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Flexible Classroom Design And Its Effects On Student-Centered Teaching And Learning

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FLEXIBLE CLASSROOM DESIGN AND ITS EFFECTS ON STUDENT-CENTERED TEACHING AND LEARNING

by

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Abstract

Despite the vast amount of research around the development of modern instructional practices in public education, there is little motivation into adapting the classroom environment to match. This has resulted in a persisting passive model of teaching due to common misconceptions about how students learn and the impacts of classroom design. The purpose of this capstone project is to present the significant influences of the classroom environment by investigating the research question, *how can physical classroom design be used to facilitate the implementation of modern teaching practices and create the most effective instructional environment for student learning?* Contemporary teaching and learning methods were researched in addition to the classroom design parameters that could facilitate these processes, before concluding the necessity for flexibility both in pedagogy and environment. This capstone discovered that the classroom furniture is the most effective way to facilitate this and create more active student-centered learning. Through the presentation of this research, as well as examples of modern and future furniture designs, this project demonstrates the possibilities and effects of a flexible classroom design. Notwithstanding the evidence, this research and the resulting furniture designs are only effective if used by the very education professionals that will be responsible for instituting a more active student-centered learning environment.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

Introduction

Fundamental Question

One of the greatest failures of the education system in our country has been its inability to change. Despite the rapid evolution of modern society into a collaborative, adaptable, and inclusive environment, the classroom has been slow to match that. Because of this, schools have failed to provide their students with the appropriate education that emulates the very pace of the world in which they live (Cornell, 2002, p. 41). As I have learned in my initial research, this is not because of an absence of modern teaching strategies, but instead, an absence of an environment in which these practices can be effectively put to use. In other words, this inability for the school system to evolve is not from a lack of desire, but rather a lack of basic design (Basye, Grant, Hausman & Johnston, 2012, p. 11).

This has led me to try to answer a fundamental question to my research. *How can physical classroom design be used to facilitate the implementation of modern teaching practices and create the most effective instructional environment for student learning?* The first chapter of this capstone will explore the historical context and my personal context related to the advancement of classroom design. The rationale behind my passion for this subject matter will be discussed as it pertains to my worldview into this research

and its importance to the profession of education. Finally a statement of purpose in my research will launch into the literature review in the next chapter.

Historical and Personal Context

Historically, whether hindered by a lack of funding, unmotivated teachers, or a stagnant bureaucracy, the necessity for change to the way our schools operate was relegated to "reactive" decisions rather than "proactive" ones (Rytivaara, 2011, p. 119). For example, rather than focus on the prevention of negative behaviors, the attention of school officials concentrates too heavily on punitive measures instead. Rather than building classroom environments that foster safety, creativity, and synergy, it seems schools are still struggling with bullying, student apathy, and grade competition. It is also apparent that students are being overwhelmingly misplaced into categorical reformatory groups, instead of adapting classrooms and materials to accommodate various learning styles to avoid these issues in the first place (p. 118). These groups include special education, literacy intervention, and even tracking into lower-level instruction classes within their grade level. What is even more, is the underlying oppression of students due to race, class, and gender that is underpinned by such actions and groups as these.

Personally, these assumptions and viewpoints that I have on education have been formed by my recent graduate education paired with my fieldwork within the schools. I have worked in various settings including early childhood, elementary, and middle school education. As I moved from class to class on a daily basis as a substitute teacher, paraprofessional, and student teacher, I have seen the functions and designs of countless classrooms. During my time in graduate school, I have learned many new and modern

teaching methods that aim to fix these problems of inequitable, corrective, reactionary practices. However, while working in these many school settings, I have yet to see these techniques being used with nearly as much regularity or consistency as I had hoped to find. This has led me to believe that schools are adapting at a rate too slow to provide maximized education to its students at any one time. My convictions on this matter stem from what I perceive to be a large systemic design deficiency that fails to provide the flexible environment necessary to adapt these more modern teaching practices. This failure in design reaches down from each district, through each of its schools, and into every classroom, restricted not only by a lack of budget, but also by a simple lack of creative, artistic knowledge.

Personal and Professional Rationale

In my many years in education, I have witnessed a wide variety of teaching styles, instructional methods, and classroom environments. Most of them have had common threads to each other and common threads to what I have learned in my graduate coursework. Almost all of them have shown a movement towards the advancement of instructional practices dissimilar from the ones I grew up with when I was once a student in those classrooms. For instance, teachers have moved away from strictly teaching algorithms in math, and focused more on teaching mathematical strategies of cognitively guided instruction. Instead of requiring each student to engage in the same phonics-based basal reader, reading instruction is now informed by individual running records of level-based books and small reading groups are structured around more skillsets including comprehension, phonemic awareness, fluency, and vocabulary. Teachers have

even incorporated more sensory breaks and tools to help students focus, rather than requiring each student to sit in a desk for focus, or visit the office for a lack thereof. Yet despite the progress that has been made in that time, I still notice a large gap between intention and execution, and I believe that it can be solved in the environment.

The possibilities of classroom design are endless, as I have witnessed in the dozens of schools and classrooms that I have visited in my years in education. However, despite this variety, the fact remains that each classroom has very similar limits to each other in their inability to change and adapt to the students around them. My passion in this topic comes from the desire to manipulate my classroom one day to adapt to each of my individual students and their learning needs. I hope to create an environment that can also easily adjust to the particular teaching method being utilized at the time, whether it be large group lecture, small group discussions, or partner groups among many other possibilities. Although it is clear to me that I am not the first educator to try this, there is another level of passion that drives me to further my research into this topic.

My love for design also comes from my career as an artist before I decided to become a teacher. I spent a large portion of my public education in the art classroom and majored in art in my undergraduate studies before becoming a practicing artist out of college. In this time, I lived and worked in multiple collaborative artist cooperatives, participated in many art shows and art crawls, and began two professional businesses in the arts. I have also taken an interest in the interior design of my spaces to set up my live/work spaces to best accommodate my artistic and business endeavors with my personal life. This has resulted in not only unique and functional arrangements, but also a

large interest in the construction of much of my furniture to coincide with these ideas. To make room for these more creative spaces, I built things such as a center island on wheels for flexibility, a bookshelf to divide a room into two, and a fold-down table for space-saving functionality. I would often place my bed in less desirable locations because it was largely unused during the day and difficult to move, such as the closet or the dining room. Little did I know that these choices would influence my work in education and my research in this capstone.

While practicing art over the past decade, I also worked as a Pre-Kindergarten teacher at a few local early childhood learning centers. It was here that I first began to integrate my artistic and design concepts directly into the classrooms in which I was working. Where it first started with unique art projects and elaborate displays, it eventually developed into my own personal fundamental design theories and furniture manipulation. I began to notice that the physical environment had a large effect on student attention, behavior, and participation, as well as my willingness as a teacher to provide better learning opportunities. Because of this, I rearranged the learning centers of my classroom to create more clearly defined boundaries between them in the way the carpet met the tile or the backs of shelves lined up together. Quiet learning centers such as the library and math table were arranged together on the other side of the classroom from the louder dramatic play and blocks centers to facilitate learning and exploration in each. The science and art areas were placed closer to the sinks where students could clean easier, which made me more apt to supply exploratory materials often thought as too messy, such as paints, sand, and soil. I began to notice that the more novel and functional

that I made the learning centers, the more students participated, the more they tried new things, and the more creative they were. Pretty soon, its effects even influenced teachers in other classrooms to follow suit in providing more exploratory opportunities in their classrooms. It got to a point where I kept my drill at work so that I could take apart the play refrigerator and rearrange the wood panels into a barn for the thematic farm unit, or take the legs off of a table and turn it upside down to make a fire pit using empty paper towel rolls as the logs.

This was only the beginning, as I began to realize that even the most simple design structures and decisions could facilitate teaching and learning in many respects. I designed an efficient system of organization and digital archive to save materials and supplies for future use. Students were more respectful of classroom materials as I created a system to rotate their availability. They were more likely to notice their artwork when I started to display it at their height, and the environment was calmer when I themed it to one or two colors. I could display more educational materials, expose more sunlight, discourage running, and divide students into smaller groups, all by simply moving the furniture to the middle of the room. Parent involvement in our class increased when I moved the parent communication board right next to the exit door and used larger signs with fewer words and high contrast colors. These are just a few examples of how I began to see the drastic differences that basic design decisions can make in a classroom.

The significance of physical classroom design to the profession of education is often overlooked by educators themselves, but I would argue that it is paramount to providing a basis with which to employ modern teaching strategies. As more schools

adopt methods of flexible grouping, universal design, and project-based learning, it is becoming increasingly difficult for classrooms to physically adapt to these new practices. As more teachers are using portfolios and assessments to guide their pedagogy and teach to various groups and individuals, they are running into issues of functionality in the ways they can instruct multiple learners at once in a myriad of ways. As more students are in need large motor movement, sensory fidgets, adaptable materials, they are victim to limited supplies; as they are in need of more breaks, safe social spaces, and healthy sitting postures, they are met with the same rigid schedules and furniture of previous generations. In reality, there are some basic design concepts that can be applied in any classroom to create spaces that serve to support various individual learning needs and teaching strategies.

Statement of Purpose

The purpose of my investigation in this capstone is to find ideas and evidence of effective classroom and furniture design that could facilitate equitable education for each and every student. As stated before, the problem of current classroom designs across the school system is the inflexible nature with which they are not only built, but also envisioned. It is my belief that there are a few conscious design decisions that can be made to promote a more student-centered education that can accommodate individual learners. These concepts can move us away from teacher-centered instruction, clunky immobile furniture, isolated and forgotten students, non-inclusive behaviors, and inflexible modes of operation. The advancement of instructional practices will be shown to originate from the proper classroom environment that can adapt to support the

particular needs of students and teachers alike. As I explore in my research, it is important to note that I do so with a social constructivist worldview. I aim to keep my questions open-ended and include qualitative reasoning in order to develop meaning as I research. Rather than begin with a theory on how classroom design can be utilized most effectively, I plan to construct a theory as I engage in my research. I understand the social complexities of this topic and how they are not only developed by historical and cultural experiences of the students, teachers, and administrators, but also by my own personal experiences and assumptions. It is with this lens that I plan to focus on how to build the best classroom environment to live, work, and interact together.

Summary

Schools of today are limited in how they can carry out new teaching models due to a lack of possibilities and budgetary limitations within the classroom. Simple design choices can open up these possibilities and create safe, collaborative environments for students of all kinds of learning abilities to thrive in (Bloom, Dole & Kowalske, 2016, p. 1). In my personal experiences, I began to make these simple decisions and affect real change within my classrooms. These changes include more student participation, higher parental involvement, easier accommodations, and effective implementation of modern teaching strategies. These have made me realize the significance of classroom design to the profession as a whole, and made me wonder how I could make an impact in my research as I look to answer the question, *how can physical classroom design be used to facilitate the implementation of modern teaching practices and create the most effective instructional environment for student learning?* The remainder of this capstone will

attempt to answer this question through research, reflection, and project-based learning. The next chapter will be a literature review of a variety of related expert resources that explore the topic of classroom design, followed by a description of the project related to this topic, and a reflection on the process.

