelcase Education. 2014. Web. 26 Sept. 2015.

Van Note Chism, Nancy. "A Tale of Two Classrooms." *New Directions for Teaching and Learning* 92 (Winter 2002): 5-12. *Wiley Online Library*. 26 Sept. 2015.

Wulsin Jr., Lawson Reed. "Classroom Design - Literature Review." The Special Committee on Classroom Design. Princeton University. Summer 2013. Web. 26 Sept. 2015.