CHAPTER TWO

Literature Review

Introduction

Research into physical classroom design, modern teaching practices, and effective student learning environments reveals a complex relationship worth discussing. This literature review will focus on the topic of classroom design in each of its sections, as the first part of this chapter will examine the grounds for classroom redesign, beginning with a brief history into how the original passive classrooms in our schools were created and have remained relatively unchanged since. The standardization of these environments is then explored in comparison with the misconception of educating to the average student with a one-size-fits-all approach to teaching, before discussing the modern wave of active learning. In order to accommodate these new practices, various choices in design are discussed, including space, flexibility, and mobility. It is then shown that the most effective way to accomplish these design modifications is simply by redesigning the furniture within the classroom. Various elements and varieties of effective furniture design are explored in regards to matching student bodies and the need for space, flexibility, and mobility. The effects of furniture on student learning are then discussed, as well as the influence it has on teaching, and how it can be used to implement the teaching practice of flexible grouping. This educational strategy is analyzed to demonstrate its use towards individualizing instruction to each student learning style

before launching into the impacts this has on student inclusion, classroom culture, and educator concerns. Finally, these modern teaching practices are related back to classroom design in order to address the research question, *how can physical classroom design be used to facilitate the implementation of modern teaching practices and create the most effective instructional environment for student learning?*

The Grounds for Classroom Redesign

Modern teaching practices have developed over the past few decades to match the increasingly diverse learning styles within schools (Brooker, 2011, p. 7). Much research has been carried out to better understand how children obtain information in today's society, and this instruction is meant to adapt to that (p. 19). Many conclusions have also been made pertaining to the effects of the classroom environment on this process. They state that particular learning environments allow for students to assume responsibility in their education and allow for teacher to create opportunities for this to occur (Duncanson, 2014, p. 31-32). Cornell (2002) argued that because of this change in modern student learning, not only do the teaching practices need to adapt, but the way in which the classroom environment is organized and designed must also match in order to best facilitate this process as well (p. 37).

A History of Passive Learning

The foundation for understanding the need for modern classroom design comes from first understanding its history since the inception of formal schooling. According to Cornell (2002), throughout their existence, classrooms have primarily been the same boxy shape with rigid, forward-facing furniture and little attention paid to the students.

Because of this immobility, teachers dictated the attention of the room, and consequently the schedule and tasks within. Not only has this educational configuration permeated every classroom in the public school system throughout this history, but it has remained relatively unchanged since (p. 33). Baker (2012) would have agreed with Cornell that this approach to educational design dominated the schools, calling this style of instruction 'passive learning' (p. 15). Basye et al. (2012) defined passive learning as a "transmission of knowledge," where the teacher simply "passed on information that students learned, often by recitation and repetition, sufficient to prepare them for the lives they would lead" (p. 10-11).

This learning style emanated from the informal hand-me-down education that children received from their parents (Basye et al., 2012, p. 10) before the first one-room schools followed suit with teacher-centered designs (Brooker, 2011, p. 14). Baker (2012) stated that educational reformer, Horace Mann, perpetuated this notion by standardizing passive learning environments in the new public school system. Eventually, schools needed to accommodate more students because of increased child labor laws, school busing, and city population. These cheap, cramped, inflexible designs not only became indispensable, but they also matched the industrialization of our workforce at the time (p. 4). Just as in a factory, students sat in tightly-packed desks in nice neat rows facing the front of a dim, stuffy room with four closed walls and loud bells dictating the schedule (Basye et al., 2012, p. 11).

It was not until the 1920s that other education philosophers such as John Dewey and Maria Montessori began to understand more about how children acquire knowledge

and the relation to the environment in which they worked (Brooker, 2012, p. 19). Despite this push towards more student-centered education, schools were still designed and built in the same ways, as architects did not become involved until the 1950s (Baker, 2012, p. 3). This modern movement finally brought many positive features to some schools, including more openness between hallways and classrooms and more windows for natural light and air (Baker, 2012, p. 3). However, Prosser (2007) cited that most architects during this time were "failing to link architectural practice with educational aims" (p. 15). Come the 1980s, schools faced limited budgets and lowered enrollment, and since then educational focus has turned back towards the traditional passive trends of the past (Baker, 2012, p. 21).

The connection to classroom design. While a lack of investment and attention towards school design has occurred in recent decades, there has not been an absence of educational research towards modernized instructional practices. Brooker (2011) called this new style of learning 'active learning,' defining it as the antithesis to passive learning, wherein students construct their own knowledge by engaging in educational tasks themselves. This approach to learning includes more independence, critical thinking, movement, and collaboration, but its implementation in current schooling is confined by the antiquated instructional and environmental designs (p. 15). Prosser (2007), noted nevertheless that "merely linking building design to educational theory ignores architectural and educational concepts and practices that are influenced by changes at different rates in each area" (p. 15). In other words, the rate at which

pedagogical methods change due to societal transformations is vastly different from the rate at which school buildings are able to be designed and constructed.

An Average Misconception

In order to comprehend the context of the problem of standardization in educational design, a helpful comparison can first be found in the cockpit of American Air Force airplanes. Trufelman (2016) detailed the account of author and scientist Rose, who told the story of fighter pilots and their fatal performances in World War II. Rose illustrated that the US military utilized average body measurements of male soldiers to design the cockpits of their first airplanes in order to find the best fit, but, to their surprise, an unexpected amount of crashes and deaths occurred. After failing to find answers in pilots, training, and technological performances, researchers were asked to recalculate the average, before one researcher saw something in the numbers. This researcher took ten of the most important anthropometric measurements, such as height or arm length, and compared them among over 4,000 soldiers, and found that not one person was average in all ten measurements. When adjusting for only three common measurements, less than 200 soldiers were average in all three. The military realized that by creating cockpits for the average pilot, they had essentially created them for no pilot to truly fit. This led to the first adjustable cockpit seats, pedals, and steering wheels that brought dramatic successes in militant flying to this day.

In a TEDx Talk, Rose (2013) compared this story to the epidemic of poor design in educational environments, stating that the standards and spaces in which students are instructed and assessed are designed to fit the average learner in order to accommodate

all learners, but have done just the opposite. Rose claimed that no student is average in every measurement by which they are assessed, so to teach to them collectively based on the average would recreate the same failed performances of the fighter pilots. For many students, the average instruction does not challenge them enough, and for others, the average assessments cover up their true talents. Retrofitting cockpits accommodated pilots who otherwise would have never fit, including some of the best fighter pilots the skies have ever seen. Rose (2013) claimed the same should be done in education for the sake of all the overlooked students, because "if you design those learning environments on average, you've designed them for nobody."

Many researchers acknowledged this individuality in learning styles as students are now known to have diverse learning profiles (Brooker, 2011, p. 7) and perform with wide variability due to the influences of their psyche and surroundings (Barrett, Zhang, Moffat, & Kobbacy, 2012, p. 678). The Dunn and Dunn Learning Styles Model lists twenty one of these influential factors on students, including such things as the time of day, their emotional state, what they ate, their social milieu, and even the design of their environment (Burke & Dunn, 2003, p. 168; Rytivaara, 2011, p. 121). Just as in the cockpit of the airplane, even the furniture of this environmental design plays a role as students fit, sit and move differently despite the rigid nature of their desks and chairs (Brooker, 2011, p. 48). Basham, Hall, Carter, and Stahl (2016) summed up the work of Rose by writing that personalizing learning to the individual rather than the average recognizes the ultimate divergence of learning styles and "essentially does away with the factory model of education" by supporting this in educational practice (p. 127).

Classroom Design Implications

This shift in pedagogical thinking brings about considerations as to how the physical environment of classrooms can influence these new student-centered instructional processes that respond to the individual needs of each learner. In review of the historical context, the passive learning that developed from decades of teacher-centered instruction and design has failed to do this (Basye et al., 2012, p. 26). Further standardizing these traditional environments has perpetuated the misconception that students conform to an inaccurate ideology of average. Educational reformers agree that students need a more active learning environment that personalizes the instruction to their individuality and allows them to construct their own knowledge rather than having it handed to them (Duncanson, 2014, p. 31-32). Once this is better understood, researchers will begin to discover how this can be most effectively achieved, and students will benefit from the advantages (Brooker, 2011, p. 20). The next section will discuss how classrooms can be redesigned in order to accomplish this, and the educational opportunities these decisions will create.

The Dynamic Learning Environment

Classroom design has a long history of stagnation that no longer fits modern pedagogical paradigms and the individual learning processes of contemporary students (Ogilvie, 2008, p. 51). Brooker (2011) illustrated that "by challenging the misconception that the school culture benefits most when the environment is designed around standardization or a particular teaching method, the focus can now shift to designs that enables teachers and students alike to shape their environments, behaviors, and

perceptions of learning" (p. 20). This next topic will discuss features to classroom environments that can integrate more active learning opportunities and flexible structures, before narrowing it down to a singular design component that can accommodate individual learning needs, adapt to modern teaching practices, and tailor to established structures of the school buildings and their cultural norms and expectations. This decision in design will be explored in its perceived implementation in the classroom, as well as the various freedoms it creates and the impacts it makes on student learning.

Design Choices

A positively designed educational setting creates notable effects on student involvement and achievement in the classroom (Ogilvie, 2008, p. 50). Barrett et al. (2012) argued that the learning environment alone can contribute up to 25% of the educational development of students (p. 688). However, despite the evidence for renewing classroom surroundings, Burke (2007) asserted that "architects, policy-makers and teachers are not sure quite how to do this" (p. 362). There are numerous 'design parameters' that have been researched such as light, sound, and air, and many have been found effective, but researchers held opposing views over the most influential ones (Barrett et al., 2012) Despite these varying viewpoints, there are a few themes that run through each source of classroom design, including space, flexibility, and mobility.

Space. According to Duncanson (2014), the simple addition of more physical space "promotes active learning" (p. 32). Area should increase 10 square feet per student in the classroom (Cornell, 2002, p. 38), however just 80 square feet of additional area could lead to many advantages, including cleaner organization and fewer distractions

(Duncanson, 2014, p. 29). In this research, Duncanson (2014) found that extra space led to higher test scores in science and language arts (p. 30).

Flexibility. The flexible use of space provides a variety of learning opportunities, and adapts to individual needs (Basye et al., 2012, p. 40). Basye et al. (2012) stated that classrooms should "be easily customizable" in order to adjust to a myriad of educational tasks (p. 56) and grouping modalities (p. 40). This mixture of activity should be able to occur at any given time of day in any location (Burke, 2007, p. 364).

Mobility. In order to facilitate this multitude of educational opportunities, classrooms need to be regularly rearranged throughout the day (Duncanson, 2014, p. 30). To save time and energy in conveniently reconfiguring the design, the contents within the physical environment should be more mobile. Movement in the furniture itself, supports better posture, more engagement, and higher achievement (Cornell, 2002, p. 35; Knight & Noyes, 1999, p. 748; Schilling & Schwartz, 2004, p. 424).

The Grounds for Furniture Redesign

The overwhelming prevalence of passive classroom design has constrained active learning practices through its immobility to change, figuratively and literally (Brooker, 2011, p. 6; Knight & Noyes, 1999, p. 748). As pedagogical thought and teaching practices have changed, so have the tools and activities, and Cornell (2002) once insisted that "since furniture is a tool with a specific function, it too must change" (p. 34). Not only does the old furniture in a classroom need to change out, but the new furniture needs to be able to change forms (Basye et al., 2012, p. 57). Keeping in mind all the "different bodies, different learning styles, and different kinds of work" in a classroom, as well as

how often students use the furniture, the design of furniture becomes incredibly important (Basye et al., 2012, p. 58-59). Students spend almost a third of their weekdays at school, and of this time, the amount they spend in a chair alone is anywhere from 2.5 hours in preschool to over 5.5 hours in high school (Knight & Noyes, 1999). When contemplating furniture usage, student posture, comfort, and fit all need to be considered first to support student health and engagement, before understanding its relation to an active learning environment.

Anthropometry. Otherwise known as the measurement of the individual human body, anthropometry plays a large role in determining the most appropriate fit for furniture. In a study of college students, Baharampour, Nazari, Dianat and AsghariJafarAbadi (2013) found that anthropometric measurements revealed a "high mismatch" to the classroom furniture, where only 8% fit the desk height, 1.6% fit the seat height, and 15% fit the seat depth, and they suggest that this mismatch leads to poor posture (p. 165). Wingrat and Exner (2005) would have agreed with this sentiment as they also found a mismatch among middle school students where only 1% fit the desk height or seat depth (p. 264). Along with Schilling and Schwartz (2004, p. 424), they believed that negative posture can damage the health of a student, causing such injuries as strains and pains in their backs, necks, and shoulders. Knight and Noyes (1999) supported this with the statistics of their studies in the way of 30% of elementary students and 36% of middle school and high school students reporting pains such as these, along with 60% of these students attributing these pains to their school furniture (p. 749). A vicious cycle begins as students assume even more unconventional sitting positions in

order to combat their pains, constantly resisting the this unsuitable furniture and consequently causing more pain (Brooker, 2011, p. 48; Schilling & Schwartz, 2004, p. 424; Wingrat & Exeter, 2005, p. 263).

The driving elements. Comparing this information to the story of the military cockpits once again shows that when the furniture is built to the average, just as learning environments are, they fail to fit any students properly. Taking this into account, along with the three themes of classroom design of space, flexibility, and mobility, it can be seen that the best way to create a dynamic learning environment is simply through the furniture. Cornell (2002) stated that "furniture needs to be more comfortable, adjustable, intuitive, reconfigurable, technology-capable, compressible, and attractive," and it should also be student-centered just like these learning environments in order to adapt to each individual student and their "learning objectives" (p. 41). There are many factors to consider in what can make classroom furniture mobile, flexible, space-saving tools that can facilitate the implementation of a variety of teaching methods and create the most effective instructional environment for students.

The first consideration for modern furniture would be the inclusion of wheels on everything from chairs, desks and tables to carts, shelves and displays so that students can roll about into various formations and teachers can easily create different spaces for learning (Basye et al., 2012; Cornell, 2002; Espey, 2008, p. 768; O'Hare, 1998). Two other features to consider would be a lightweight build for more effortless maneuverability and the ability to fold it up for simple and effective space-saving storage (Basye et al., 2012; Cornell, 2002). Introducing swivel to student seats would facilitate

discussion and encourage natural seated positions (Basye et al., 2012; Ogilvie, 2008; O'Hare, 1998; Wingrat & Exner, 2005). Other considerations would contain manipulability to accommodate these varying bodies, learning styles, comfort levels and school activities, including such things as flip-up tabletops, tilting seats, rocking backs, lumbar support, adjustable seat height, and fold-down armrests. (Basye et al., 2012; Cornell, 2002; Gurzysnki-Weiss, Long & Solon, 2015). Many of these options also provide positive sensory experiences through movement, including swiveling, tilting, rocking, bouncing and wheeling (Basye et al., 2012; Schilling & Schwartz, 2004). This proves advantageous as many researchers claimed that passive sitting is not only detrimental to student health and achievement, but that students perform best when they are allowed opportunities for movement (Cornell, 2002, p. 35; Knight & Noyes, 1999, p. 748; Schilling & Schwartz, 2004, p. 424).

There are many examples of alternative seating already available in some classrooms that contain a few of these features, including therapy balls, bean bag chairs, and soft benches (Basye et al., 2012, p. 56; Schilling & Schwartz, 2004, p. 424). Another option would be something like a “nodal chair” as documented by Gurzynski-Weiss et al. (2015), complete with wheels, swivel desktops, and storage compartments under the ergonomic swivel seats (p. 64). A few other options include “Stokki stools” which have convex bases that allow for rocking (Basye et al., 2015, p. 56), and the more traditional “Chair 2000,” as detailed by Knight and Noyes (1999) that offers more lumbar support and a sloping back to aid student posture, but remains static otherwise (p. 751). The advantages of these features and examples will be discussed next, but it is important to

note that providing a wide variety of seating for students will serve their individual dispositions and inclinations the best (Basye et al., 2012, p. 58).

Effects on Student Learning

Many studies demonstrated that furniture design increases individual student engagement and their achievement in the classroom (Espey, 2008, p. 767). One such study of elementary school students by Wingrat and Exeter (2005) revealed that students demonstrated more "on-task behavior" when provided with a different chair that had ergonomic design with a curved, rocking seat back, and shorter seat height to support "positive sitting" (p. 266-270). In addition to lessening back and neck pain, their improved posture also led to better handwriting, which these researchers argued led to better grades (p. 264). Basye et al. (2012) reported a study of college students where surveys showed that newly designed active learning environments increased student participation and achievement as well. Over 70% of students reported either better grades, better attendance, and even more creativity and almost 85% reported higher levels of participation, as faculty members reported even higher numbers in most categories (p. 41).

Movement in furniture also plays an important role in these effects on student learning as it activates brains for learning (Basye et al., 2012, p. 52). For example, student engagement and efforts are shown to increase with the use of therapy balls as class seating, while classroom disruptions decreased as students were able to expel energy (Schilling & Schwartz, 2004, p. 428-429). Another means of movement discussed earlier is the use of swivel seats, which led to higher test scores for college students in a

study by Ogilvie (2008) that attributed this increase to more engaging discussion as students could turn to each other easier (p. 55-56). Even the use of taller desks and tables that required standing positions led to less back pains and higher student achievement (Basye et al., 2012, p. 58).

In contrast to these successes, not all furniture design choices have resulted in an outcome. In a study on the impact of classroom design on "team-based" learning, Espey (2008) found that design had no effect on student productivity and grades between individuals and groups in three different classrooms (p. 768-770). Also, a study of the addition of swiveling rolling nodal chairs by Gurzynski-Weiss et al. (2015) found no differences in the behaviors of students or teachers in moving about the room as compared to traditional furniture (p. 70), and only small differences in student interactions (p. 71). Despite the apparent positive statistical effects on student health, behavior, and performance of other such features cited earlier such as therapy balls and swivel seats, there seems to be another factor influencing the success of these design choices with this furniture: how it is used.

Active learning occurs when this adaptable furniture can move to construct new spaces in any place at any time for different learning opportunities (Basye et al., 2012, p. 52; Duncanson, 2014, p. 31). How a classroom is organized with this furniture also demonstrates expectations to students of the types of learning that is to occur (Brooker, 2011, p. 25). The most important thing to keep in mind is that variety is not only important in the types of furniture, but also the multiple types of uses (Basye et al., 2012, p. 52). Cornell (2002) wrote that mobile shelves, cabinets, and white boards can act as

partitions to separate quiet, independent spaces from more lively, shared spaces (p. 37-38). Student creativity is stimulated by these flexible environments (Basye et al., 2012, p. 37) as well as student choice which leads them to higher-level learning (Easley, 2017, p. 20).

Creating these flexible spaces through the use of mobile furniture ultimately leads to more student collaboration, which Cornell (2002) stated is "the biggest pedagogical factor driving change in classroom design" (p. 38). Basye et al. (2012) wrote that collaboration is the key to active learning and is one of the most necessary skills in modern enterprise (p. 36). They also contended that collaboration directly affects student performance and is promoted through furniture and classroom design (p. 36-37). Cornell (2002) would have agreed with this by illustrating that even the shape, size, orientation, and clustering of tables and desks can lead to more collaboration (p. 37). In a study of a college classroom utilizing mobile furniture to facilitate "team-based" learning, over 75% of students reported that the furniture was the leading indicator of their success and willingness to engage in this brand of learning (Espey, 2008, p. 773). It also improves communication between students and teachers (Basye et al., 2012, p. 37) as it allows for the teacher to move about more freely among collaborators as the facilitator of this learner-driven environment (Cornell, 2002, p. 39).

Effects on Teaching

Student-centered instruction and active learning are philosophies that have been around for almost a century, thanks to the influences of educational reformers such as Montessori and Dewey, but their implementation is only recently beginning to take

shape, due in part to classroom and furniture design (Baker, 2012, p. 3; Burke, 2007, p. 364). Basye et al. (2012) bound these two philosophies together by defining active learning as created by education that "places the student at the center of the learning process" (p. 26) and they argued that this type of education is a positive one no matter the context or environment (p. 136). However, O'Hare (1998) stated that through the design of classrooms and their furniture, active learning and student-centered instruction can not only be attained, but inspired (p. 719). In other words, modern teaching practices not only demand modern furniture, but this furniture can inspire those teaching practices. Cornell (2002) would have agreed, commenting that "if properly designed and placed, furniture is more than a place to sit; it can be a strategic asset" (p. 42).

Thus far, it has been decided that physical classroom design can be used to create the best environment for students, through the design choices of creating space, being flexible, and offering mobility. Upon review, the easiest way to create this is through the design decision of integrating proper furniture design, complete with moveable, adjustable features to accommodate varying bodies, learning styles, and classroom activities. And the most effective instructional environment that is created by this design component has also been decided to be student-centered active learning. The upcoming final section will answer the research question of how classroom design, particularly through the design of the furniture, can be used to facilitate the modern instructional practices to create this student-centered, active learning environment.

Pedagogical Transformation

History again plays a role in this final section as the shift towards student-centered education depends upon not only on a knowledge of where we have been, but an understanding of where we want it to go. Basye et al. (2012) argued that if teaching practices do not switch away from teacher-centered instruction towards models of active learning and collaboration, "then even the best designed physical environment will degenerate into a modern replica of the industrial age school" (p. 136). They also said that student learning will not be positively affected by their environment unless teachers make the intentional choice to implement modern instructional approaches while their reinvented classroom design (p. 49). As demonstrated by Cornell (2002) in Table 1 below, many of the changes that occur in this shift in pedagogy that have already been

Table 1. Emerging paradigm of teaching and learning

From an industrial economy	*To a knowledge economy*
Passive learners	Active learners
Directed learning	Facilitated learning
Knowledge revealed	Knowledge discovered
Explicit knowledge	Explicit and tacit
Knowledge is discrete	Knowledge is embedded
Single assessments	Multiple assessments
Single intelligence	Multiple intelligences
Instructor technology	Ubiquitous technology
Alone	Alone and together
Just in case	Just in time
Content	Content and process
Linear and planned	Planned and chaotic

Note. Reprinted from *The impact of changes in teaching and learning on furniture and the learning environment,* by Cornell, retrieved from doi:10.1002/tl.77 Copyright 2003 by EBSCO Publishing.

laid out thus far in the previous sections (p. 34). This section will discuss the modern teaching practice of flexible grouping that coincides with flexible classroom and furniture design to provide the most effective learning environment for students. It will examine the effects this has on individualizing instruction, particularly towards otherwise overlooked students, and on the classroom climate and culture as a whole. Finally it will consider the challenges teachers and schools might face in adapting to these changes, before discussing the pedagogical connections to classroom design.

Flexible Grouping

This teaching method is defined as placing students into various arrangements for different learning opportunities based on particular needs or purposes at the time (J. Flood, Lapp, S. Flood & Nagel, 1992, p. 615; Hoffman, 2002, p. 47). Unsworth (1984) asserted that the groups are to be flexible, meaning that they are not to remain the same at any point, as they can and should change at any time (p. 299). Moveable furniture in the classroom can facilitate this reorganization of these flexible groupings (Duncanson, 2014, p. 30). And just the same as modern furniture, "group membership is not fixed"; groups can form or dissolve at any point, as well as change size, composition, of focus (Unsworth, 1984, p. 299). There are many different ways to accomplish this and factors to consider in doing so, but this strategy is predicated on matching the individual needs of each students with the group formations (J. Flood et al., 1992, p. 615).

Grouping modalities. Researchers and educators agreed that there are a multitude of ways in which to arrange groups of students, but they remained split on the best ways to categorize them. The following topics are an organized collection of their

various assertions, divided into four categories of form, content, style and purpose. The definition of each will be explained further in depth, but it is critical to understand that variety, balance, and flexibility between these various modalities is of utmost importance.

Form. Simply put, the form of the group refers to the size and location, and is guided by the space available. Group sizes vary from the independent work of one, to partners, small groups of three to four students, large groups up to half class, or the whole class (Flood et al., 1992, p. 610). Size and location depend on the arrangement of the furniture in the classroom. All groups have a form, and this form depends on the content, style and purpose of the groupings, which are all influenced by the types of furniture available.

Content. Groups based on this nature take the content that is to be learned into account first before student learning style or teaching purpose. Examples include groups that work together on completing a particular task, developing a skill, or exploring a topic (Flood et al., 1992, p. 610). Other instances involve groups formed based on the materials and technology available (p. 611), or where students are in the process of an activity, whether at the beginning, middle or end of a task (Basye et al., 2012, p. 34).

Style. Flexible groups that are formed in this way are based on the learning style of the students within and are more homogenous in nature, often influencing the content they work on. The most common example is groups based on ability, where high-achievers are challenged separately from low-achievers who can receive intervention (Flood et al., 1992, p. 608). Other examples include groups based on instructional delivery whether by teacher, student, or done together; or groups based on

student strategy, separating analytical thinkers from creative types, for instance (p. 610). Still, other groupings divide students by work habits or social habits into either quiet, independent settings or communal, lively scenarios (Basham et al., 2016, p. 131; Flood et al., 1992, p. 610; Rytivaara, 2011, p. 122-123).

Purpose. The final category is reserved for the intention behind the instruction, where groups are formed based on the goals for student learning or effective teaching. These groupings are more heterogenous and often mix-and-match learning styles and content groups into various forms (Rytivaara, 2011, p. 122-123; O'Hare, 1998, p. 708-709). First, mixed ability or cluster grouping challenges and inspires lower-level students working with higher-level students (Gentry & Owen, 1999, p. 224). Next, jigsaw grouping combines various students with knowledge of homogenous topic, strategy, task or skill groups into a heterogeneous group to share and learn with each other (Flood et al., 1992, p. 610). Lastly, other examples include social groupings to monitor behavior (Rytivaara, 2011, p. 125), student choice groupings that build independence (Espey, 2008, p. 767; Hoffman, 2002, p. 49), or random groupings for the sake of novelty (Flood et al.,1992, p. 610).

Educational impact of individualized instruction.

Flexible grouping creates advantages in the individual ways in which they are created, but collectively they cater to a wide array of student needs and styles. Teachers can formulate groups based on their understanding of each student and the contexts in which they work best, as well as their own intentions for the learning that is to take place within those groups (Duncanson, 2014, p. 31). Gentry and Owen (1999) reported that

80% of teachers believe that cluster grouping allows them to individualize instruction to student needs (p. 235). Burke and Dunn (2003) asserted that educational delivery designed to meet individual needs boosts student performance (p. 167), cited in their study of "style-based teaching," involving teachers receiving training on individualized instruction. "Gradually, the teachers began to teach to students' learning style preferences for sound (noise versus quiet), lighting (bright versus soft), seating (formal versus informal), mobility, and learning (active engagement versus passive engagement)," as well as the size and leader of the group (p. 168). After individualizing their instruction with flexible grouping modalities and elements of classroom and furniture design over the course of three years, their students showed significant gains in student scores on standardized tests in all three different grade levels in this study, particularly the doubling of second grade scores (p. 169). Aside from their educational achievement, these grouping modalities have had many other benefits, including less need for pullout, including positive social interaction, community building, and classroom management (Rytivaara, 2011, p. 125).

Inclusionary practices. This expanding transformation of pedagogy encompasses a wide diversity of modern teaching practices at a time when there is an expanding diversity in student demography and, consequently, learning styles (Rytivaara, 2011, p. 119). For many years, it has been documented that teaching to particular student learning styles and needs is an inclusionary practice that "has helped to reverse underachievement" for students with special needs and students of various multicultural backgrounds (Burke & Dunn, 2003, p. 167-168). Rytivaara (2011) argued that this

instructional delivery alleviates the disproportionate numbers of minorities in special education as well as the overuse of pullout instruction for students with special needs, because their learning styles are no longer contrasted (p. 125). Basham et al. (2016) stated that special education students often have multiple types of disabling conditions that "overlap and interlock, creating complex profiles" that demand this type of complex instruction to match (p. 128). Rytivaara (2011) would have agreed, calling this a "continuum of abilities" that require an "equivalent continuum" of teaching practices that flexible grouping and individualized instruction provide (p. 118).

Classroom culture. The cultivation of a positive classroom environment with effective teaching practices has specific influence on classroom culture (Prosser, 2007, p. 17). Changing instructional approaches from the limited "convergent" approaches of the past industrial settings to the multiplicative "divergent" approaches of future classroom environments creates a dynamic, inventive climate of learning processes (Brooker, 2011, p. 24). Flexible grouping can create scaffolding opportunities to teach concepts as groups change structures (Flood et al., 1992, p. 610), and Hoffman (2002) contended that because it allows for different students to work with each other in diverse contexts, the students may "provide scaffolding" for each other, and they learn to understand and respect each other more (p. 49). Due to this, Gentry and Owen (1999) confirmed that cluster grouping creates "positive classroom environments" as reported by surveys on school culture from parents, teachers, and students (p. 235).

Concerns and Challenges

Despite the advantages of this pedagogical shift towards student-centered, active learning, teachers might simply revert to traditional methods for many reasons; the first being unfamiliarity (Basye et al., 2012, p. 136). Bloom et al. (2016) argued that teachers and students might also have a difficult time understanding their new "roles and responsibilities," especially as compared to the established norms of the school, and the heightened expectations of state standards (p. 2). Basye et al. (2012) reflected this by citing concerns from administrators or parents who have a limited understanding of the procedures and effects of these modern teaching practices (p. 77). Rightfully so, as a lack of teacher knowledge or training of these practices of flexible grouping or individualized instruction could limit their effective implementation as well (Burke & Dunn, 2003, p. 167; Flood, et al., 1992, p. 609). Acknowledging this apprehension from various stakeholders, Burke and Dunn (2003) have proven this pedagogy to be an effective means of instruction with the proper teacher development, consequently helping to reverse this stigma (p. 169).

The second challenge is complexity, as "helping students develop these skills… is made all the more difficult because many future careers don't yet exist" (Basye et al., 2012, p. 11). Teachers might also struggle to create flexible groupings due to the immense variability in modalities and learning styles of the students (Brooker, 2011, p. 21). Many individual grouping modalities also come with their own sets of challenges, as ability grouping is now believed to inhibit lower level students from achieving higher levels (Flood et al., 1992, p. 608; Unsworth, 1984, p. 298), whereas mixed ability grouping is argued not to challenge higher level students enough (Gentry & Owen, 1999,

p. 225). These negative effects could be more prevalent if teachers do not change group structures and teaching methods as flexible grouping and individualized instruction call for (Unsworth, 1984, p. 299-300). In response to this concern in complexity, Brooker (2011) argued that "shifting that burden of differentiation to the students both allows for that variation and empowers students to discover their own learning styles," which allows them to develop agency in their own learning, and encourages their educational growth beyond grade school (p. 21).

The final reason of concern is management, as teachers worry about maintaining on-task behavior and keeping track of student development, due to their perceived reduced authority and the chaotic alternating environment (Basye et al., 2012, p. 80). Teachers also require ample time to observe students, formulate groups, assess progress, and apply various methods and tasks accordingly (p. 77). However, Rytivaara (2011) believed that this type of pedagogical practice is actually the answer to classroom management, arguing that flexible grouping can intentionally be formed to prevent behavior and monitor student progress, ultimately saving time (p. 125).

In review, with the transformation of classroom and furniture design comes the transformation of teaching practice, as flexible and mobile furniture facilitates the use of flexible grouping. By creating various grouping modalities around form, content, style, and purpose, teachers can individualize their instruction to each student, which in turn affects inclusionary practices of minorities and special education students, as well as the classroom culture and climate. Overall, modern teaching practices are developing with the intent of personalizing instruction, but there are some concerns and challenges of

educators in their implementation. In the next section, these concerns will be shown to have tremendous impact on the outcomes of classroom design.

Classroom Design Conclusions

This research found that a classroom that provides active, student-centered learning is the most effective instructional environment for students. It was also discovered that many modern teaching practices are ones that predicate themselves on the creation of this type of learning and can be accomplished with flexible grouping. Finally, an exploration into physical environment found that classroom design can have an effect on this individualized instruction and learning as well, particularly through the design of the furniture. Duncanson (2014) supported this by stating that student participation in flexible active learning must be facilitated by the individualized instruction of teachers, which is in turn encouraged by the physical environment (p. 31). However, encouragement is different from outcome. This discourse prompts the rationale for this exploration into the research question of *how can physical classroom design be used to facilitate the implementation of modern teaching practices and create the most effective instructional environment for student learning?*

The overlying concern and challenge behind the facilitation of this pedagogical transformation lies in the reciprocal dependency between physical environment, teacher instruction, and student learning. The original intent of this research was to demonstrate that modern classroom design choices would result in modern instruction and learning. What was discovered was that these changes in design can in fact facilitate the implementation of modern teaching practices, and they can create the most effective

instruction environment, however they do not demand it. Basye et al. (2012) claimed that "if there is no desire for a more collaborative and personalized pedagogy, then even the best designed physical environment will degenerate into a modern replica of the industrial age school" (p. 135). Classroom design can create opportunity, but it is up to the teachers to utilize these spaces as intended in order for these opportunities to end in results.

Summary

Meeting the individual needs of all students has become one of the greatest goals and greatest challenges in education, as it has been discovered that passive learning environments and standardized pedagogical delivery failed to accomplish this. The ongoing search to individualize instruction can be facilitated with effective classroom design in order to provide students with the personalized education they deserve. By creating more space, flexibility, and mobility within the classroom using a variety of specialized furniture, a more active learning environment is created as instruction moves towards a student-centered approach. Although this transformation in pedagogy to meeting all individual needs cannot be completed simply through classroom design, it can be emboldened. The next chapter will describe the intents and parameters of a project-based learning opportunity to accomplish just that.

CHAPTER THREE

Project Description

Introduction

Individualized student-centered classrooms deserve personalized user-centered furniture, but the reality rarely matches. As previously discussed, some of the reason for this is budgetary, and some of the reason is naivety, but really most of the reason is actually visionary. This chapter will outline the description of a project that I completed to provide a vision for student-centered furniture design. The first section of this chapter lays out my approach to this project, including the three components of my philosophical worldview, research design, and research methods, which informed my intentions and decisions in the completion of the rest of this project. After that, I describe the steps of the project in full, complete with the setting, timeline, audience, and rationale as to why I conducted the project in certain ways, as well as the goals of my designs according to my research. Finally, I provide a component of critical reflection into the importance of this project to the field of education, and how its uses can be assessed. All of this helps to answer the research question, *how can physical classroom design be used to facilitate the implementation of modern teaching practices and create the most effective instructional environment for student learning?* As discussed last chapter, the answer to this question is through the design of the furniture within, and this project aimed to provide insight into how that can be done.

Research Approach

For this capstone, I selected an approach in completing this project on furniture design that is similar to the qualitative approach of a research study. This approach was modeled after the research designs of Creswell (2014) and involved three components, including philosophical worldview, research design, and research methods (p. 3), which will be discussed after the rationale.

Approach Rationale

There are many reasons that I chose a qualitative approach, as it has a more flexible framework with which to pursue the various emerging elements of the project that are dependent on each other, including more research, drawings, designs, and a presentation. Rather than following a more restrictive and measurable quantitative approach, I emulated a more open-ended manner of inquiry similar to the nature of my original research question. The subject of furniture design is also more complex and subjective, which lended itself more to engagement and interpretation to uncover these intricate relationships between classroom furniture, teaching methods, and learning styles. As was established in the previous chapter, designing furniture to the average is a historical mistake that I attempted to find alternatives to in my additions to this field of research.

Philosophical Worldview

Creswell (2014) wrote that "social constructivists believe that individuals seek understanding of the world in which they live and work" (p. 7). With this, I assert my constructivist philosophical worldview on this topic as I believe that there is a wide array

of views and opinions on the design of classroom furniture from users like me. In other words, each user has their own impressions of this furniture based on their past experiences in school, and these understandings have shaped what the furniture means to them. This worldview supported my attempts to keep questioning open-ended, hypothesize the viewpoints and needs of the user, and form theoretical furniture designs based on these things.

Research Design

The procedures that I utilized in this research reflected a design of grounded theory from Creswell (2014), as they involved multiple levels and types of exploration and information (p. 13). The project entailed many different kinds of methods organized to intertwine with each other, and were often dependent on each other. This project formed and presented an abstract end product of finalized furniture designs and a visual presentation (Appendix A) from these interactions. Despite not being an actual theory, these artistic designs served a similar capacity in project format of a grounded theory research design.

Research Methods

The methods to complete this project began with further research and image analysis of furniture and user design. A variety of other methods followed, including two-dimensional (2D) drawings, and three-dimensional (3D) designs, as well as a finalized presentation of all of this work. Although not a research study in itself, many of these processes aligned with qualitative research methods laid out by Creswell (2014) as they are emerging in nature and seek out themes and patterns in the research in order to

form and present the final product (p. 17). These three components of a constructivist worldview, grounded theory design, and qualitative research methods made up the qualitative approach I mirrored in the completion of this project, as described in the next section.

Project Description

The end result of this project was a variety of student-centered classroom furniture designs guided by my research and placed into a presentation. The steps to accomplish these final products are laid out as follows, starting with the context in which it took place, a detailed timeline of events, and the audience it was intended for. Ultimately, I created the final designs and presentation as a researcher, without direct collaboration with architects, students, or education professionals, so it is important to note the particular rationale that informed my decisions and supported my goals of designing user-centered furniture.

Setting

This project took place in a variety of locations, but was primarily conducted on the computer, where I researched furniture, created 3D designs, and formed a presentation of my project. The 3D designs were made using the 3D modeling software, SketchUp. Other settings included the physical spaces of libraries, coffee shops, and homes where I created 2D drawings on paper simply using pencils and a ruler. Lastly, the online space to form and display the final presentation was the web-based presentation software, Prezi.

Timeline

The first step in this process was to begin a presentation of my research into the topic of flexible classroom design, particularly classroom furniture design. As I formulated this presentation, I also conducted further research from my sources to use in my furniture designs. First, I looked into the structure and effects of various types of traditional and modern furniture that either neglected or demonstrated the three specific classroom design choices of space, flexibility, and mobility outlined in the last chapter. Next, further research into anthropometric, ergonomic, and utilitarian effects and features of furniture design was also performed. Lastly, an investigation into the ways in which students and teachers have been active in the processes of classroom design was also used to compose informal hypotheses on their perspectives and influences on furniture design. These three research practices were loosely documented in the presentation, and then coalesced into 2D drawings and 3D models that integrated the three design choices, driving elements, proportional considerations, and user perspectives in attempts to create highly effective furniture designs. Finally, these designs were placed in the presentation along with prior research and shared online.

Audience

This project is presented at the end of this capstone as well as in an online presentation for a specific audience. The display of this visual work is suitable for the internet as it provides an immediate and intimate connection between a larger worldwide audience and influential classroom design research and ideas. This online audience consists of educators, designers, artists, and architects, with the capacity to share its message and bring these ideas into their own work and eventually into more classrooms.

Format Rationale

Finding the answer to this research question on classroom design provided the rationale to the topic of furniture design, as this is what can provide the flexibility, mobility, and space necessary to modern learning. The rationale behind the final product of 2D and 3D designs, as well as a digital presentation of this research, was the fact that a visual topic is best explained through visual demonstration. Finally, the justification for further research into design specifically came from a variety of sources that argue for multiple considerations to be made, including historical context, proportional considerations, and user perspectives. These contributed to the following research design aims of the very furniture that I created.

Research Design Goals

Beginning with the original designs of the school, Burke (2007, p. 369) and O'Hare (1998, p. 707) argued that architects create simple, standardized environments without taking into account the needs of the people within. Prosser (2007) contended that they also fail to assess their designs by reviewing the impacts and consequences (p. 16). Burke (2007) reflected this sentiment in stating that "schools do not stop evolving once the architect and builders have left but continue to be re-shaped over time through habitation" (p. 370). This provided my motivation to analyzing and presenting various types of modern furniture as compared to common historical standardized furniture. More importantly, it also demonstrated the need for goals in my furniture design processes so that the fundamental considerations of historical context and user profiles are not only taken into account, but remain at the center of my designs. These "Research Design

Goals" (Appendix B) included using specific design choices and driving elements in the designs of my furniture, as well as accounting for the proportions and perspectives of the student user.

Design choices and driving elements. As laid out in the previous chapter, classroom design should be focused around the design choices of space, flexibility, and mobility in order to create a dynamic learning environment. The singular entity that can integrate all three of these features is the classroom furniture itself. These choices were the first goal of my research design aims, and the most integral component to my furniture designs. The designs were focused on maximizing space, adjusting parts or uses for flexibility, and integrating lightweight moving parts for mobility. As a result of this, the second goal of these designs was to incorporate the proper driving elements to achieve these three design choices. This included such features as wheels, swiveling pieces, adjustable parts, and the many others discussed in the previous chapter.

User proportions. As discovered earlier, anthropometric, ergonomic, and utilitarian features also need to be considered in regards to classroom furniture design. Baharampour et al. (2013) completed a study verifying that furniture design must include analysis of anthropometric measurements (p. 165). Many sources agreed that properly fitted furniture would lead to less body pains and more attentive behavior (Brooker, 2011, p. 48; Schilling & Schwartz, 2004, p. 424; Wingrat & Exeter, 2005, p. 263). Trufelman (2016) cited that the field of ergonomics was born to help fit our bodies to the very furniture we sit in. Lastly, Cornell (2002) argued for other utilitarian features to be reviewed in addition to functional use, including comfort, safety, health, usability, and

psychological appeal (p. 35). Because of this, the third design goal was for user proportions to be taken into account and the furniture be designed to accommodate all body sizes rather than simply average dimensions.

User perspectives. Finally, many sources declared that user-centered design is essential to the creation of schools, as the students and teachers are just as much responsible for its design as the architects and builders. They argued that these users should be a primary voice in this process of design (Burke, 2007, p. 363; Cornell, 2002, p. 35; Duncanson, 2014, p. 37; Prosser, 2007, p. 27). This theory, known as 'visual voice' to Burke (2007) or 'visual culture' to Prosser (2007), provided the rationale to researching the needs and viewpoints of students and incorporating these into my final designs. Prosser (2007) emphasized that designers should not only study how people interact with the furniture around them, but also allow their perspectives to drive the design of the furniture they use (p. 19). Consequently, the fourth and final goal of my furniture designs was to take user perspectives into account, by not only studying and incorporating student ideas, but also creating user-centered designs that allow the students to have choice in how the furniture is adjusted, constructed, or arranged in real time.

Purpose and Assessment

The purpose of this project was to contribute ideas and influences to the field of education that could be utilized by the intended audience for future uses. This includes research, designs, and a presentation that could be used to write grants, present to school boards, influence manufacturing, or design modern classroom spaces and the furniture

within, among many other things. As discussed in the first chapter, I personally experimented with the various uses of furniture to design my classroom in different ways, resulting in what I considered to be a more active and individualized learning environment. The second chapter was then dedicated to providing literary evidence to this experimentation by demonstrating the need for more active learning, as well as a movement towards flexible teaching practices, and the classroom design necessary to enact this. This project then displayed that evidence with some correlated researched designs, as well as ideas and designs of my own, in order to achieve its purpose.

The assessment of this project is demonstrable in the relationship between my furniture designs and the research in the presentation. As listed earlier, my personal furniture designs were guided by four "Research Design Goals" entailing specific design choices, multiple driving elements, user proportions, and user perspectives. These goals were formulated from the research that has been presented thus far in this capstone and placed in the project presentation. Within that presentation, each design displays its own "Research Design Achievements" (Appendices B-D) that outline how the design itself fulfills the four goals. This documents the assessment of this project along with a section of the presentation on the effects of modern classroom furniture design.

Summary

In summation, this culminating project reflected a qualitative research approach and a constructivist worldview to emulate an emerging grounded theory design that included research methods of further research, image analysis, drawings, designs, and presentation. It followed a specific timeline in varied settings to be presented online to an

audience of educators and designers in order to further the modern design of classroom furniture. The rationale of the topic of furniture design stemmed from the resolution to the research question, and the justification of a visual final product came from the visual nature of the topic itself. Further research into this topic demonstrated the necessity of "Research Design Goals" in order to create classroom furniture designs of my own. Finally, the purpose of this particular project was to provide ideas of design to the education domain that provide the possible answer to the research question, *how can physical classroom design be used to facilitate the implementation of modern teaching practices and create the most effective instructional environment for student learning?* The next chapter is a reflective narrative on the procedure of completing this project of classroom furniture designs and the conclusions that can be drawn from this research.

CHAPTER FOUR

Conclusions

Introduction

While designers and architects need to progress their work to match modern education practices, teachers have a responsibility "as part of their job, [to] become the architects of interior space to serve the needs of children" (Duncanson, 2014, p. 30). Basye et al. (2012) urges for these architects, designers, and educators to "imagine a classroom space that fits the learning instead of learning that fits the space" (p. 50). With this audience in mind, this project was created to help in not only envisioning these spaces, but actually creating them. In review, its purpose is to display the research supporting the redesign of classrooms, and provide visionary designs as to how this can be done. It is meant to be an informative overview to gain knowledge and inspiration, as well as a presentation tool to gain the proper support and funding. Ultimately, this project answers the fundamental question, *how can physical classroom design be used to facilitate the implementation of modern teaching practices and create the most effective instructional environment for student learning?* After a review of the research and project details, this final chapter draws conclusions on the process of this project, from its limitations to its implications. It ends with a personal reflection of its creation and a concluding synopsis of its relation to the conceptual framework of the Hamline University School of Education.

Research Review

The literature review of the second chapter was the first step in answering this research question, as it studied the antiquated history of passive learning environments found in schools today and how they fall short in providing the proper education. It was discovered that these static environments lacked the capacity to adapt to modern teaching practices due to common misconceptions about student learning as well as a lack of space, flexibility, and mobility. This research also found that the classroom furniture has the greatest potential to reverse this through its ability to move, adapt, and create. Modern furniture provides the answer to the research question as it can result in active student learning, flexible teaching practices, and student-centered learning environments if used properly. These positive outcomes were the impetus and the goal for the basis of the next step in answering this research question with a project of presentation and furniture design.

Project Review

As described in the third chapter, the project that I created was intended to demonstrate the answer to the research question as well as contribute to the field of education with design tools and ideas. This project began and ended with a visual presentation of the classroom furniture design research, and it predicated itself on illustrated examples, many designs of which I generated myself to show the visionary possibilities of the future. The first part of the presentation introduced the rationale for classroom redesign, including the historical context, common misconceptions, and modern movement of design within our schools. The next part presented the research for

furniture redesign, including the necessary design choices, driving elements, user proportions, and user perspectives. The third section of the presentation displayed pieces of traditional and modern furniture before documenting three of my own personal classroom furniture designs. The first design of mine is a piece of furniture, entitled the "BEO (Built for EveryOne) Chair" (Appendix C), resembling a glorified office chair with the maximal amount of adjustable parts to fit all body sizes, including the seat, back, table, base, and armrests for positive student posture, comfort, and health. The second design is a set of pieces, known as "Rack Stacks" (Appendix D), which includes three-pronged metal frames (racks) that serve as bases to a creative variety of possible desks and chairs (packs) by using lightweight plastic pegs (stacks) to hold up different flat surfaces (flats & backs) at varying heights. The last piece of furniture, named the "Swap Box" (Appendix E), is a six-sided box made of lightweight plastic that can be flipped onto any one of its sides to reveal a different type of chair or desk, with embedded spherical wheels on most sides. As outlined before, these designs followed four "Research Design Goals" in order to rectify classroom design inadequacies, and displayed their fulfillment of these goals in their "Research Design Achievements." Lastly, the final part of the presentation summarized the effects of more active, flexible, student-centered environments created by furniture such as this. As laid out in the next sections, many challenges and limitations arose in creating this project, followed by implications to be considered upon its completion.

Project Limitations

This project was initially intended to focus on my personal furniture designs to demonstrate a more accessible visual answer of my research question to its intended audience. However, I quickly realized the necessity of also presenting the research question to which that answer belongs to. However, with this change came additional challenges in regards to content and prioritization. The most difficult part was simplifying, rearranging, and reducing the academic language to make the presentation more approachable. This was also dependent on the incorporation of more visuals, including multiple tables, charts, and figures. Due to this, certain aspects of this project inevitably receded, including my own furniture designs, which were the original focal point. While still remaining a cornerstone to the project, their intricacy and usage became more secondary in nature. Despite the changes, the project became more compelling and influential with the proper support of comprehensible research to justify these personal designs.

In the end, the final artifact was reshaped into a presentation to not only inform the audience on the details and importance of the topic, but also to provide them with a presentation tool to use in reshaping their own environments. As an informative tool, I can foresee it being a useful educational illustration of the rationale, research, and effects of the topic of classroom design, with limitations only in the amount of information presented. However, as a presentation tool, I anticipate it still being too verbose for such things as meetings, pitches, and proposals. Fortunately, despite being a secondary artifact, I foresee my personal classroom furniture designs providing the simple imagery necessary to make up for this. Both of these artifacts provide ideas and inspiration

through their use of artistic creativity and visual accessibility, but their impact requires a look into the implications of their possible implementation.

Project Implications

Similar to the literature review, this project breaks down each part of the research question, including teaching, learning, and environment, and defines active student-centered education as the ultimate goal of the physical design. It identifies the obstructions to this, including the history, misconceptions, and disconnect of educational design, before demonstrating that the answer lies in the design of the furniture. This assertion made way for the presentation of my own personal furniture designs and the inferences that can be made as to the impact they might have. The first presumption found in this capstone is the positive effects of these designs including more involved learning, differentiated teaching, and a flexible environment. Alternatively, another presumption from this project are the concerns and challenges of this new type of active education. These consist of unfamiliarity with these new practices, complexity in their implementation, and the management of a new dynamic classroom environment. The final inference that can be made is that no challenge can be overcome and no positive outcomes can be reached without the willingness to do so. As discussed in the final conclusions of the capstone project, it is up to the school professionals to transform their pedagogy by using these designs to their advantage. As an educator myself, it is important to reflect on the ways in which I plan to use this breadth of knowledge to accomplish just that.

Personal Reflection

The process from identifying a topic and conducting research to producing a project was one of growth and learning. In my research, I began to not only understand just how impactful classroom furniture can be to the design of the classroom, but also how little this is understood and refashioned by the education professionals that matter the most to this subject. This lack of visionary knowledge in the field of education provided the encouragement that I needed to demonstrate the gaps between pedagogical expectations and the immutable design of most classrooms. It gave me reason to find solutions in prioritized design choices, form research goals for future designs of furniture, and generate my own designs to exhibit the creative possibilities. I was also able to justify my work with my research into the effects of modern classroom design and how they might correlate to the achievements of my personal designs. As a researcher, my next pursuit of this topic would be to prototype, test, and assess furniture, as well as create methods of training educational professionals to make effective use of it.

As an educator, I learned a lot about myself and my plans for the future as I continue on with teaching elementary school students. I believe that I now have the knowledge and capacity to use my classroom furniture in ways that I would not have otherwise, and that my students will reap the benefits in their posture, health, engagement, and achievement. Whether through the repurposing or rearranging the furniture, I have the confidence to experiment with my surroundings to create an active student-centered learning environment and a more collaborative classroom culture. My plans are to utilize more flexible grouping practices to individualize and differentiate my instruction as well. Lastly, with my awareness of the probable challenges in these new

practices, I will be prepared and motivated to overcome them through this research on the topic of classroom design.

Conclusion

This capstone was created as a part of my pursuit of the degree of Master of Arts in Teaching from the Hamline University School of Education. As shown in the effects sections of the presentation and capstone, this project aligns with the tenets of the conceptual framework of that program in the following ways. First, it helps to "Promote Equity in Schools and Society (PE)" by creating inclusive environments and supporting individualized instruction, especially for multicultural and special needs students. It also aims to "Build Communities of Teachers and Learners (BC)" by advocating for change towards a more collaborative classroom environment between teachers and students. Next, it helps to "Construct Knowledge (CK)" by demonstrating how students obtain information and it supports more student-centered practices based on this. Lastly, it attempts to "Practice Thoughtful Inquiry and Reflection (PR)" with the use of research and reflection in its formation. Overall, this capstone project is the culmination of this conceptual framework and my graduate work in my ongoing pedagogical growth, especially as it pertains to classroom design.

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Appendix A

Capstone Project Presentation

Flexible Classroom Design

The capstone project presentation entitled “Flexible Classroom Design” can be accessed using the following link: https://prezi.com/view/eVcw9s5Alx3GMtFcPIQq/

Appendix B

Capstone Project Research Design Goals

Research Design Goals

1. Use 3 Design Choices

- Furniture should maximize space.
- Flexible furniture should be adjustable.
- Mobile furniture should be easy to move.

2. Utilize Driving Elements

- Furniture should include as many elements as possible to create space, flexibility, and mobility. This includes wheels, swivels, etc.

3. Take User Proportions Into Account

- Furniture should be designed to accommodate all body sizes rather than average dimensions.

4. Take User Perspectives Into Account

- Student designs should be studied and incorporated.
- Designs should be user-centered and allow the students to have choice in how the furniture is constructed or arranged in real time.

Appendix C

BEO (Built for EveryOne) Chair Furniture Design

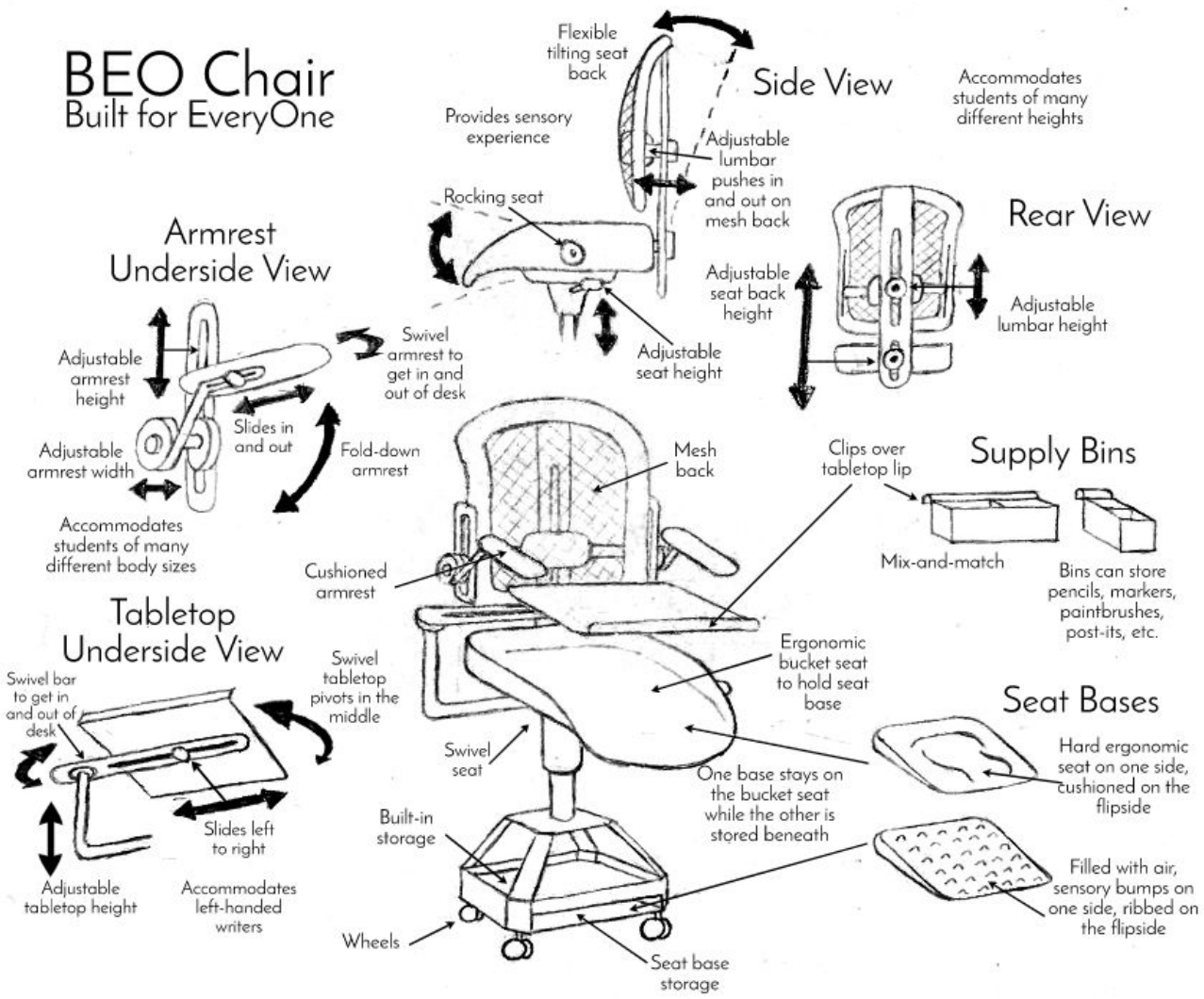

Figure B1. BEO chair overview.

BEO (Built for EveryOne) Chair Research Design Achievements

1. Design Choices

- Maximizes space by combining desks and chairs as one, and including built-in storage.
- Flexibility demonstrated through the adjustable parts.
- Wheels create mobility.

2. Driving Elements

- Wheels, built-in storage, adjustable swivel tabletop, variety of seat bases, variety of storage containers, tilting back, adjustable seat height, swivel tilting seat, adjustable lumbar & adjustable fold-down swivel armrests.

3. User Proportions

- Maximal amount of adjustable parts to fit all body sizes.

4. User Perspectives

- Students have choice in which seat base to use based on their preference, activity, learning style, or learning goals.
- Driving elements allow for easy reconfiguration of student groups.

Appendix D

Rack Stacks Furniture Design

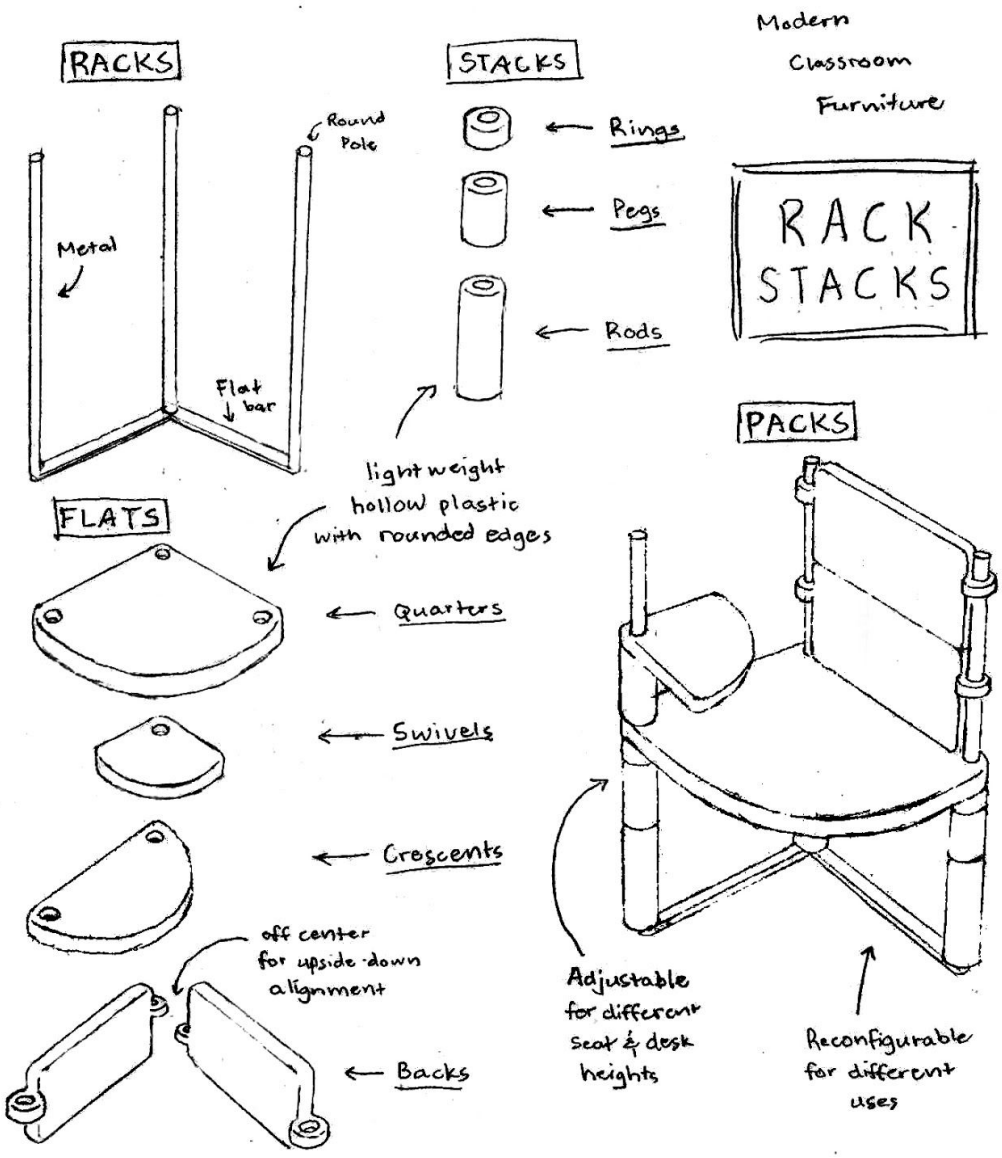

Figure C1. Rack stacks overview.

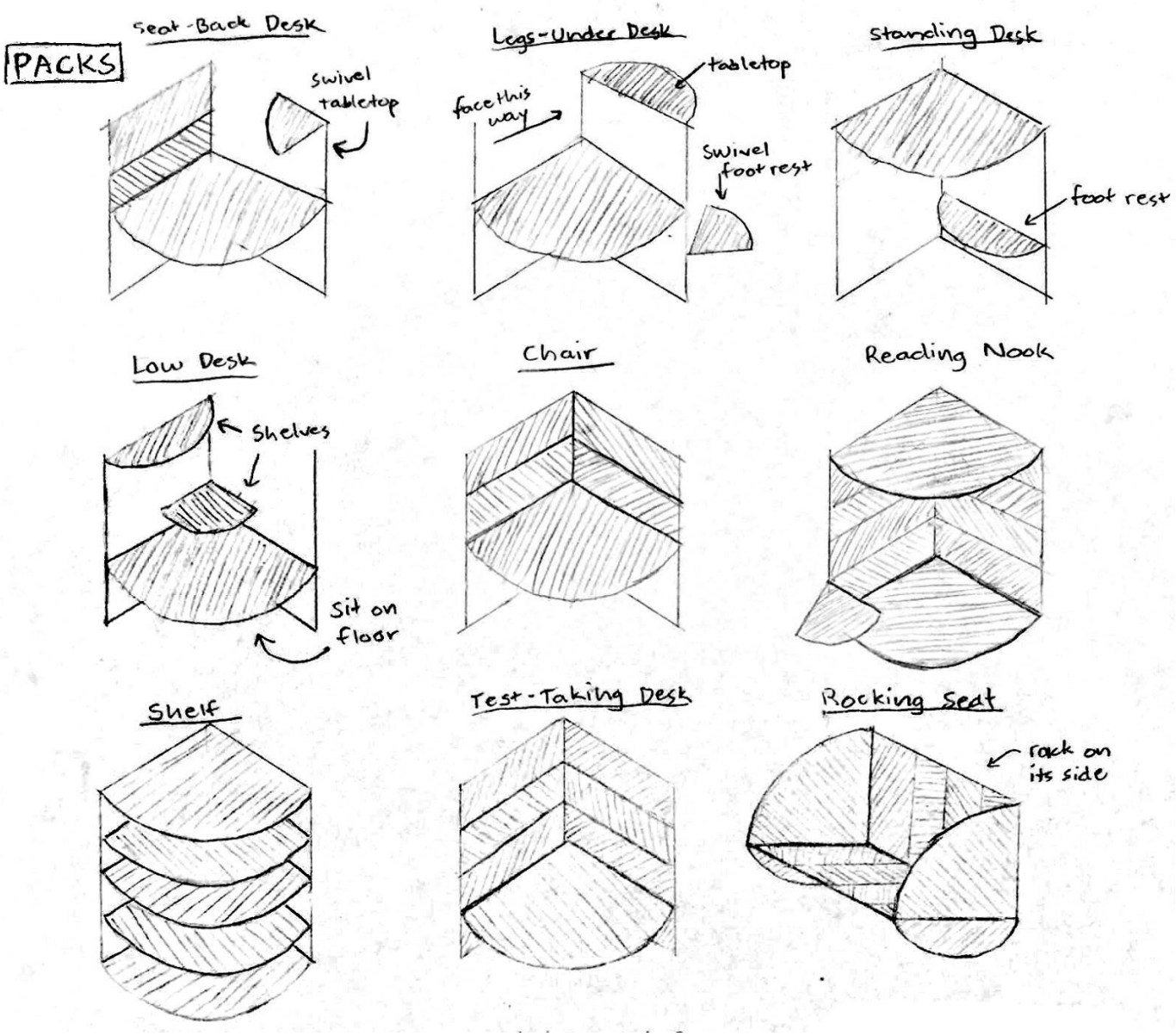

Figure C2. Rack stack packs.

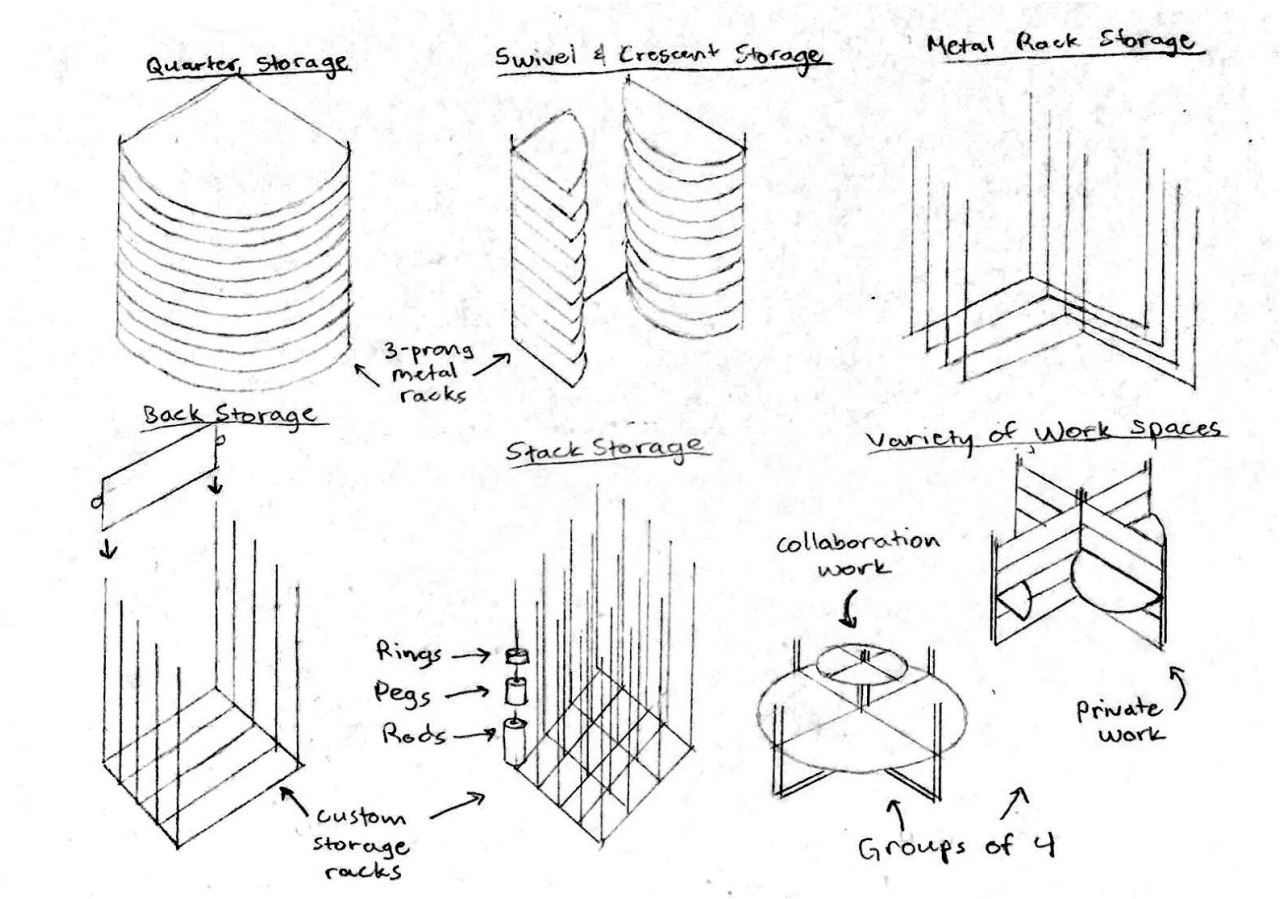

Figure C3. Rack stack storage and work spaces.

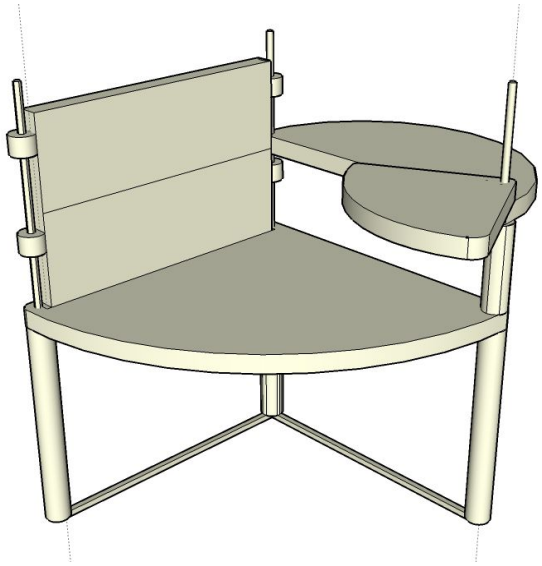

Figure C4. Rack stack pack model front view.

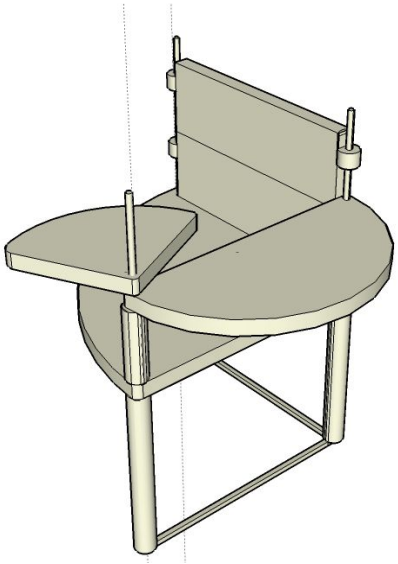

Figure C5. Rack stack pack model side view.

Rack Stacks Research Design Achievements

1. Design Choices

- Maximizes space with slim profile and very compact storage.
- Flexibility demonstrated through the manipulation of the various parts.
- Lightweight construction allows for easy mobility.

2. Driving Elements

- Lightweight, stackable, adjustable seat and table heights, possible rocking base, swivel tabletops & foot rests, & built-in storage shelves.

3. User Proportions

- Chairs and tabletops of varying heights can be created.

4. User Perspectives

- Students have choice in what type of furniture to create based on their preference, activity, learning style, or learning goals, or even their own creativity.

Appendix E

Swap Box Furniture Design

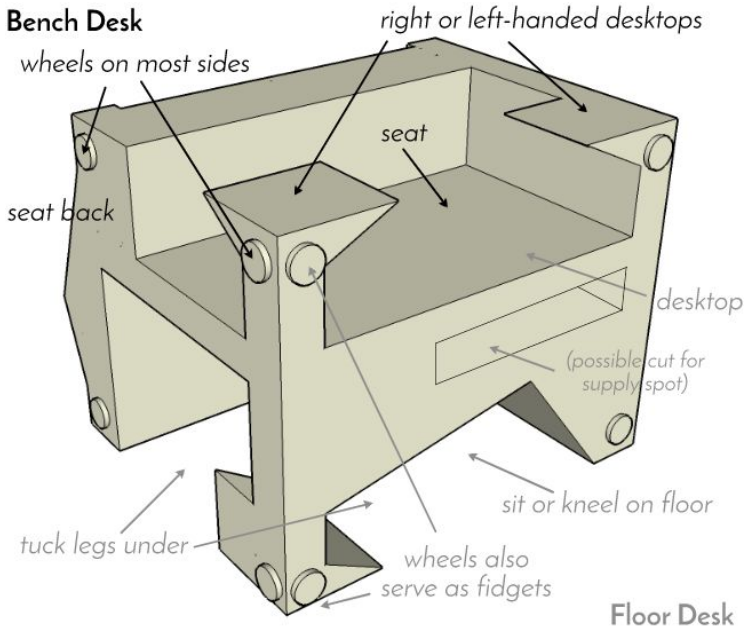

Figure D1. Swap box bench desk and floor desk.

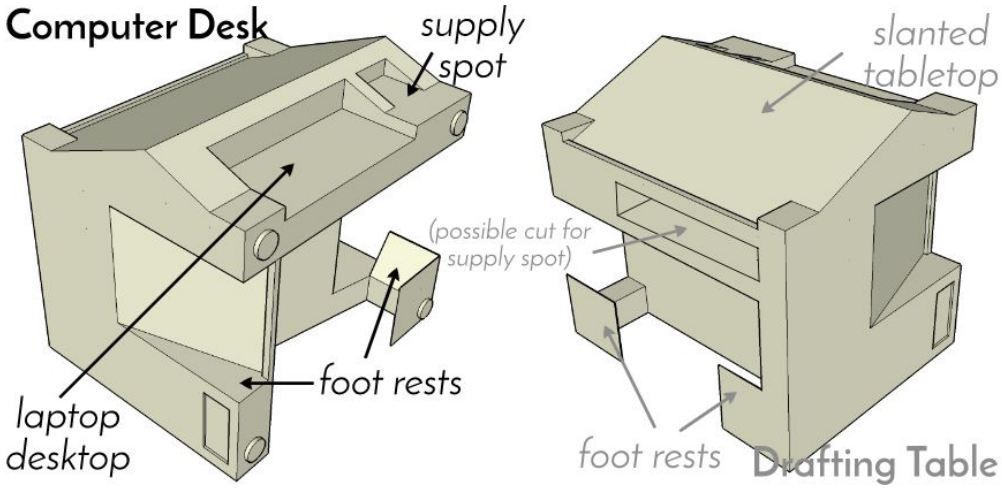

Figure D2. Swap box computer desk and drafting table.

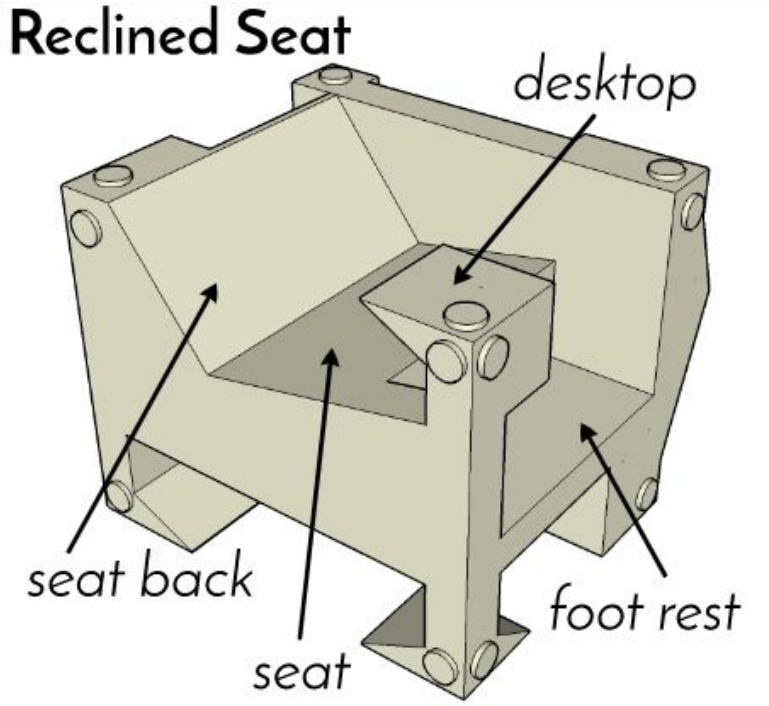

Figure D3. Swap box reclined seat.

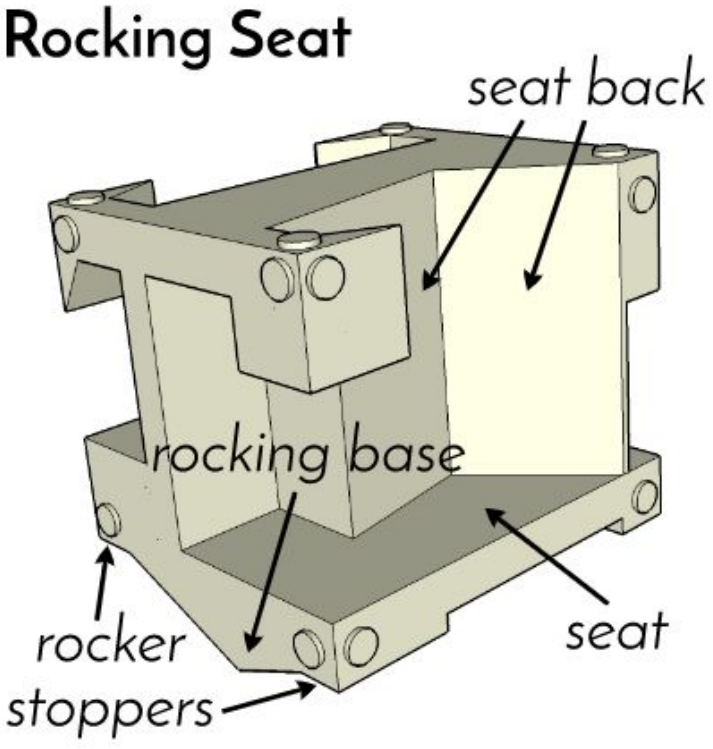

Figure D4. Swap box rocking seat.

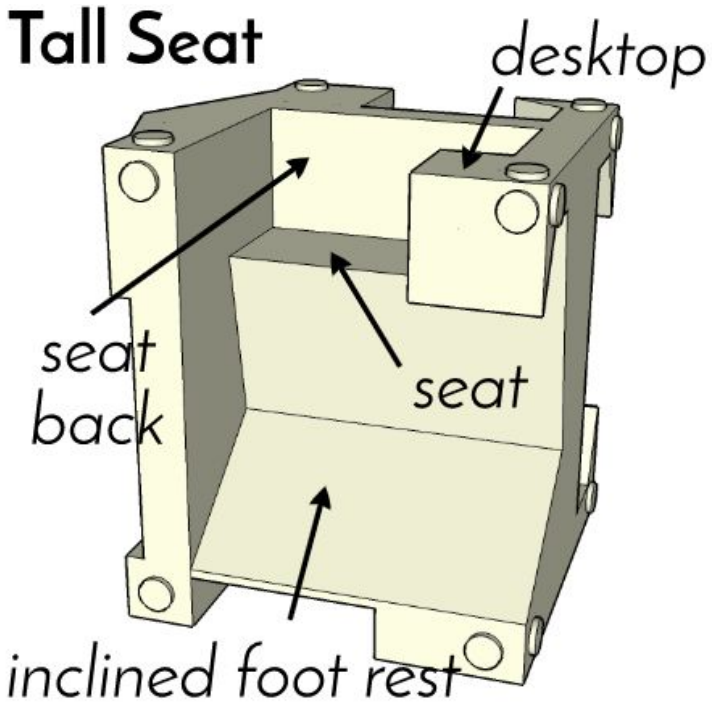

Figure D5. Swap box tall seat.

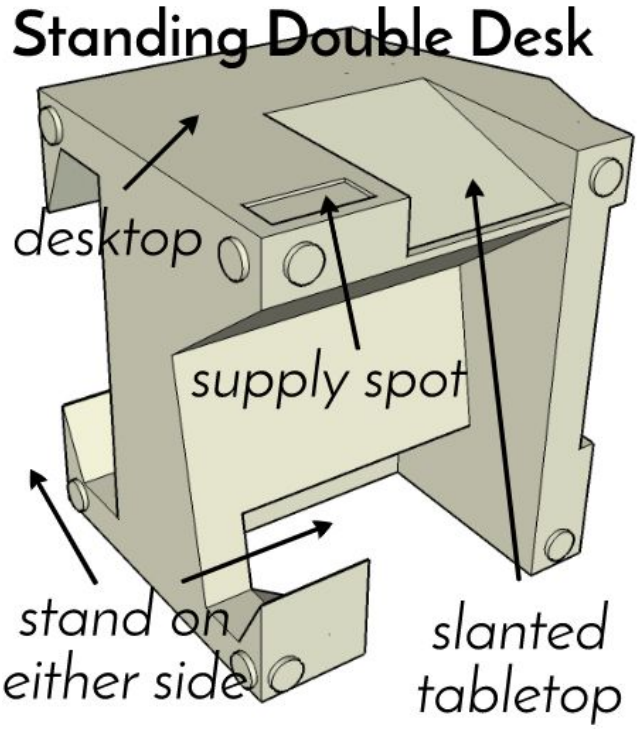

Figure D6. Swap box standing double desk.

Swap Box Research Design Achievements

1. Design Choices

- Maximizes space by combining desks and chairs as one, and including built-in supply spots.
- Flexible in nature by flipping to a different side.
- Wheels on most sides create mobility.

2. Driving Elements

- Wheels, lightweight, varying seat and table heights, rocking base, & built-in storage.

3. User Proportions

- Chairs and tabletops of varying heights on each side.
- Desktops and tabletops slant down to differing heights.

4. User Perspectives

- Students have choice in which side to use based on their preference, activity, learning style, or learning goals.